112th Congress, 2d Session – – – – – – – – – – – – – – House Document 112–90

# SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT

## COMMUNICATION

FROM

## THE ASSISTANT SECRETARY OF THE ARMY, CIVIL WORKS, THE DEPARTMENT OF DEFENSE

TRANSMITTING

SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA FINAL ENVIRONMENTAL IMPACT STATEMENT AND OCEAN DREDGED MATERIAL DISPOSAL SITES FINAL ENVIRONMENTAL IMPACT STATEMENT

## PART 1 OF 2

FEBRUARY 27, 2012.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

FEB 14 2012

Honorable John Boehner
Speaker of the House
of Representatives
U.S. Capitol Building, Room H-232
Washington, D.C. 20515-0001

Dear Mr. Speaker:

In response to a resolution adopted by the Committee on Environment and Public Works of the U.S. Senate on June 5, 1997, the Secretary of the Army supports the authorization and construction of navigation improvements for the Sabine-Neches Waterway (SNWW) channel in Southeast Texas and Southwest Louisiana. The proposal is described in the report of the Chief of Engineers, dated July 22, 2011, which includes other pertinent reports and comments. The views of the States of Louisiana and Texas are set forth in the enclosed communications. The Secretary of the Army plans to implement the project at the appropriate time, considering National priorities and the availability of funds.

The recommended plan would contribute to the economic efficiency of commercial navigation in the SNWW. The recommended plan is the Locally Preferred Plan (LPP) and consists of the following features: 1) deepen the SNWW from 40 to 48 feet and deepen the offshore channel from 42 to 50 feet from offshore to the Port of Beaumont Turning Basin; 2) extend the 50 foot deep offshore channel by 13.2 miles to deep water in the Gulf, increasing the total length of channel from 64 to 77 miles; 3) taper and mark the Sabine Bank Channel from 800 feet wide to 700 feet wide; 4) deepen and widen Taylor Bayou channels and turning basins; 5) ease selected bends on the Sabine-Neches Canal and Neches River Channel; and 6) construct new and enlarge/deepen existing turning and anchorage basins on the Neches River Channel. The environmental benefits of the Neches River dredged material disposal plan would fully offset the environmental impacts within the State of Texas and on Federal lands, and some of the impacts in the State of Louisiana, by restoring degraded marsh habitat and nourishing three miles of Gulf shoreline in each state. A mitigation plan was developed specifically for Louisiana which compensates for unavoidable impacts to intertidal marsh habitat. The National Economic Development (NED) plan has similar features to the LPP, however, the SNWW would be deepened to 49 feet and the offshore channel would be deepened for a length of 16.5 miles.

The estimated Project First Cost is $1,057,000,000 plus an additional first cost of $7,830,000 that would be incurred over a 30-year period for mitigation construction efforts utilizing material from regular maintenance dredging of a separate Federal navigation project. Therefore, the estimated Total Project First

Cost is $1,064,800,000. The estimated Total Project First Cost includes the cost of constructing the general navigation features and the value of lands, easements, rights-of-way and relocations estimated as follows: $897,200,000 for channel modification and dredged material placement; $87,400,000, for environmental mitigation; $53,200,000 for bridge fender modifications; $1,280,000 Federal cost for cultural resources mitigation; $766,000 for Corps administrative costs; $3,730,000 for the value of lands, easements, rights-of-way, and relocations (except utility relocations) provided by the non-Federal sponsor; and $21,400,000 for one-half of the cost of utility relocations borne by the non-Federal sponsor pursuant to Section 101(a)(4) of WRDA 1986, as amended. The remaining one-half cost of deep draft utility relocations will be borne by the individual utility owners. The recommended navigation project is the LPP, not the NED plan. The recommended LPP is shallower and will be less costly than the NED plan which has an estimated first cost of $1,147,837,000. The LPP qualifies as a Categorical Exemption to the NED plan because net benefits continue to increase as the non-Federal sponsor's budget constraints have been reached and no smaller plan maximizes net benefits.

The Sabine-Neches Navigation District is the non-Federal cost sharing sponsor and fully supports the LPP and is legally capable of fulfilling the requirements to be the non-Federal sponsor. Cost sharing is applied in accordance with the provisions of Section 101 of the Water Resources Development Act (WRDA) of 1986, as amended, as follows: 1) the costs for the deepening of the channel from 40 to 45 feet will be shared at the rate of 75 percent Federal and 25 percent by the non-Federal sponsor. Accordingly, the Federal and non-Federal shares of the estimated $780,000,000 first cost in this zone are estimated to be $585,000,000 and $195,000,000, respectively, with the difference of $1,280,000 being the Federal cost for cultural resources mitigation; 2) the costs for the deepening of the channel from 45 to 48 feet will be shared at the rate of 50 percent Federal and 50 percent by the non-Federal sponsor. Accordingly, the Federal and non-Federal shares of the estimated $259,000,000 first cost in this zone are estimated to be approximately $130,000,000 each. Total annual costs for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) are estimated to be $32,900,000. In accordance with Section 101 of WRDA 1986, OMRR&R costs between 40 and 45 feet are allocated as 100 percent Federal and for depths greater than 45 feet costs are allocated as 50 percent Federal and 50 percent non-Federal. For the LPP, the annual OMRR&R costs are $20,600,000 for up to the 45-foot depth of the project at 100 percent Federal expense and $12,300,000 for project depths greater than 45 feet, at 50 percent Federal and 50 percent non-Federal expense or $6,150,000 each.

Based on October 2011 price levels, a discount rate of 4 percent, and a 50-year period of economic analysis, the average annual benefits for the recommended LPP are estimated at $115,600,000 and average annual costs are estimated at $89,700,000, including the annual cost of OMRR&R. The recommended plan has net benefits estimated at $25,900,000 and a benefit-to-cost ratio of 1.3 to 1. In comparison, the NED plan has average annual benefits

estimated at $123,400,000, average annual costs estimated at $94,800,000, including OMRR&R, net benefits estimated at $28,600,000 and a benefit-to-cost ratio of 1.3 to 1.

The recommended plan has been formulated to avoid, minimize and mitigate for potential environmental losses. One portion of the dredged material management plan would use the dredged material to build fish and wildlife habitat, and is also the least cost plan. An Independent External Peer Review (IEPR) was conducted before finalization of the feasibility report and the Corps satisfactorily addressed all critical issues raised by the IEPR panel.

The Office of Management and Budget (OMB) advises that there is no objection to the submission of the report to Congress. However, OMB also advises that should Congress decide to authorize this project for construction, to please be aware that the project will be required to compete for funds with other proposed investments considered in future budgets. I am providing a copy of this transmittal and OMB's letter dated January 26, 2012, to the House Committee on Appropriations' Subcommittee on Energy and Water Development, and the House Committee on Transportation and Infrastructure's Subcommittee on Water Resources and Environment. I am providing an identical letter to the President of the Senate.

Very truly yours,

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

Enclosures

2012 FEB 17 PM 2:48

9 Enclosures

1. Record of Decision, dated, February 1, 2012
2. OMB Clearance Letter, dated, January 26, 2012
3. Report of the Chief of Engineers, July 22, 2011
4. Cy, Dept of the Interior ltr to USACE, Apr 1, 2011
5. Cy, NRCS to USACE, Mar 15, 2011
6. Cy ltr USACE Response to LA, Apr, 04, 2011
7. Sponsor's letter of support, Mar 04, 2011
8. Project Slides
9. Feasibility Report and Environmental Assessment (or Environmental Impact Statement, Mar 2011 and Addendum, Jul 2011

# RECORD OF DECISION

## Sabine-Neches Waterway Channel Improvement Project
## Southeast Texas and Southwest Louisiana

The Final Feasibility Report (FR) and the Final Environmental Impact Statement (FEIS), dated March 2011, and the report of the Chief of Engineers, dated July 22, 2011, for the Sabine-Neches Waterway (SNWW) address navigation improvement opportunities along the Texas and Louisiana border. Based on these reports, the reviews of other Federal, State, and local agencies, input from the public, and the review by my staff, I find the plan recommended by the Chief of Engineers to be technically feasible, economically justified, environmentally acceptable, and in the public interest. Thus, I approve the SNWW Channel Improvement Project for construction.

The FR/FEIS documents the evaluation of both structural and non-structural alternatives to address the navigational improvement needs of the SNWW. The recommended plan is the Locally Preferred Plan (LPP) which consists of the following modifications to the existing SNWW:

- Deepening the SNWW from the Port of Beaumont Turning Basin through the Sabine Pass Jetty Channel from -40 to -48 feet and the offshore Outer Bar and Sabine Bank Channels from -42 to -50 feet;
- Extending the -50 foot deep offshore channel by 13.2 miles, increasing the total length of the channel from 64 to 77 miles;
- Decreasing the width of the Sabine Bank Channel from 800 to 700 feet;
- Tapering and marking the Sabine Bank Channel from 800 feet wide (Station 23+300) to 700 feet wide (Station 25+800);
- Deepening to -48 feet of Taylor Bayou channels and turning basins and associated various widenings of these same areas;
- Widening selected bends on the Sabine-Neches Canal and Neches River Channel;
- Constructing new turning and anchorage basins, and enlarging/deepening existing turning and anchorage basins on the Neches River Channel to -48 feet; and
- Constructing habitat features as part of the least cost disposal method for the SNWW Dredged Material Management Plan (DMMP):
    - The Neches River habitat features (Rose City East, Bessie Heights East, and Old River Cove) would restore approximately 2,853 acres of emergent marsh, improve 871 acres of open water habitat, and nourish 1,234 acres of existing marsh.
    - The Gulf Shore habitat feature would periodically nourish three miles of shoreline in Texas and three miles of shoreline in Louisiana.
- Compensatory mitigation consisting of:
    - Restoring 2,783 acres of emergent marsh, improving 957 acres of shallow water habitat, and stabilizing and nourishing 4,355 acres of existing marsh in the Willow and Black Bayou areas of Louisiana. These actions would provide 1,181 Average Annual Habitat Units (AAHUs) to compensate for a loss of 1,159 AAHUs.

- Monitoring performance of habitat features and mitigation measures, with an adaptive management plan for corrective action, if needed.

In addition to the no action plan, over 120 structural combinations of depths and widths and three non-structural alternatives for navigation improvements were evaluated as described in the FR/FEIS. Nonstructural alternatives considered were offshore oil terminals, a vessel traffic management system, and modification of pilot rules. The no action plan and six deepening alternatives (-45, -46, -47, -48, -49, and -50 feet) were advanced for final evaluation and are fully described and evaluated in the FR/FEIS, which is incorporated herein by reference. The -49 foot depth was identified as the national economic development plan. The recommended plan is the -48 foot plan, which is also the environmentally preferable alternative and the plan preferred by the local sponsor.

All practicable means to avoid or minimize adverse environmental effects have been incorporated into the recommended plan, and the compensatory mitigation plan would address all unavoidable impacts. Primary impacts would be a reduction in the biological productivity of intertidal marsh and the loss of marsh acreage in Louisiana due to increased salinities. All adverse impacts in Texas and some in Louisiana would be offset by the environmental benefits of the DMMP habitat features. The compensatory mitigation would address the remaining adverse impacts in Louisiana.

Technical and economic criteria used in the formulation of alternative plans were those specified in the Water Resource Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations and guidelines were considered in the evaluation of alternatives and the selection of the recommended plan. The Louisiana Office of Coastal Management found the recommended plan to be conditionally consistent with Louisiana's Coastal Resource Program, per Section 307 of the Coastal Zone Management Act of 1972, as amended. The U.S. Army Corps of Engineers does not concur with the State of Louisiana's conditional consistency determination, and has determined that the recommended plan is fully consistent to the maximum extent practicable with the state's Coastal Resource Program. Water Quality Certifications under Section 401 of the Clean Water Act have been received from both the States of Louisiana and Texas. Based on review of these evaluations, I find that the public interest would best be served by implementing the recommended plan. This Record of Decision completes the National Environmental Policy Act process.

FEB 14 2012

Date

Jo-Ellen Darcy

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

JAN-27-2012 08:50 OMB P.02

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

January 26, 2012

The Honorable Jo-Ellen Darcy
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington, D.C. 20310-0108

Dear Ms. Darcy:

As required by Executive Order 12322, the Office of Management and Budget (OMB) has completed its review of the Army Corps of Engineers (Corps) feasibility study for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana.

In its economic analysis the Corps estimates that the project has a benefit-to-cost ratio of 1.3 at a discount rate of 4 1/8 percent. The report also notes that the estimated economic costs would exceed the benefits at a discount rate of 7 percent, which is the discount rate that the Administration uses to decide whether to include funds in the President's budget for project construction.

The Office of Management and Budget does not object to you submitting this report to Congress. However, when you do so, please advise the Congress that, should the Congress authorize this project for construction, the project would need to compete with other proposed investments for funding in future budgets.

Sincerely,

Richard A. Mertens
Deputy Associate Director
Energy, Science and Water Division

TOTAL P.02

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

JUL 22 2011

CEMP-SWD (1105-2-10-a)

SUBJECT: Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on navigation improvements for the Sabine-Neches Waterway (SNWW) in Southeast Texas and Southwest Louisiana. It is accompanied by the report of the Galveston District Engineer and the Southwestern Division Engineer. These reports are in response to a Congressional resolution adopted on 5 June 1997 by the Senate Committee on Environment and Public Works. The committee requested a review of the reports on the SNWW and other pertinent reports to determine the feasibility of modifying the channels serving the ports of Beaumont, Port Arthur, and Orange, Texas in the interest of commercial navigation. Pre-construction engineering and design activities for this proposed project, if funded, would be continued under this authority. The existing SNWW 40-Foot Navigation Project was authorized by the River and Harbor Act of 1962 and construction of the 40-foot project was completed in 1968.

2. The report recommends a project that will contribute to the economic efficiency of commercial navigation. The SNWW is a system of navigation channels that have been superimposed upon the Sabine-Neches estuary in Texas and Louisiana. The study evaluated navigation and environmental problems and opportunities for the entire estuarine system, which is defined as the study area. The study area encompasses a 2,000-square-mile area, which contains the smaller project area that includes those areas that would be directly affected by construction of the project (i.e. the dredging footprint, existing and proposed placement areas, and mitigation areas). The study area includes the following water bodies and adjacent coastal wetlands: Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River channel up to the new Neches River Saltwater Barrier, the Sabine River channel to the Sabine Island Wildlife Management Area, the GIWW west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf of Mexico.

3. The reporting officers recommend the Locally Preferred Plan (LPP) to modify the existing SNWW. The LPP consists of the following improvements:

a. Deepen the SNWW from 40 to 48 feet and the offshore channel from 42 to 50 feet in depth from offshore to the Port of Beaumont Turning Basin;

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b. Extend the 50-foot deep offshore channel by 13.2 miles to deep water in the Gulf, increasing the total length of channel from 64 to 77 miles;

c. Taper and mark the Sabine Bank Channel from 800 feet wide to 700 feet wide;

d. Deepen and widen Taylor Bayou channels and turning basins;

e. Ease selected bends on the Sabine-Neches Canal and Neches River Channel;

f. Construct new and enlarge/deepen existing turning and anchorage basins on the Neches River Channel.

Dredged material placement for this project would be provided in accordance with the Dredged Material Management Plan (DMMP) developed during the study. Deepening of the SNWW would generate approximately 98 million cubic yards of new work material and 650 million cubic yards of maintenance material over the 50-year period of economic evaluation. Material from the extension channel, Sabine Bank Channel, Sabine Pass Outer Bar Channel, and Sabine Pass Jetty Channel would be placed offshore, either in existing placement areas or newly designated sites. Material from the inland reaches would be placed in existing confined, upland placement sites adjacent to each reach. Expansion of some existing upland sites would also be required. Some dredged material from the inland reaches would be used beneficially to restore large degraded marsh areas on the Neches River and nourish the Gulf shoreline at Texas and Louisiana Points.

4. As discussed further in the report of the Galveston District Engineer and the Southwestern Division Engineer, the recommended plan includes preliminary conclusions that 41 pipelines located within the SNWW Channel must be relocated and are classified as utility relocations for which the non-Federal sponsor must perform or assure performance. In accordance with Section 101(a)(4) of the Water Resources Development Act (WRDA) of 1986, as amended, one-half of the cost of each such relocation will be borne by the owner of the facility being relocated and one-half of the cost of each such relocation will be borne by the non-Federal sponsor. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government. The recommended plan also includes preliminary conclusions that there are an additional 5 pipelines that must be removed but not replaced. The Government, in coordination with the non-Federal sponsor, will conduct further analysis and finalize its conclusions during the period of pre-construction engineering and design.

5. Environmental benefits of the Neches River beneficial use (BU) features would offset all environmental impacts in the state of Texas and on all Federal lands, by restoring 2,853 acres of emergent marsh, improving 871 acres of shallow water habitat, and nourishing 1,234 acres of existing marsh in Texas. After consideration of project impacts in Texas and on Federal lands in the project area, the Neches River BU features will provide a net increase of 316 Average

Annual Habitat Units (AAHUs). The Gulf Shore BU features would offset minor erosion impacts to Gulf shorelines in Texas and Louisiana by periodically nourishing three miles of shoreline in each state. Unavoidable environmental impacts on non-Federal lands in Louisiana would be fully compensated by restoring 2,783 acres of emergent marsh, improving 957 acres of shallow water habitat, and stabilizing and nourishing 4,355 acres of existing marsh. These actions will provide 1,181 AAHUs to compensate for a loss of 1,159 AAHUs in Louisiana. Post-construction monitoring and adaptive management plans for the BU features and mitigation areas will be required until such time that the following performance criteria are met, as determined by the Division Commander: (1) each mitigation site and the Neches River BU features have an aerial coverage of 60 to 80 percent native, typical, emergent marsh vegetation; and invasive noxious and/or exotic plant species comprise less than 4 percent of mitigation site marsh coverage; (2) Texas Point BU feature shows a decreased erosion rate averaging less than 44 ft/yr after two disposal events; and (3) Louisiana Point BU feature shows an accretion rate averaging more than 1.2 ft/yr after two disposal events.

6. The recommended navigation project is not the National Economic Development (NED) plan. The recommended SNWW improvement is shallower and will be less costly than the NED plan and is the LPP supported by the non-Federal sponsor. The Sabine-Neches Navigation District is the non-Federal cost sharing sponsor.

7. Project Cost Breakdown Based on October 2010 Prices.

a. Total First Cost of Constructing Project. The estimated total first cost of constructing the project is $1,053,000,000 which includes the cost of constructing the general navigation features and the value of lands, easements, rights-of-way and relocations estimated as follows: $894,500,000 for channel modification and dredged material placement; $79,000,000 for environmental mitigation; $52,800,000 for bridge fender modifications; $1,270,000 Federal cost for cultural resources; $774,000 for additional Corps administrative costs; $3,690,000 for the value of lands, easements, rights-of-way, and relocations (except utility relocations) provided by the non-Federal sponsor; and $21,300,000 for the one-half of the cost of utility relocations borne by the non-Federal sponsor pursuant to Section 101(a)(4) of WRDA 1986, as amended.

b. Estimated Federal and non-Federal Shares. The estimated Federal and non-Federal shares of the total first cost of constructing the project are $707,000,000 and $345,990,000, respectively, as apportioned in accordance with the cost sharing provisions of Section 101 of WRDA 1986, as amended, as follows:

(1) The costs for the deepening of the channel from 40 to 45 feet will be shared at the rate of 75 percent by the Government and 25 percent by the non-Federal sponsor. Accordingly, the Federal and non-Federal shares of the estimated $772,000,000 cost in this zone will be approximately $579,000,000 and $193,000,000, respectively, with the difference of $1,270,000 being the Federal cost for cultural resources.

(2) The costs for the deepening of the channel from 45 to 48 feet will be shared at the rate of 50 percent by the Government and 50 percent by the non-Federal sponsor. Accordingly, the Federal and non-Federal shares of the estimated $256,000,000 cost in this zone will be approximately $128,000,000 each.

(3) In addition to payment by the non-Federal sponsor of its share of costs as estimated and addressed in sub-paragraphs (1) and (2) above, the estimated non-Federal share of $345,990,000 includes $3,690,000 for the estimated value of lands, easements, rights-of-way, and relocations (except utility relocations) that it must provide pursuant to Section 101(a)(3) of WRDA 1986, as amended, and $21,300,000 for one-half of the estimated costs of utility relocations borne by the non-Federal sponsor pursuant to Section 101(a)(4) of WRDA 1986, as amended.

c. Additional 10 Percent Payment. In addition to the non-Federal sponsor's estimated share of the total first cost of constructing the project in the amount of $345,990,000, pursuant to Section 101(a)(2) of WRDA 1986, as amended, the non-Federal sponsor must pay an additional 10 percent of the cost of the general navigation features of the project in cash over a period not to exceed 30 years, with interest. The value of lands, easements, rights-of-way, and relocations provided by the non-Federal sponsor under Section 101(a)(3) of WRDA 1986, as amended, and the costs of utility relocations borne by the non-Federal sponsor under Section 101(a)(4) of WRDA 1986, as amended, will be credited toward this payment.

d. Operations and Maintenance Costs. The additional annual cost of operation and maintenance for this recommended plan is estimated at $32,800,000. In accordance with Section 101(b) of WRDA 1986, the non-Federal sponsor will be responsible for an amount equal to 50 percent of the excess of the cost of the operation and maintenance of the project over the cost which would be incurred for operation and maintenance of the project if the project had a depth of 45 feet. The excess annual cost attributable to operation and maintenance for the depth in excess of 45 feet is $12,300,000 with the non-Federal sponsor responsible for $6,150,000.

e. Associated Costs. Estimated total project associated costs of $43,500,000 include $20,700,000 in non-Federal costs associated with dredging of berthing areas and development of other local service facilities; $1,500,000 for navigation aids (a U.S. Coast Guard expense); and $21,300,000 for the one-half of the cost of utility relocations to be borne by the facility owners in accordance with Section 101(a) (4) of WRDA of 1986, as amended.

f. Authorized Project Cost and Section 902 Calculation. The total estimated first cost of the project for the purposes of authorization and calculating the maximum cost of the project pursuant to Section 902 of WRDA 1986, as amended, should include the estimates for general navigation features (GNF) construction costs, the value of lands, easements, and rights-of-way,

the value of relocations provided under Section 101(a)(3) of WRDA 1986, as amended, and the one-half of the costs of utility relocations borne by the non-Federal sponsor for utility relocations under Section 101(a)(4) of WRDA 1986, as amended. Accordingly, as set forth in paragraph 7.a. above, based on October 2010 prices, the estimated total first cost of the project for these purposes is $1,053,000,000 with a Federal share of $707,000,000 and a non-Federal share of $345,990,000.

8. Based on October 2010 price levels, a discount rate of 4 1/8 percent, and a 50-year period of economic analysis, the project average annual benefits and costs for the SNWW improvements are estimated at $115,400,000 and $90,600,000, respectively, with a resulting net benefit of $24,800,000 and a benefit-to-cost ratio of 1.3 to 1.

9. In accordance with the Corps Engineering Circular on review of decision documents, all technical, engineering, and scientific work underwent an open, dynamic, and vigorous review process to ensure technical quality. This included an Agency Technical Review (ATR), an Independent External Peer Review (IEPR), and a Corps Headquarters policy and legal review. All concerns of the ATR have been addressed and incorporated into the final report. The IEPR was completed by Battelle Memorial Institute. A total of 18 comments were documented. The comments were related to plan formulation, vessel fleet analysis, benefits, dredging and sedimentation, risk and uncertainty, and impact of salinity changes. In response, sections in the main report and EIS were expanded to include additional information. The final IEPR Report was completed in June 2010 with all comments addressed sufficiently.

10. Washington level review indicates that the plan recommended by the reporting officers is technically sound, environmentally and socially acceptable, and on the basis of congressional directives, economically justified. The plan complies with all essential elements of the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Land Related Resources Implementation Studies, except for the measurement of the National Economic Benefits which was modified by Section 6009 of the ESAA of 2005. Further, the recommended plan complies with other administration and legislative policies and guidelines. The views of interested parties, including Federal, State and local agencies, have been considered.

11. I concur in the findings, conclusions, and recommendations of the reporting officers. Accordingly, I recommend that navigation improvements for the Sabine-Neches Waterway be authorized in accordance with the reporting officer's recommended plan at an estimated cost of $1,053,000,000 with such modifications as in the discretion of the Chief of Engineers may be advisable. My recommendation is subject to cost sharing, financing, and other applicable requirements of Federal and State laws and policies, including Section 101 of WRDA 1986, as amended. This recommendation is subject to the non-Federal sponsor agreeing to comply with all applicable Federal laws and policies including that the non-Federal sponsor must agree with the following requirements prior to project implementation.

a. Provide 10 percent of the total cost of construction of the GNFs attributable to dredging to a depth not in excess of 20 feet; plus 25 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet; plus 50 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 45 feet as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to commercial navigation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to commercial navigation;

(3) Provide, during construction, any additional funds necessary to make its total contribution for commercial navigation equal to 10 percent of the total cost of construction of the GNFs attributable to dredging to a depth not in excess of 20 feet; plus 25 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet; plus 50 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 45 feet;

b. Provide all lands, easements, and rights-of way (LER), including those necessary for the borrowing of material and the disposal of dredged or excavated material, and perform or assure the performance of all relocations, including utility relocations, all as determined by the Federal Government to be necessary for the construction or operation and maintenance of the GNFs;

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the GNFs, an additional amount equal to 10 percent of the total cost of construction of the GNFs less the amount of credit afforded by the Government for the value of the LER and relocations, including utility relocations, provided by the Sponsor for the GNFs. If the amount of credit afforded by the Government for the value of LER, and relocations, including utility relocations, provided by the Sponsor equals or exceeds 10 percent of the total cost of construction of the GNFs, the Sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of LER and relocations, including utility relocations, in excess of 10 percent of the total cost of construction of the GNFs;

d. Provide, operate, and maintain, at no cost to the Government, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

e. Provide 50 percent of the excess cost of operation and maintenance of the project over that cost which the Federal Government determines would be incurred for operation and maintenance if the project had a depth of 45 feet;

f. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating and maintaining the GNFs;

g. Hold and save the United States free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;

h. Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence are required, to the extent and in such detail as will properly reflect total cost of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20;

i. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601–9675, that may exist in, on, or under LER that the Federal Government determines to be necessary for the construction or operation and maintenance of the GNFs. However, for lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the Federal Government provides the Sponsor with prior specific written direction, in which case the Sponsor shall perform such investigations in accordance with such written direction;

j. Assume complete financial responsibility, as between the Federal Government and the Sponsor, for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under LER that the Federal Government determines to be necessary for the construction or operation and maintenance of the project;

k. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA;

l. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, (42 U.S.C. 1962d-5b) and Section 101(e) of the WRDA 86, Public Law 99-662, as amended,

(33 U.S.C. 2211(e)) which provide that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

m. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4601-4655) and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way necessary for construction, operation, and maintenance of the project including those necessary for relocations, the borrowing of material, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

n. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c);

o. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project; and

p. Not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefor, to meet any of the Sponsor's obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that such funds are authorized to be used to carry out the project.

12. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to the

CEMP-SWD
SUBJECT: Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana

Congress, the States of Louisiana and Texas, the Sabine Neches Navigation District (the non-Federal sponsor), interested Federal agencies, and other parties will be advised of any significant modifications and will be afforded an opportunity to comment further.

MERDITH W.B. TEMPLE
Major General, USA
Acting Commander

# United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

TAKE PRIDE IN AMERICA

APR 1 2011

ER 11/225

Mr. Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Headquarters
U.S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

Dear Mr. Brown:

The U.S. Department of the Interior (Department) has reviewed the Chief's Report, Final Feasibility Report (FFR) and Final Environmental Impact Statement (FEIS) for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas, and Southwest Louisiana.

Our U.S. Fish and Wildlife Service (FWS) Lafayette, LA and Clear Lake, TX Field Offices were members of the Sabine Neches Interagency Coordination Team (ICT) and prepared the March 2010 Final Sabine-Neches Waterway Fish and Wildlife Coordination Act Report. We offer the following comments based upon further review and analysis by the FWS.

Sabine-Neches Waterway Chief's Report

The Chief's Report is consistent with the information found in the March 2011 Sabine-Neches FFR and FEIS. The project features, beneficial use and mitigation benefits are accurate as presented in those reports and the March 2010 Fish and Wildlife Coordination Act Report.

Section 7a (page 3) - Project Cost Breakdown based on October 2009 Prices. - The 2009 first cost is listed as $1,029,000,000 in the Chief's Report, but listed as $1,071,877,000 ($1,100,935,000 in Budget year 2012 price levels), in the March 2011 Feasibility Report that reported at the October 2009 price level (page S-5). The current 2011 first and other costs should be considered for listing.

Sabine-Neches FEIS

Page 5-1, Mitigation Plan, Table 5.1-1 – The numbers in the table are incorrect. The table should be consistent with Table VIII-1 in the Feasibility Report (page VIII-2).

Page 5-5, Mitigation Plan, Table 5.1-2 – The numbers in the table are incorrect, but are correct in the paragraph preceding that table. The numbers should be consistent with Table VIII-2 (page VIII-5) of the Feasibility Report.

Page 5-22, Willow Bayou Mitigation, First Paragraph, Sentence 6 – 1,112 acres of existing marsh will be re-nourished, not the 1,966 acres stated.

Sabine-Neches FFR

Page VI-26, Table VI-14. Impact Analysis and Mitigation Need – The Texas net land loss should be – 247 acres and the project total land loss before DMMP BU should be -938 acres.

Page VIII-2, Table VIII-1, Net Project Impacts and Benefits – Recommended plan benefits for Texas intermediate and brackish marsh should be 305 and 363 AAHUs respectively.

Page VIII-13, Mitigation Plan, Table VIII-5 – The AAHUs for the LA 2-ADD B measure should be 214, not 21. Table VIII-5 should be consistent with EIS Table 5.5-1 (page 5-21 EIS).

Thank you for the opportunity to provide comments. If you have any questions regarding these comments, please contact Mr. Darryl Clark, FWS, Lafayette, LA, at 337-291-3111, or Darryl_Clark@fws.gov.

Sincerely,

Willie R. Taylor, Director
Office of Environmental Policy
And Compliance

**United States Department of Agriculture**

NRCS

Natural Resources Conservation Service
3737 Government Street
Alexandria, LA 71302

(318) 473-7751
Fax: (318) 473-7626

March 15, 2011

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works
Headquarters
U.S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

RE: Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana

Dear Mr. Brown:

Per your request, we have reviewed the soils information for the project location as it pertains to prime and unique farmlands. The only segment of the project which contains prime farmlands is from the Sabine River /GIWW east to Gum Cove Ridge. See enclosed farmland classification map and legend. The soils which are prime farmland are indicated in green and contain the following map units for Calcasieu parish; Cr--Crowley-Vidrine silt loams, Ju--Judice silty clay loam, Lt--Leton silt loam, Mn--Midland silty clay loam, Mr--Morey loam, Mt--Mowata-Vidrine silt loams, and Ju--Judice silty clay in Cameron parish. The prime farmland soils in this segment have a relative value of 95. The remaining segment from the Sabine Island Wildlife Management Area south and east along the Sabine River to the Gulf are in the marsh and the soils are not prime farmland. Please find the attached NRCS-CPA-106 Farmland Conversion Impact Rating for corridor type projects form with our agencies information completed.

Please contact me regarding all future requests at the address shown above.

Respectfully,

Kevin D. Norton
State Conservationist

Attachment

cc: Charles Guillory, State Soil Scientist, Alexandria, Louisiana
Frank Chapman, District Conservationist, NRCS, Lake Charles Field Office
Gerald Trahan, MLRA Soil Survey Leader, Opelousas, Louisiana

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

Planning and Policy Division

Mr. Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division
Louisiana Department of Natural Resources
Office of Coastal Management
P.O. Box 44487
Baton Rouge, Louisiana 70804-4487

Dear Mr. DuCote:

Reference is made to your letter dated April 4, 2011, regarding the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) Final Environmental Impact Statement (FEIS). Your letter raises the same issues that were the subject of coordination between our agencies during the feasibility stage of the project. Each issue raised in your letter has been fully addressed by the Galveston District. Our position has not changed and the U.S. Army Corps of Engineers finds that each issue raised has been satisfactorily addressed.

Your letter will be made a part of the project record. We continue to offer to coordinate with Louisiana Department of Natural Resources every step of the way as this project moves forward. To that end, if you have questions or concerns please contact Mr. Tom Hughes, (202) 761-5534.

Sincerely,

for Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Printed on Recycled Paper

JEFF R. BRANICK
County Judge

Jefferson County Courthouse
P.O. Box 4025
Beaumont, TX 77704

Beaumont (409) 835-8466
Pt. Arthur (409) 727-2191 Ext. 8466
Facsimile (409) 839-2311

March 4, 2011

USACE – Galveston District
Attn: Ms. Janelle Stokes
P.O. Box 1229
Galveston, TX 77553-1229

In Re: Sabine – Neches Waterway Channel Improvement Project FEIS and FFR

Dear Ms. Stokes:

We are in receipt of your notice to submit comments regarding the FEIS and FFR. We previously commented on our support for the Neches Waterway Channel Improvement Project. A copy of the Resolution previously passed by the Jefferson County Commissioners' Court supporting same is attached.

I would ask that you also extend our thanks and appreciation for all of the fine work the USCE has performed and we again wish to reiterate our support for this project.
The proposed enhancement of this waterway will provide much needed improvements to help us maintain our national security and to enhance our competitiveness in the world market. It is our earnest desire that this project work proceed at the earliest date.
With kindest regards, I remain,

Sincerely yours,

Jeff R. Branick, County Judge

Cc: Randy Reese

Meeting Date:

FEB 8 2010

Agenda Item No. 8

17

# Resolution

| | | |
|---|---|---|
| STATE OF TEXAS | § | COMMISSIONERS' COURT |
| | § | |
| COUNTY OF JEFFERSON | § | OF JEFFERSON COUNTY, TEXAS |

BE IT REMEMBERED at a meeting of Commissioners' Court of Jefferson County, Texas, held on the 8th day of February, 2010, on motion made by Everette D. Alfred, Commissioner of Precinct No. 4, and seconded by Mark L. Domingue, Commissioner of Precinct No. 2, the following Resolution was adopted:

## Resolution Concerning the Sabine-Neches Waterway Channel Project

**WHEREAS,** the U.S. Army Corps of Engineers (USACE), in concert with Sabine-Neches Navigation District has proposed a project to widen and deepen the Sabine-Neches Waterway; and

**WHEREAS,** the USACE has prepared a study analyzing the feasibility and environmental impacts of proposed modifications to the portions of the Sabine-Neches Waterway that serves the ports of Beaumont and Port Arthur, Texas; and

**WHEREAS,** the USACE study clearly demonstrates the necessity for these improvements to provide a safe waterway that will accommodate the current needs of our ports and industry; and

**WHEREAS,** the proposed improvements reasonably accommodate environmental concerns; and

**WHEREAS,** the proposed improvements are clearly cost effective and will provide a positive economic benefit and enable our ports to facilitate the handling of vital military cargo; and

**NOW THEREFORE,** be it resolved that the Commissioners' Court of Jefferson County, Texas Urges all elected officials and citizens to support this project and the adoption of the plan for these improvements as proposed.

SIGNED this 8th day of February, 2010.

JUDGE RONALD WALKER
County Judge

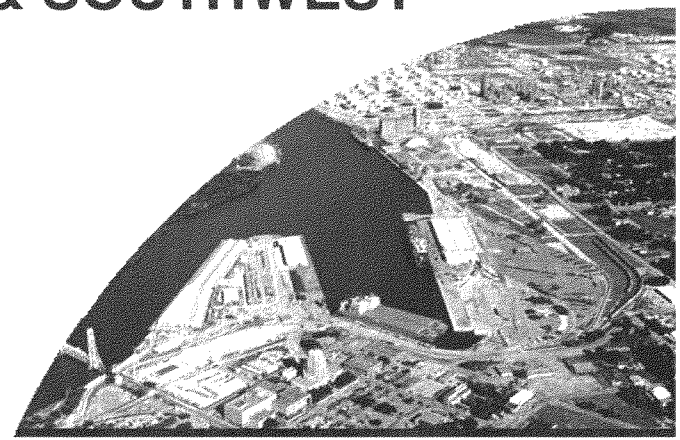
COMMISSIONER EDDIE ARNOLD
Precinct No. 1

COMMISSIONER MICHAEL S. SINEGAL
Precinct No. 3

COMMISSIONER MARK L. DOMINGUE
Precinct No. 2

COMMISSIONER EVERETTE D. ALFRED
Precinct No. 4

# SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT, SOUTHEAST TEXAS & SOUTHWEST LOUISIANA



ASA/OMB Briefing Slides

Galveston District

July 2011

US Army Corps of Engineers

BUILDING STRONG®

# Study Authority

**This feasibility study was conducted in response to the June 5, 1997 congressional resolution from the Committee on Environment and Public Works, House of Representatives.**

**The Resolution States:**

***"The Secretary of the Army shall review previous reports on the Sabine-Neches Waterway published as Senate Document No. 80, 83rd Congress, Second Session; House Document No. 553, 87th Congress, Second Session; and other pertinent reports to determine the feasibility of modifying the channels serving the ports of Beaumont, Port Arthur, and Orange, Texas in the interest of commercial navigation."***

# Study Purpose

- Determine feasibility of providing navigational improvements to the SNWW
- Maintain coastal and estuarine natural resources

# Non-Federal Sponsor

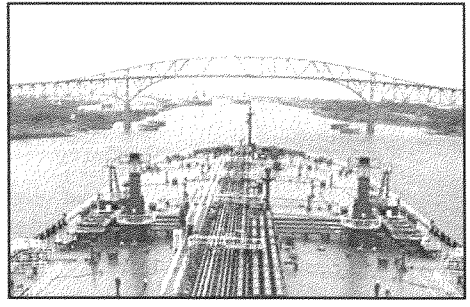
SABINE • NECHES

NAVIGATION DISTRICT

# Vicinity/Project Location

# Problems and Opportunities

- **Navigation and Commerce**
  - Existing SNWW designed for vessels with loaded drafts of 36 feet
  - Larger vessels use SNWW today
  - Tankers lighter before entering SNWW
  - Longest deep-draft waterway in Texas
  - Narrow channel reaches
  - Large amounts of dredged material

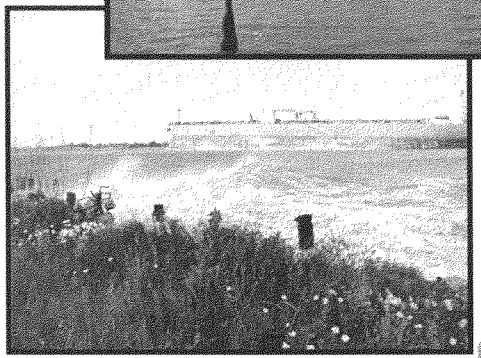




XXX

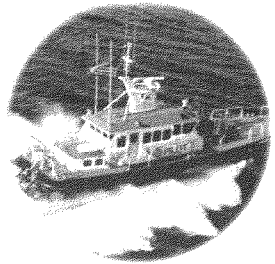
# Problems and Opportunities

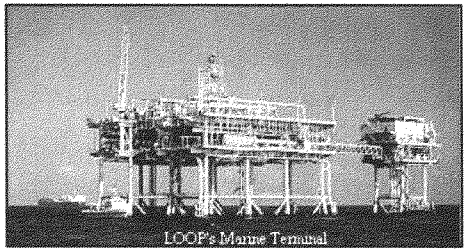
- **Environmental**
  - Very large study area with complex salinity and circulation patterns
  - Existing and potential increase in salinity intrusion and wetland impacts
  - Need for increase in beneficial use of dredged material
- **Economic**
  - Transportation efficiency



# Alternatives Considered

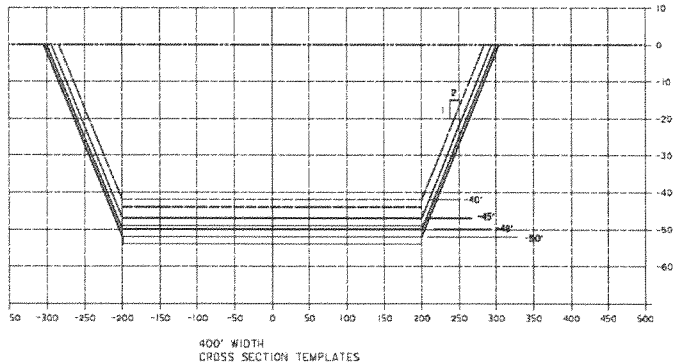
- No Action Alternative
- Nonstructural Alternatives
  - ▶ Vessel Traffic Service
  - ▶ Relaxation of Pilots Rules
  - ▶ Alternative Mode of Commodity Transport
    - Existing Louisiana Offshore Oil Port (LOOP)
    - Inactive proposal for Bulk Oil Offshore Transfer System (BOOTS)

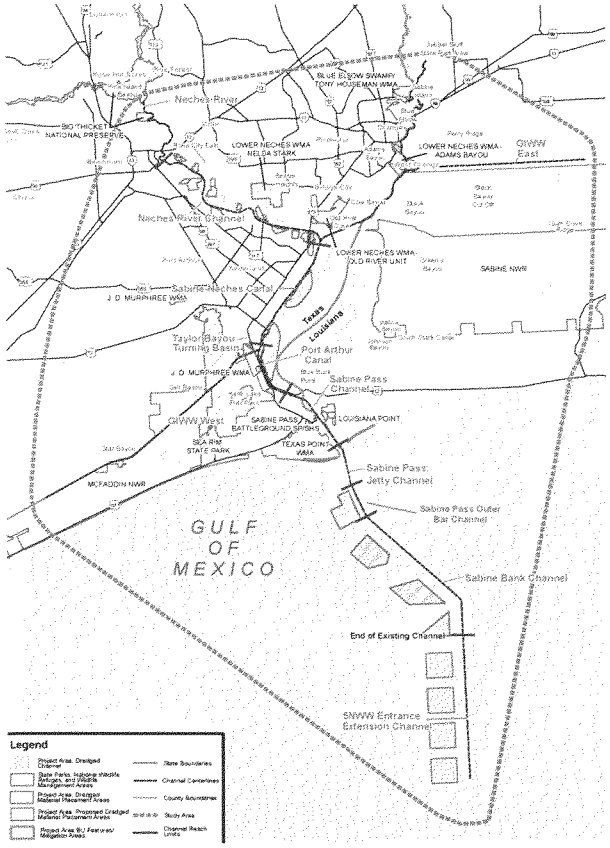




# Alternatives Considered

- Structural Alternatives
  - More than 120 combinations of different channel depths and widths
  - Deepening to 43, 45, 46, 47, 48, 49, 50, 53, and 55-foot depths
  - Widening from 500 to 700 feet for all depths




Neches River
BIG THICKET NATIONAL PRESERVE
BLUE ELBOW SWAMPY
TOM HOGEMAN WMA
LOWER NECHES WMA NELDA STARK
LOWER NECHES WMA - ADAMS BAYOU
GIWW East
Neches River Channel
LOWER NECHES WMA OLD RIVER UNIT
SABINE NWR
Sabine-Neches Canal
J D MURPHREE WMA
Texas
Louisiana
Taylor Bayou Turning Basin
Port Arthur Canal
J D MURPHREE WMA
Sabine Pass Channel
GIWW West
SABINE PASS BATTLEGROUND SPRINGS
LOUISIANA POINT
SEA RIM STATE PARK
TEXAS POINT WMA
Sabine Pass Jetty Channel
McFADDIN NWR
Sabine Pass Outer Bar Channel
GULF OF MEXICO
Sabine Bank Channel
End of Existing Channel
SNWW Entrance Extension Channel
Legend
Project Area: Dredged Channel
State Parks, Nature Wildlife Refuges, Wildlife Management Areas
Project Area: Dredged Material Placement Areas
Project Area: Proposed Dredged Material Placement Areas
Project Area BU Features/ Mitigation Areas
State Boundaries
Channel Centerlines
County Boundaries
Study Area
Channel Reach Units

# Project Map

# Recommended Plan Features

- **Plan consists of:**
  - Deepening to 48-foot channel
  - Dredged Material Management Plan
  - Beneficial Use Plan
  - Marsh Mitigation

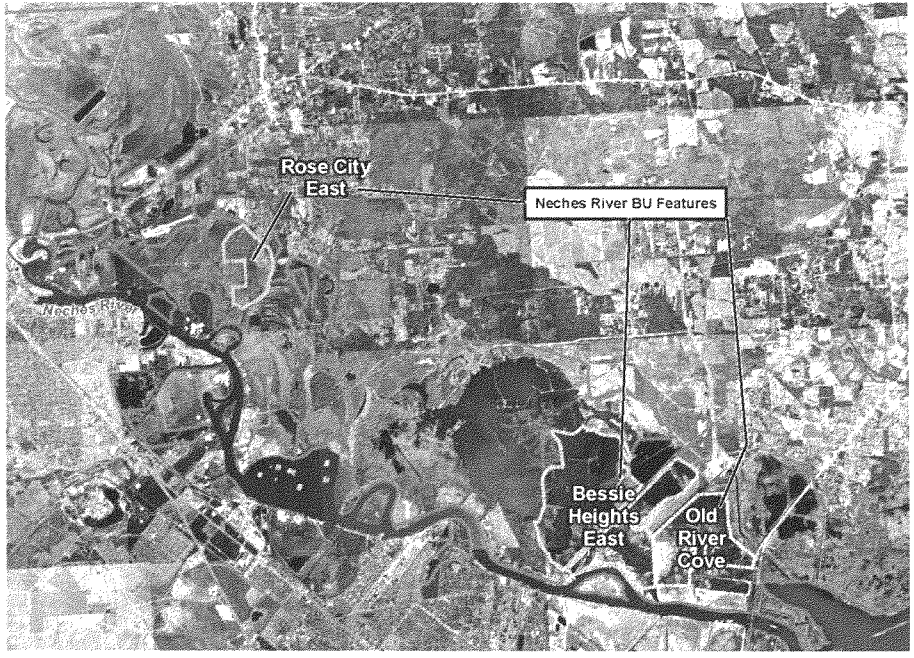
# Navigation Features

- Deepening SNWW to Beaumont to 48 feet
- Extending the Entrance Channel 13.2 miles offshore
- Deepening and widening Taylor Bayou channels and turning basins
- Adding/enlarging turning and anchorage basins along Neches River Channel
- Bend easing on Sabine-Neches Canal and Neches River Channel

# 50-Yr Dredged Material Management Plan

- Offshore channels
  - 4 existing and 4 new Ocean Dredged Material Disposal Sites (ODMDS)
  - New sites to be established by EPA using ODMDS EIS prepared by USACE and approved by EPA
  - Material determined suitable for unconfined ocean disposal by EPA
  - All sites are dispersive and have unlimited future capacities
- Inshore channels
  - Regular levee lifts at 16 existing upland placement areas
  - 2 expanded upland placement areas (PA 18A and PA 24A)
  - 2 groups of least-cost Beneficial Use (BU) features
    - Neches River BU Feature
    - Gulf Shore BU Feature

# Beneficial Use Map



# Beneficial Use Features

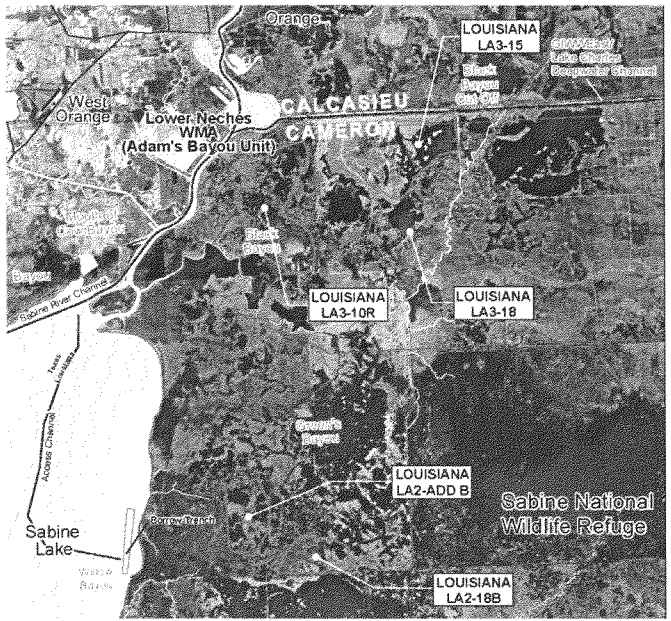
| Neches River BU Marsh Restoration | Acres |
|---|---|
| ▶ Rose City East (modified) | 345 |
| ▶ Bessie Heights East | 1,869 |
| ▶ Old River Cove | 639 |
| Total | 2,853 |

| Gulf Shoreline BU Nourishment | |
|---|---|
| ▶ Texas Point | 3 mi |
| ▶ Louisiana Point | 3 mi |

# Mitigation Plan Measures

- BU features compensate for all Texas impacts
- Unavoidable impacts in Louisiana mitigated by restoration of 5 large degraded marshes
  - ►2 in Willow Bayou watershed
  - ►3 in Black Bayou watershed

# Mitigation Measures




| | Emergent Marsh Acres Restored |
|---|---|
| **Willow Bayou** | |
| ▪ LA 2-18B | 251 |
| ▪ LA 2-ADD B | 436 |
| **Black Bayou West** | |
| ▪ LA 3-10R | 792 |
| **Black Bayou East** | |
| ▪ LA 3-15B | 683 |
| ▪ LA 3-18B | 621 |
| **Total Acres** | 2,783 |

# LPP Selection

- NED Plan is 49-foot depth
- LPP is 48-foot depth (Less in scope than NED)
  - Net benefits continue to increase beyond the 48' LPP depth
  - Greater benefits than smaller scale plans
  - Non-Federal sponsor's financial constraints
  - Cost-Sharing is same as NED Plan

**Economic Comparison LPP/NED**

(Made at October 2009 price level; 4.375% interest rate; cost in $1000's)

| | 48-foot | 49-foot |
|---|---|---|
| First Cost ($) | 1,071,877 | 1,152,079 |
| Total Annual Cost ($) | 91,341 | 96,626 |
| Avg. Annual Benefits ($) | 115,074 | 122,875 |
| Net Excess Benefits ($) | 23,733 | 26,249 |
| BCR | 1.3 | 1.3 |

# Economic Summary

(Updated from October 2009 price level)
(October 2010 price level; 4.125% interest rate)

| | |
|---|---|
| **Investment Costs** | |
| Total Project Construction Cost | $1,096,817,000 |
| Interest During Construction Costs | 114,700,000 |
| **Total Investment Cost** | $1,211,517,000 |
| **Average Annual Costs** | |
| Interest and Amortization of Initial Investment | $57,600,000 |
| Deferred Construction (F&W Mitigation) | 214,000 |
| Incremental O&M | 32,800,000 |
| **Total Average Annual Costs** | $90,614,000 |
| | |
| **Average Annual Benefits** | $115,400,000 |
| **Net Annual Benefits** | $24,786,000 |
| **Benefits-Cost Ratio** | 1.3 |

# Estimated Project Cost

(October 2010 price level)

| | |
|---|---|
| Channel Modification/Dredged Material Placement | $894,500,000 |
| Environmental Mitigation | 79,000,000 |
| Bridge Fender Modifications | 52,800,000 |
| Federal Cost for Cultural Resources | 1,270,000 |
| Additional Corps Administrative Costs | 774,000 |
| Lands, Easements, Rights-of-way and Relocations | 3,690,000 |
| Deep-Draft Utility Relocations (Non-Fed. Sponsor) | 21,300,000 |
| **TOTAL PROJECT COST (rounded)** | $1,053,000,000 |
| | |
| Deep-Draft Utility Relocations (facility owners) | 21,300,000 |
| Aids to Navigation – Channel Markers (USCG) | 1,500,000 |
| Berthing and Dock Modifications | 20,700,000 |
| **ASSOCIATED COSTS** | $43,500,000 |

# Cost Apportionment

(October 2010 price level)

| | Non-Federal Share | Federal Share |
|---|---|---|
| Channel Modification/Dredged Material Placement | $280,500,000 | $614,000,000 |
| Environmental Mitigation | 25,400,000 | 53,600,000 |
| Bridge Fender Modifications | 14,800,000 | 38,000,000 |
| Federal Cost for Cultural Resources | 0 | 1,270,000 |
| Additional Corps administrative costs | 194,000 | 580,000 |
| Lands, Easements, Rights-of-way and Relocations | 3,690,000 | 0 |
| Deep-Draft Utility Relocations (Non-Fed. Sponsor) | 21,300,000 | 0 |
| Additional 10% non-Federal repayment | 84,400,000 | (84,400,000) |
| **TOTAL PROJECT COST** | **430,000,000** | **623,000,000** |
| | | |
| Deep-Draft Utility Relocations (facility owners) | 21,300,000 | 0 |
| Aids to Navigation – Channel Markers (USCG) | | 1,500,000 |
| Berthing and Dock Modifications | 20,700,000 | 0 |
| **ASSOCIATED COSTS** | **$42,000,000** | **$1,500,000** |

# Environmental Compliance

- Draft Feasibility Report (DFR)/Draft EIS (DEIS) released in December 2009
- Received highest rating (lack of objections) from USEPA
- Section 7 Endangered Species Act consultation complete
- Section 401 Water Quality Certification received from TX and LA

- Historic Properties Programmatic Agreement executed with TX and LA SHPOs for Section 106 compliance

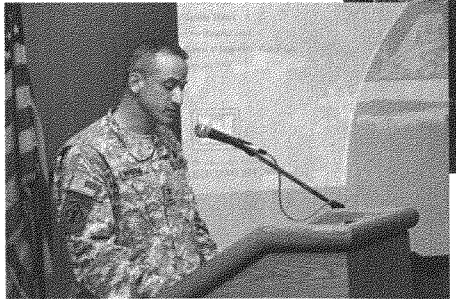
# Environmental Compliance

- Coastal Zone Consistency
  - Concurrence from TX
  - Conditional Consistency proposed by LA but not accepted by USACE
    - Louisiana Department of Natural Resources notified in letter on April 26, 2010 and in letter on July 20, 2011.
  - Recommended Plan is fully consistent to the maximum extent practicable with the enforceable policies of both state programs; therefore we are proceeding with the project.

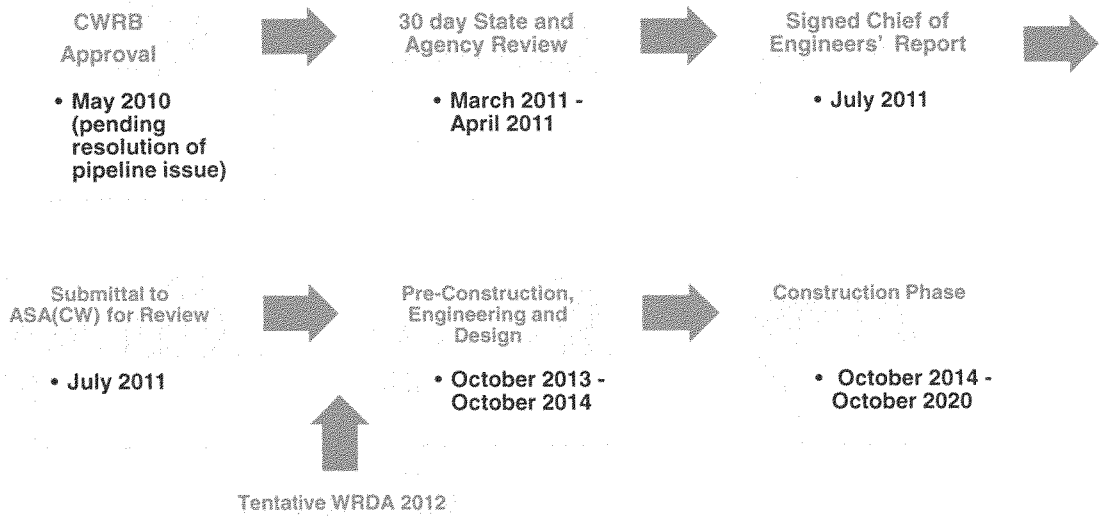
- Recommended Plan is compliant with all other applicable Federal and State regulations and pertinent Executive Orders

# Public Involvement

- Three scoping meetings in TX and LA 2000 and 2003
- Series of workshops in TX and LA in 2002 to identify BU opportunities
- Public meetings (one TX, one LA) 2010 on draft reports
- All comments and responses incorporated into report
  - Nearly all resource agency comments were positive
  - Local Texas governments expressed support
  - Majority of 31 public comments related to pipeline removals



# Future Timeline



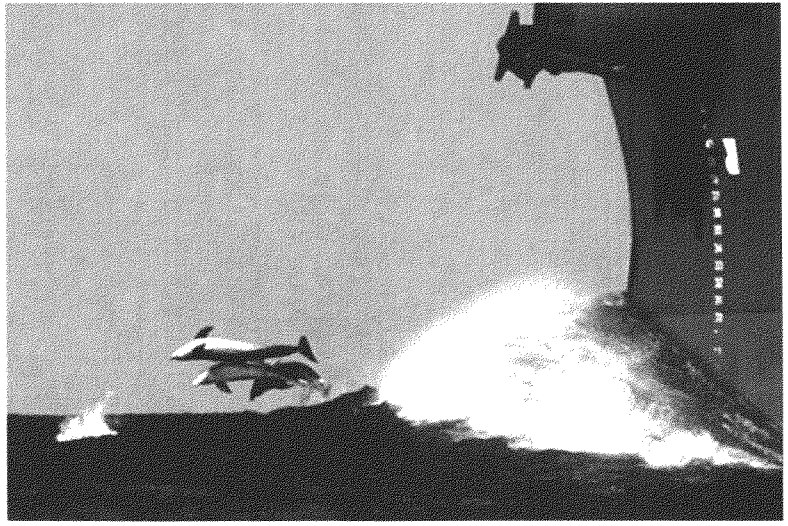
# CWRB

- 25 MAY 2010
- Approved subject to resolution of pipeline relocation issue and completion of IEPR back-check

# CWRB Issue Resolution

- IEPR
  - Back-check was completed 16 June 2010
- Pipeline Relocation Issue
  - All pipelines within the channels that must be removed and replaced will be considered "utility relocations."
  - In accordance with Sec 101(a) WRDA 1986, the non-Federal sponsor is responsible for performing all relocations, including utility relocations, with the cost of each utility relocation shared equally between the owner of the facility and the non-Federal Sponsor.

# QUESTIONS?





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# FINAL FEASIBILITY REPORT
# FOR
# SABINE-NECHES WATERWAY
# CHANNEL IMPROVEMENT PROJECT
# SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

## VOLUME I

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

March 2011

# INTRODUCTION

This Feasibility Report was prepared as a final response to the study authorization contained in the Senate Committee on Environment and Public Works Resolution adopted on June 5, 1997. The report presents the results of studies investigating the need to deepen and widen the Sabine-Neches Waterway (SNWW) along the border of Texas and Louisiana. In response to the study authority, the reconnaissance phase of the study was initiated in September 1998. The reconnaissance investigations resulted in a finding that there was an interest in continuing the study into the feasibility phase. The Jefferson County Navigation District, as the non-Federal sponsor (Sponsor), and the U.S. Army Corps of Engineers (USACE) initiated the feasibility phase of the study on March 6, 2000. The feasibility phase study cost was shared equally between the USACE and the Sponsor. In 2002, the Jefferson County Navigation District was renamed the Jefferson County Waterway and Navigation District (JCWND), and in 2007 the JCWND was renamed the Sabine Neches Navigation District (SNND); the latter designation is used throughout the remainder of this document.

This syllabus is intended to inform the reader of the major factors that were considered in the investigation and influenced the decisions documented in the Final Feasibility Report (FFR) and Final Environmental Impact Statement (FEIS).

# MAJOR CONCLUSIONS AND FINDINGS

## Planning Objectives

The water resources problems to be solved with this study are the navigational and safety issues that have developed on the SNWW because of the growth in the area. The investigation of the problems and opportunities in the study area led to the establishment of the following planning objectives:

- Improve the navigational efficiency along the SNWW waterway; and
- Maintain the ecological value of coastal and estuarine resources within the project area.

## Alternatives

Over 120 alternatives at nine different depths (43, 45, 46, 47, 48, 49, 50, 53, and 55 feet) in combination with several different width scenarios were evaluated in order to address the planning objectives and the problems and opportunities identified by the Sponsor and the public.

## Identification of the National Economic Development Plan

The Federal objective in water resources planning is to contribute to the National Economic Development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other planning requirements. Through thorough investigation and analysis, deepening the SNWW to 49 feet (with selective widening) is the best plan to meet the NED objective. However, the Sponsor has indicated that the 48-foot plan is preferred because the cost of the NED and deeper plans would make the project unaffordable. The 48-foot plan is the Locally Preferred Plan (LPP) and is the Recommended Plan.

## Recommended Plan and Locally Preferred Plan

The alternative plan selected for recommendation is the 48-foot plan that is also the LPP. The Recommended Plan calls for the following modifications to the existing SNWW:

- Deepening the SNWW from 40 to 48 feet and offshore channel from 42 to 50 feet in depth from offshore to the Port of Beaumont Turning Basin;
- Extending the 50-foot-deep offshore channel by 13.2 miles, increasing the total length of the channel from 64 to 77 miles;
- Decreasing the width of the Sabine Bank Channel from 800 to 700 feet;
- Tapering and marking the Sabine Bank Channel from 800 feet wide (Station 23+300) to 700 feet wide (Station 25+800 through the end of the channel);
- Deepening and widening of Taylor Bayou channels and turning basins;
- Easing selected bends on the Sabine-Neches Canal and Neches River Channel; and
- Constructing new and enlarging/deepening existing turning and anchorage basins on the Neches River Channel.

## Features of the Recommended Plan

The Recommended Plan consists of navigation channel improvements (see following table), marsh mitigation, and a 50-year Dredged Material Management Plan (DMMP) with beneficial use (BU) areas, upland placement areas (PAs), and Ocean Dredged Material Disposal Sites (ODMDS).

Sixteen existing and two expanded upland PAs are proposed for use with the Recommended Plan. Offshore placement consists of four existing and four new ODMDSs. As part of the DMMP, dredged material would be used beneficially to restore degraded marsh areas on the Neches River and nourish the Gulf shoreline along the Texas and Louisiana coasts. Both BU features are least-cost plans and as such are considered General Navigation Features (GNF) of the Recommended Plan. The Neches River and Gulf Shore BU features would offset all direct and indirect marsh impacts in Texas by creating 2,853 acres of emergent marsh vegetation, improving 871 acres of open water habitat, and nourishing 1,234 acres of existing marsh in Texas. Benefits of the Neches River BU Feature more than offset the direct

impact of conversion of 86 acres of fresh marsh to a confined placement area (PA 24A) and the indirect impact of the increase in salinity over approximately 39,000 wetland acres in Texas. The Gulf Shore BU Feature offsets minor erosion impacts by periodically nourishing 6 miles of Texas and Louisiana Gulf shorelines.

Project Dimensions for Recommended Plan

| Reach | Station | to | Station | Bottom Width (feet) | Project Depth (feet) |
|---|---|---|---|---|---|
| Extension Channel | 165+443 | | 95+734 | 700 | 50 |
| Sabine Bank Channel | 95+734 | | 25+800 | 700 | 50 |
| Sabine Bank Channel | 25+800 | | 23+300 | 700–800* | 50 |
| Sabine Pass Outer Bar Channel | 23+300 | | 0+000 | 800 | 50 |
| Sabine Pass Jetty Channel | –214+88 | | 0+00 | 800–500 | 48 |
| Sabine Pass Channel | 0+00 | | 296+25 | 500 | 48 |
| Port Arthur Canal | 0+00 | | 325+84 | 500 | 48 |
| Sabine-Neches Canal | 0+00 | | 592+94 | 400 | 48 |
| Neches River Channel | 0+00 | | 980+00 | 400 | 48 |
| **Taylor Bayou** | | | | | |
| Entrance Channel | 0+00 | | 25+27 | 406–764 | 48 |
| East Turning Basin | 0+00 | | 17+65 | 532–354 | 48 |
| West Turning Basin | 25+27 | | 41+30 | 776 | 48 |
| Connecting Channel | 41+30 | | 71+50 | 470–250 | 48 |
| Taylor Bayou Turning Basin | 71+50 | | 106+25 | 1,000 | 48 |

*Sabine Pass Outer Bar Channel would be 800 feet wide to address maneuverability issues caused by current velocities around end of jetties

The primary impact of the Recommended Plan is an indirect impact associated with a small increase in salinity and an associated reduction in biological productivity over approximately 182,000 acres of intertidal marsh in Louisiana, and the potential loss of 691 acres of marsh in Louisiana as some marsh converts to open water. The mitigation plan compensates for all impacts by restoring 2,783 acres of emergent marsh, improving 957 acres of shallow-water habitat, and stabilizing and nourishing 4,355 acres of existing marsh in the Willow and Black Bayou areas, Louisiana.

## Environmental Compliance

All project components were evaluated for environmental impacts, and an FEIS has been prepared in accordance with Council on Environmental Quality requirements. A mitigation plan was developed to compensate for all unavoidable environmental impacts. USACE has evaluated the proposed SNWW Channel Improvement Project (CIP) for consistency with the Texas and Louisiana coastal management programs, and concluded that the Recommended Plan is fully consistent to the maximum extent practicable with the enforceable policies of both state programs. The Texas Coastal Coordination Council has concurred with the USACE consistency determination. The Louisiana Department of Natural Resources, Office of Coastal Management (LDNR-OCM), found that the SNWW CIP is conditionally

consistent with their state program. Since conditional consistency as proposed by LDNR-OCM is not acceptable, LDNR-OCM has been notified that USACE will proceed with the project. Additional information on this matter is presented in FEIS Section 6.0. Clean Water Act §401 State Water Quality certification has been received from Texas and Louisiana for this action. Short-term increases in turbidity may be caused by the unconfined flow of dredged material during construction of BU features and mitigation measures. There would be temporary, minor impacts from ocean placement at the new ODMDSs. Proposed channel improvements should increase safety, thus decreasing the probability of a spill. A Clean Water Act §404(b)(1) evaluation of the proposed action, provided in the FEIS (Appendix E), describes the effects of the proposed discharges. The Recommended Plan is the least environmentally damaging practicable alternative. Coordination with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) regarding potential endangered species impacts has been concluded. Critical Habitat for wintering piping plovers is present in the Louisiana portion of the Gulf Shore BU Feature. The USFWS has concurred that the BU feature may affect, but is not likely to adversely affect, the species or its Critical Habitat because the Gulf Shore BU Feature would protect existing Critical Habitat. Hopper dredging of the Entrance Channel is likely to adversely affect but not jeopardize the continued existence of loggerhead, Kemp's ridley, and green sea turtles. In the Biological Opinion, the NMFS authorizes the incidental lethal take of four sea turtles and has identified reasonable and prudent measures to be adopted during construction. Based upon recent chemical analyses of water and sediment collected from within the channels, the potential for encountering hazardous material during dredging operations is considered minimal. Shoaled sediments and new work material that would be dredged from the SNWW during construction has been determined to be of sufficient quality to be used for beneficial uses. In compliance with requirements of the Clean Air Act and the State of Texas, the TCEQ has provided written concurrence that emissions from the Recommended Plan are conformant with the Texas State Implementation Plan for the Beaumont-Port Arthur area, and the USACE has prepared a Final General Conformity Determination. Potential impacts to historic properties will be addressed in accordance with the terms of the Historic Properties Programmatic Agreement with the SNND.

## Benefits and Costs of the Recommended Plan

### *Project Benefits*

The basic economic benefits from a navigation improvement project are the reduction in transportation costs for commodities and the increase in the value of output for goods and services. Specific transportation savings may result from the use of larger vessels, more-efficient use of large vessels, more-efficient use of existing vessels, reductions in transit time, and lower cargo handling and tug assistance costs. Based on the economic analyses performed during the study, total average annual project benefits are estimated at $115,074,000. Transportation cost savings are expected to occur for the following:

- Crude Petroleum Imports
- Petroleum and Chemical Products
- Grain Exports

- Steel Slab and Iron Ore
- Limestone and Rock
- Liquefied Natural Gas (LNG) traffic (benefits stop at 43 feet)

***Project Costs (October 2009 Price Levels)***

The First Cost of all project components in current dollars totals $1,071,877,000. Based on Budget Year 2012, the first cost would be $1,100,935,000. The Fully Funded Cost for the project (e.g., First Costs and escalation in current dollars) totals $1,161,372,000. The LPP investment cost of all components totals $1,191,259,000 in current dollars, and includes $119,382,000 in interest during construction (IDC). The total average annual LPP investment cost for the project is $91,341,000. The LPP cost includes average annual incremental costs for operations and maintenance (O&M) ($32,067,000) and deferred construction for fish and wildlife mitigation ($215,000).

***Benefit-Cost Ratio***

Based on the annualized project benefits estimated at $115,074,000 and annualized project costs estimated at $91,341,000, the benefit-cost ratio for the Recommended Plan is 1.3.

***Cost Sharing***

General navigation features (GNF) costs for deepening from the existing authorized depth of 40 feet down to 45 feet are cost shared at 25 percent non-Federal and 75 percent Federal; costs for deepening below 45 feet (recommended authorized depth of 48 feet) are cost shared at 50 percent non-Federal and 50 percent Federal. Fish and wildlife mitigation to compensate for project impacts is considered a GNF and is cost shared in the same manner as other GNF costs. The Sponsor also must pay an additional 10 percent of the GNF costs in cash over a period not to exceed 30 years. This additional 10 percent cash contribution is offset by credit for Lands, Easements, and Rights of Way (LER) and relocations (including utility relocations) pursuant to Section 101(a)(2) of Water Resources Development Act of 1986, as amended. Owners of berth and dock facilities that would require modification are responsible for 100 percent of those associated costs. The U.S. Coast Guard (USCG) is responsible for 100 percent of the cost for new channel markers (aids to navigation).

## PUBLIC COORDINATION

The USACE and SNND developed a public involvement plan as part of the study process to ensure responsiveness to the needs and concerns of stakeholders and to ensure public involvement through an open, interactive process. Extensive coordination with State and Federal resource agencies was conducted throughout the study process, primarily through an Interagency Coordination Team (ICT) and workgroup meetings. Over 30 workgroup meetings and 11 ICT meetings were held during the study process.

## NON-FEDERAL SPONSOR SUPPORT

SNND fully supports the project and is willing to sponsor project construction in accordance with the items of local cooperation set forth in this report. The Sponsor has indicated financial capability to satisfy its obligations for the construction of the Recommended Plan. A self certification has been prepared by the Sponsor and provided to the USACE.

## AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

The USACE has evaluated the proposed SNWW CIP for consistency with the Louisiana coastal management program, and concluded that the Recommended Plan is fully consistent to the maximum extent practicable with the enforceable policies of the state's coastal management program. The Louisiana Department of Natural Resources, Office of Coastal Management, found that the SNWW CIP is conditionally consistent with their state program. Since conditional consistency as proposed by LDNR-OCM is not acceptable, LDNR-OCM has been notified that USACE will proceed with the project. See FEIS Section 6.0 for further details.

Coordination with the Louisiana Department of Wildlife and Fisheries (LDWF) has not been able to resolve issues related to the offset of project impacts to Federal lands using benefits from BU features in Texas, LDWF requirements that the Recommended Plan include additional BU features, and royalty, license, and further assessment requirements concerning areas in Sabine Lake that would be affected by the removal of fill material for use in marsh mitigation. The USACE has proposed that an assessment survey be completed, following the protocol established by the LDWF, during the Preconstruction Engineering and Design phase of the SNWW CIP.

In order for the four new ODMDSs to be approved for use, the Environmental Protection Agency (EPA) must publish a final rulemaking in the *Federal Register*. An FEIS for the proposed ODMDS and a Final Site Management and Monitoring Plan have been prepared and accepted by EPA for use in this rulemaking at a later date (FEIS, Appendix B).

Issues related to contaminated materials in PA 17 (a capped landfill and other waste disposal areas within the PA) must be resolved by the non-Federal sponsor before the PA can be used as part of the Recommended Plan. Alternative placement areas are available should this not be resolved in time for use.

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4 Real Estate Plan

**VOLUME II – FEIS MAIN REPORT**

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## Acronyms and Abbreviations

| | |
|---|---|
| 3-D | three-dimensional |
| AAHU | average annualized habitat units |
| AB | anchorage basins |
| ADV | Acoustic Doppler Velocity |
| AIS | Automatic Identification System |
| ATR | Agency Technical Review |
| Bcf | billion cubic feet |
| Bcf/d | billion cubic feet/day |
| BCR | Benefit-to-Cost Ratio |
| BOOTS | Bulk Oil Offshore Transfer System |
| BU | Beneficial Use |
| CAP | Continuing Authorities Project |
| CAR | Coordination Act Report |
| CE/ICA | cost-effectiveness analysis and incremental cost analysis |
| CEPRA | Coastal Erosion Planning and Response Program |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CHL | Coastal and Hydraulics Laboratory |
| CIP | Channel Improvement Project |
| CWPPRA | Coastal Wetlands Planning, Protection and Restoration Act |
| CZMA | Coastal Zone Management Act |
| CZMP | Coastal Zone Management Plan |
| DAMP | Dewatering Management Practices |
| DMMP | Dredged Material Management Plan |
| DWT | deadweight tons |
| EC | Engineering Circular |
| EFH | Essential Fish Habitat |
| EGM | Economic Guidance Memorandum |
| EIA | Energy Information Administration |
| EIS | Environmental Impact Statement |
| EMCM | Emergent Marsh Community Model |
| EOP | Environmental Operating Principles |
| EPA | Environmental Protection Agency |
| ER | Engineering Regulation |
| ERDC | Engineer, Research and Development Center |
| FEIS | Final Environmental Impact Statement |
| FERC | Federal Energy Regulatory Commission |

| | |
|---|---|
| FFR | Final Feasibility Report |
| FWOP | future without project |
| FWP | future with project |
| GEC | Gulf Engineers and Consultants, Inc. |
| GICA | Gulf Intracoastal Canal Association |
| GIWW | Gulf Intracoastal Waterway |
| GLO | General Land Office |
| GMFMC | Gulf of Mexico Fisheries Management Council |
| GNF | General Navigation Features |
| HEP | Habitat Evaluation Procedure |
| HFP | Hurricane Flood Protection |
| HS model | hydrodynamic-salinity modeling |
| ICT | Interagency Coordination Team |
| IDC | interest during construction |
| IH | Interstate Highway |
| IPCC | Intergovernmental Panel on Climate Change |
| IWR | Institute of Water Resources |
| JCWND | Jefferson County Waterway and Navigation District |
| LACPRA | Louisiana Coastal Protections and Restoration Authority |
| LBG/TEA | Louis Berger Group and Toxicological and Environmental Associates |
| LCWCR/WCRA | Louisiana Coastal Wetlands Conservation and Restoration/Wetlands Conservation and Restoration Authority |
| LDNR | Louisiana Department of Natural Resources |
| LDNR-OCM | Louisiana Department of Natural Resources, Office of Coastal Management |
| LDWF | Louisiana Department of Wildlife and Fisheries |
| LER | Lands, Easements, and Rights of Way |
| LNG | liquefied natural gas |
| LOOP | Louisiana Offshore Oil Port |
| LPP | Locally Preferred Plan |
| mcy | million cubic yards |
| mcy/yr | million cubic yards per year |
| MLK | Martin Luther King |
| mm | millimeters |
| msl | mean sea level |
| MW | Hydrodynamic and Salinity Modeling Workgroup |
| NAWMP | North American Waterfowl Plan |
| NDC | Navigation Data Center |
| NED | National Economic Development |

| | |
|---|---|
| NEPA | National Environmental Policy Act |
| NMFS | U.S. National Marine Fisheries Service |
| NRC | National Research Council |
| NRHP | National Register of Historic Places |
| NWR | National Wildlife Refuge |
| O&M | operations and maintenance |
| ODMDS | Ocean Dredged Material Disposal Sites |
| P&G | Principles and Guidelines |
| PA | placement area |
| PADD | Petroleum Administration Defense District |
| PED | Preconstruction Engineering and Design |
| PGL | Policy Guidance Letters |
| PIE | Pacific International Engineering |
| ppt | parts per thousand |
| RED | Regional Economic Development |
| RHA | River and Harbor Act |
| RSLR | relative sea level rise |
| RSM | Regional Sediment Management |
| SCM | Swamp Community Model |
| SH | State Highway |
| SI | Suitability Indices |
| SNND | Sabine Neches Navigation District |
| SNWW | Sabine-Neches Waterway |
| SPA | Sabine Pilots Association |
| STWAVE | Steady State Spectral Wave Model |
| TB | turning basins |
| TBA | turning basin anchorage |
| Tcf | trillion cubic feet |
| TDH | Texas Department of Health |
| TPCS | Total Project Cost Summary |
| TPWD | Texas Parks and Wildlife Department |
| TWDB | Texas Water Development Board |
| USACE | U.S. Army Corps of Engineers |
| USCG | U.S. Coast Guard |
| USDA | U.S. the Department of Agriculture |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| VLCC | Very Large Crude Carriers |

| | |
|---|---|
| VTS | Vessel Traffic Service |
| WMA | Wildlife Management Area |
| WRDA | Water Resources Development Act |
| WVA | wetland value assessment model |

# I. STUDY INFORMATION

## I.A OVERVIEW

This Feasibility Report was prepared to determine the feasibility of modifying the portion of the existing Sabine-Neches Waterway (SNWW) that serves the ports of Beaumont and Port Arthur, Texas. The Port of Orange was not interested in participating in the study; therefore, modifications to the Channel to Orange were not considered in this study. To allow for a more effective, safe, and efficient waterway, the study focused on eliminating the major problems contributing to the inefficiencies on the waterway. The study reviewed and analyzed alternatives to address the insufficient channel depth and width, as determined by fleet forecasts. The possibility of conducting two-way traffic in portions of the channel, and ways of maintaining a safe waterway for all commercial and public users were also investigated. Economic benefits and costs were identified for proposed channel modifications, and recommendations were made that would maximize project benefits.

## I.B STUDY AUTHORITY

This Feasibility Report was conducted in response to the June 5, 1997, Senate resolution from the Committee on Environment and Public Works. The resolution states:

> The Secretary of the Army shall review previous reports on the Sabine-Neches Waterway published as Senate Document No. 80, 83rd Congress, Second Session; House Document No. 553, 87th Congress, Second Session; and other pertinent reports to determine the feasibility of modifying the channels serving the ports of Beaumont, Port Arthur, and Orange, Texas, in the interest of commercial navigation.

## I.C PURPOSE AND SCOPE

This report presents the findings of a feasibility investigation conducted to determine whether there is a Federal interest in providing channel improvements to the SNWW. This report analyzes the problems and opportunities, and expresses desired outcomes as planning objectives. Alternatives were then developed to address these objectives. These alternatives include a plan of no action and various combinations of structural and nonstructural measures. The economic and environmental impacts of the alternatives were then evaluated to identify the Recommended Plan. The report also presents details on U.S. Army Corps of Engineers (USACE) and Sponsor participation needed to implement the plan. The report concludes with a plan that is recommended for Congressional authorization (the Recommended Plan).

## I.D PROJECT AREA DESCRIPTION

### Physical Description of Study Area

The SNWW is an approximately 64-mile federally authorized and maintained waterway located in Jefferson and Orange counties in southeast Texas and Cameron Parish, Louisiana. The area surrounding

the waterway is generally referred to as the "Golden Triangle" and is delineated by the three major Texas seaports of Port Arthur, Beaumont, and Orange. Sabine Pass, Sabine Lake, and the Sabine River together form part of the boundary between the states of Texas and Louisiana (Figure I-1). Improvements to the 30-foot Sabine River Channel to Orange were not evaluated due to the expectation of continued low utilization of the existing project depth.

The SNWW is a system of navigation channels that has been superimposed upon the Sabine-Neches estuary in Texas and Louisiana. The estuary includes Sabine Lake, tidal portions of the Sabine and Neches rivers, and a number of tidally influenced bayous and shallow coastal lakes. The only connection with the Gulf of Mexico is a long narrow pass called Sabine Pass through which all tidal interchange occurs. Sabine Pass is stabilized by jetties that extend 4.1 miles into the Gulf of Mexico. The jetties were initially constructed for navigational purposes in the late 1880s.

The existing SNWW is made up of seven reaches as shown in Table I-1, beginning with the Sabine Bank Channel in the Gulf of Mexico and working upstream to the Neches River Channel.

Table I-1
Existing Sabine-Neches Waterway Channel Dimensions

| Channel Reach | Authorized Depth (feet) | Bottom Width (feet) | Length (miles) |
|---|---|---|---|
| Sabine Bank Channel | 42 | 800 | 14.7 |
| Sabine Pass Outer Bar Channel | 42 | 800 | 3.4 |
| Sabine Pass Jetty Channel | 40 | 800–500 | 4.0 |
| Sabine Pass Channel | 40 | 500–1,133 | 5.6 |
| Port Arthur Canal (including Taylor Bayou) | 40 | 500–1,788 | 6.2 |
| Sabine-Neches Canal | 40 | 400–1,060 | 11.3 |
| Neches River Channel | 40 | 400 | 18.6 |

The SNWW enters from deep water in the Gulf through the Entrance Channel, which is divided into the Sabine Bank Channel and the Sabine Pass Outer Bar Channel. It enters into Sabine Pass through the Sabine Pass Jetty and Sabine Pass channels, and follows the west bank of Sabine Lake to Port Arthur in the Port Arthur Canal. The project includes Taylor Bayou Channels and Turning Basins (TB) at the confluence of the Port Arthur Junction Area. On the west side of Sabine Lake, the Sabine-Neches Canal is separated from the lake by an artificially created band of land called Pleasure Island, that extends to the near the mouth of the Neches River. From the northwestern to the northeastern corner of Sabine Lake, another section of the Sabine-Neches Canal connects the mouths of two rivers, the Neches River (to Beaumont, Texas) and the Sabine River to the east (to Orange, Texas). The Neches River Channel ends at the Beaumont TB just south of the Interstate Highway (IH) 10 Bridge. The deep-draft portion of the authorized Federal project generally provides for a channel 42 feet deep and 800 feet wide at the entrance to the Gulf of Mexico, a channel 40 feet deep and 500 feet wide to Port Arthur, and a channel 40 feet deep

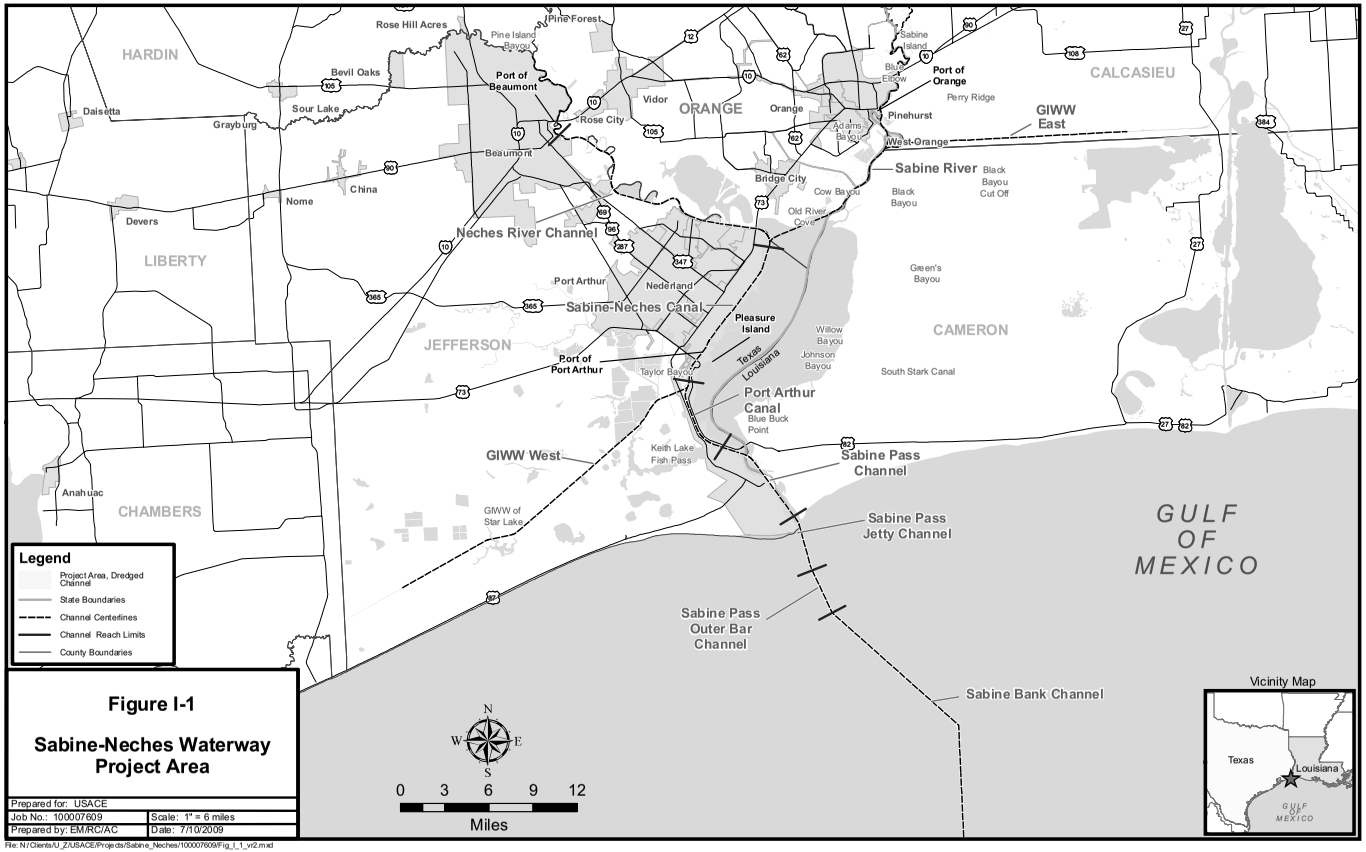


**Figure I-1**

**Sabine-Neches Waterway Project Area**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 6 miles |
| Prepared by: EM/RC/AC | Date: 7/10/2009 |

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and 400 feet wide to Beaumont by way of the Neches River. The existing SNWW channel has four open-water dredged material placement areas (PAs) and 24 upland confined PAs.

Shallow- and deep-draft vessels use the same channel where the routes of the Gulf Intracoastal Waterway (GIWW) and SNWW overlap. The GIWW coincides with parts of the SNWW, entering from the west just south of Port Arthur, extending through the confined channel reach at Pleasure Island, crossing the more exposed northern edge of Sabine Lake, and following the Sabine River Channel north to just south of the City of Orange, where the GIWW turns eastward and continues into Louisiana.

## Study Area

The study area includes the area for which environmental effects of alternatives have been analyzed (Figure I-2) and encompasses a 2,000-square-mile area, which contains the smaller area referred to as the "project area." The project area includes those areas that would be directly affected by construction of the Channel Improvement Project (CIP) (i.e., dredging footprint, existing and proposed PAs, and mitigation areas). The study area includes the following water bodies and adjacent coastal wetlands: Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River channel up to the new Neches River Saltwater Barrier, the Sabine River channel to the Sabine Island Wildlife Management Area (WMA), the GIWW west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf of Mexico.

The major rivers within the study area are the Sabine and Neches rivers, and smaller streams such as Taylor, Adam, Cow, and Little Cypress bayous on the Texas side. Major bayous flowing into Sabine Lake from Louisiana include Lighthouse, Johnson's, Madame Johnson's, Willow, Three, and Black bayous. Approximately 80 percent of the freshwater drainage bypasses Sabine Lake, traveling down the SNWW and flowing into the Gulf of Mexico or southwestward into the GIWW (Gosselink et al., 1979).

## Environmental Setting

### Terrain

The coastline of the study area differs from most of the Texas coast in that there are no barrier islands or lagoons. The study area is characterized by a diversity of features that are a result of the natural transition between marine and freshwater environments and anthropogenic impacts. The mainland portion of the study area can be classified as either coastal-marsh or coastal-prairie. These extensive wetland areas occur in areas less than 5 feet above mean sea level (msl) and extend inland 4 to 15 miles along the entire Gulf shoreline. Expansive marsh borders Sabine Lake on the southeast side, PAs on the west and north sides of the lake, and swamps and bottomland hardwoods extend up the lower reaches of the Neches and Sabine rivers.

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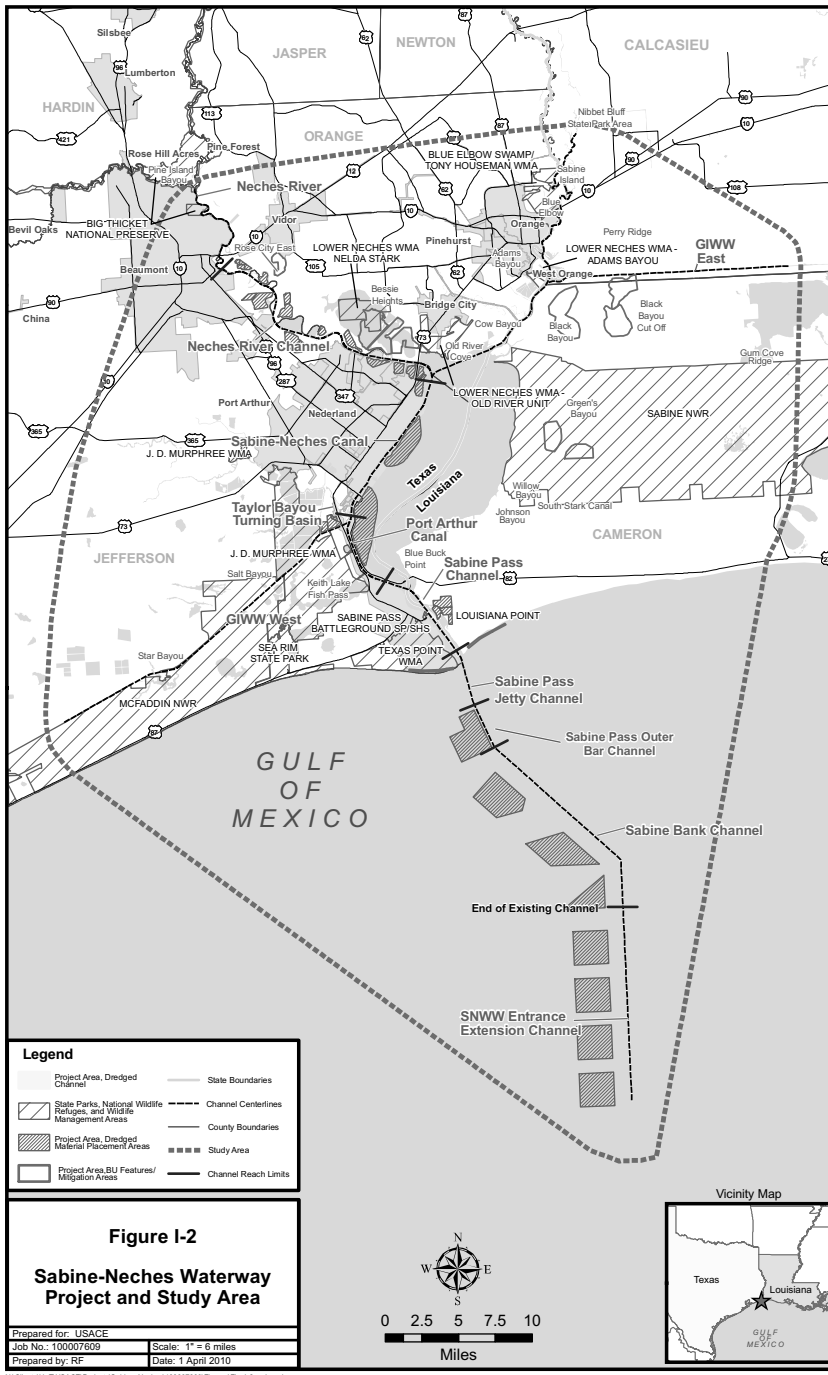


**Figure I-2**

**Sabine-Neches Waterway Project and Study Area**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 6 miles |
| Prepared by: RF | Date: 1 April 2010 |

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The gentle sloping coastal prairie lies landward of the coastal marshes and is broken into smaller prairie segments by belts of pine and hardwood trees and by small meandering coastal streams with their associated wetlands. Farmers and ranchers are the principal users in the higher marsh areas. Cities and industries cover most of the higher elevations, and this is largely restricted to the west bank of Sabine Pass and Sabine Lake, and between the mouth of the Sabine and Neches rivers, northwest of Sabine Lake.

The timberlands in the flood-prone areas were commercially lumbered in the past but have experienced only small-scale lumbering in the twentieth century. Topography of the study area is essentially featureless, except for the surface expression of salt domes (Big Hill, Fannett, and Spindletop in Texas and Hackberry in Louisiana). These salt domes are still producing limited quantities of oil and gas.

Sabine Lake has a water surface area of approximately 100 square miles and a maximum natural depth of 9 feet. Due to the abundance of rainfall in this region, the rivers and bayous of this reach provide substantial freshwater inflow into Sabine Lake. However, instream flows to this reach have been altered from their natural hydrograph due to major impoundments in the middle and upper Sabine and Neches River basins. The combined discharges of the Sabine and Neches rivers into the northern part of Sabine Lake constitute the greatest freshwater input to any Texas bay. These rivers discharge large quantities of fine sediments into the lake but do not form deltas at their mouths because most of this material remains in suspension and is dispersed over the northern portion of the lake. During flood flows, these fine sediments are dispersed over the entire lake, and some are expelled through the Sabine Pass into the Gulf of Mexico.

The Gulf in the study area consists of open seas, coastline, and a dredged channel extending from the jettied Sabine Pass seaward. This area is heavily influenced by the Mississippi River Delta located to the east. When the Mississippi River occupied one of its western courses, sediment deposits were carried westward by littoral currents that built the Chenier Plain (Davis, 1996). The Chenier Plain is a unique salt marsh area on the extreme eastern edge of the Texas Gulf Coast, and is part of a much larger chenier plain in western Louisiana. A chenier plain is a series of sandy or shelly ridges or “cheniers,” many more than 10 feet high, separated by clayey or silty marsh deposits. The distance from chenier to chenier may be as much as 1 or 2 miles or more.

Chronic erosion is believed to be associated with the diversion of sand and other sediment resulting from channelization and regulation of the Mississippi and Atchafalaya rivers to the east, and the Sabine and Neches rivers in Texas. The Sabine Pass jetties intercept sediment moving westward in the littoral drift, creating a wide, muddy, tidal flat next to the east jetty (PBS&J, 2006; USACE, 2004). Texas Point is undergoing severe beach erosion, with shoreline retreat of up to 1,150 feet between 1974 and 2000 (King, 2007; Morang, 2006). This is the highest rate of shoreline loss on the upper Texas coast, and a Texas Coastal Erosion Planning and Response Program (CEPRA) has identified several parts of the study areas as “critical erosion areas” (Texas General Land Office [GLO], 2004, 2005). In Louisiana, persistent erosion along the shoreline between Ocean View and Holly Beach, on the order of –4.3 feet/year between 1985 and 1998, was recorded here prior to Hurricane Rita (USACE, 1971a, 2004). Nearer to Louisiana

Point, significant accretion over the last 100 years has slowed to +1.2 feet/year, and the behavior of this shoreline has become erratic, with some areas eroding and some accreting (USACE, 2004).

The study area lies in the easternmost portion of the humid climatological zone of Texas and usually has mild summers and winters. Winds generally are from the south or southeast except during the winter when polar fronts (northers) move across the state. Winds from these northers are important in lowering water levels and help to flush coastal estuaries. Temperatures are moderated by the influence of the winds from the Gulf, resulting in mild winters and relatively cool summer nights. The mean daily temperature ranges from the mid-50s (degrees Fahrenheit, °F) in December and January to the mid-80s in the summer months. The temperature rarely drops below 22°F or rises above 98°F. Relative humidity levels average approximately 78 percent throughout the year (USACE, 1975). Freezing temperatures occasionally occur during the winter but rarely last more than a few days. The historical temperature variance has been from a low of 11°F to a high of 107°F. The growing season, or the average period from the last frost in spring to the first frost in fall, is about 294 days.

The study area is also subject to dense fog throughout the year, but such conditions are most prevalent during the fall and winter months. Heavy fog occurring on an average of 29 days per year tends to hamper navigation by producing limited-visibility conditions along the waterway. Clear days during the year average about 117; partly cloudy days, 191; and cloudy days, 57.

Another effect of the nearness of the Gulf is abundant rainfall distributed throughout the year. The average annual rainfall is about 52 inches, with monthly precipitation averaging from 3.2 inches to about 6.6 inches. The area is occasionally subject to periods of intense rainfall, which may occur during any time of the year, but are usually associated with tropical storms, which typically occur from June through October.

### Tides

The Sabine Lake area is a dynamic estuary only recently subject to the extensive mixing of fresh and seawater due to tidal currents. The tidal inlet at Sabine Pass differs from the other Texas tidal passes in that it is very long, 7 miles, and narrow, 0.4 mile, and is solidly entrenched in earlier geologic deposits. Normal tidal fluctuation in the area is relatively small with a diurnal range of 1 to 2 feet. A tidal range varying from 1.03 at Sabine Pass to 0.65 foot at Orange can be derived from the tide records. These ranges are typical of the Gulf coast area. Water levels in the SNWW are also influenced by the prevailing winds from the south-southeast direction. Water levels generally rise slightly with winds out of the south and south-southeast and fall, sometimes significantly, with winds from the north or northwest. Water surface elevations in the SNWW can vary greatly when driven by wind and storm activity. Water levels as low as –4 feet during strong northwesterly winds and as high as +16 to +18 feet during hurricane surges have been observed.

### Salinity

The SNWW estuarine system exhibits very complicated circulation and salinity patterns (Brown and Stokes, 2009). Fresh water enters the system via several tributaries, including the Sabine River, the Neches River, and other smaller inflows. The Neches River flows directly into Sabine Lake and the Sabine-Neches Canal. The Sabine River flows into Sabine Lake, the Sabine National Wildlife Refuge (NWR) and into Calcasieu Lake via the GIWW. During times of low flow, the direction of this flow is reversed and higher salinity Calcasieu waters flow westward into the Sabine basin (Gammill et al., 2002).

The Sabine-Neches Canal connects the Neches River Channel to Sabine Pass, flowing through a narrow, confined channel between Pleasure Island on the east and the Port Arthur area on the west. This canal acts as a flow pathway for both fresh water from the inflowing rivers, and saline waters intruding via tidal propagation through Sabine Pass. This combination results in highly stratified conditions in the Sabine-Neches Canal. The stratification contributes to saltwater intrusion migrating up the Sabine-Neches Canal and into the northwest corner of Sabine Lake and the lower reaches of the Neches River. To combat these conditions, a saltwater barrier (Neches River Saltwater Barrier) has been installed approximately 30 stream-miles upstream of Rainbow Bridge to prevent saltwater intrusion north of the Port of Beaumont. As a result of the intrusion, the observed salinity in Sabine Lake is highest at both the southern end (where the lake connects to Sabine Pass) and at the northern end (where the lake connects to the Sabine-Neches Canal). The lowest salinities are observed in the central and eastern portions of Sabine Lake, which are farthest from the hydraulic connection to sources of saline water.

The estuary experiences wide swings in salinity levels that are associated with periods of drought and high freshwater inflows. During periods of drought, the flow in the Neches and Sabine rivers can drop drastically and a saltwater wedge can proceed farther upstream of both the Sabine and Neches rivers from the Gulf (Lower Neches Valley Authority, 2002; Sabine River Authority of Texas, 2002). The strength and intensity of winds and intensity of rainfall influences salinity levels in the SNWW, Sabine Lake, and Calcasieu Lake. The salinity of the waterway ranges from open Gulf levels of about 34 parts per thousand (ppt) to 0 ppt in the upper reaches of the Neches and Sabine River channels. Sabine Lake is predominantly a brackish-water estuary with salinity content ranging from 15 ppt at Sabine Pass to 0 ppt at times at the northern end of the lake. During periods of normal rainfall, high-salinity water transported by the SNWW is buffered by inflows from the Sabine and Neches rivers, direct rainfall, and coastal watershed inflows that have little effect on the salinity levels of Sabine Lake and the surrounding marshes. On the other hand, during periods of high flows, the SNWW and Sabine Lake can experience occasional freshwater conditions (very low salinity levels) due to large quantities of fresh water entering the system from the Sabine and Neches rivers (Coalition to Restore Coastal Louisiana, 2002).

### Geology

The soils of Jefferson and Orange counties, Texas, and Cameron Parish, Louisiana, are separated mainly into Holocene and Pleistocene sediments with modern river sediments in the vicinity of the Neches and Sabine River channels. The coastal zone in the study area has evolved to its present condition by erosion,

deposition, compaction, and subsidence, all of which are still active. Gradual faulting continues as Pleistocene and older Gulf basin muds continue to compact.

The site geology is characterized by modern marine deposits overlaying recent Holocene deposits that in turn overlay Beaumont and Lissie formations of the Pleistocene Series (Bureau of Economic Geology, 1982). The modern deposits are generally normally consolidated clays, silts, and fine sands that were deposited through natural overwash and sedimentation processes or through man-made depositional processes. The recent deposits of the Holocene consist of silts, clays, silty sands, clayey sands, and clayey silts that exhibit the characteristics of normally to lightly overconsolidated materials. These deposits are generally encountered to depths of 30 to 40 feet. Beaumont Clay is the predominant Pleistocene formation whose eroded surface forms the upper limit of stiff to very stiff clay material. Lenses of fine-grained, poorly graded sand and silt, and a few calcareous nodules are sometimes encountered in this formation. The clay fraction is composed of montmorillonite, kaolinite, illite, and finely ground quartz, in that order of prevalence, and it has a high shrink-swell potential.

Sabine Lake was formed from the flooding of an ancient river valley (Kane, 1959) and was later separated from the Gulf by the advancement of the Gulf shoreline and deposition of the beach ridge/mudflat complex known as the Chenier Plain (Gould and McFarlan, 1959). Two types of landforms characterize the Chenier Plain: broad marshes containing organic clays and peat, and long narrow relict beach features called cheniers that appear as ridges parallel to the coast. The Chenier Plain fronts the entire study area on the Gulf shoreline in both Texas and Louisiana.

High-volume freshwater inflow into Sabine Lake helped maintain Sabine Pass as a narrow and relatively shallow link between the Gulf and Sabine Lake (Morton, 1996). Filling of Sabine Lake with sediment continues from the Sabine and Neches rivers and the Gulf of Mexico. Muddy river deposits slowly fill the upper parts of the estuarine systems and are responsible for much of the muddy sediment that fills the upper part of Sabine Lake. Only small amounts of bedload sand have been deposited in the estuarine system.

## Fish and Wildlife Resources

The SNWW study area contains estuarine, wetland, and upland habitats that support a variety of fish and wildlife resources. Since the study area has tidal and freshwater habitats, wildlife species are diverse. The area also supports productive sport and commercial fishing. Due to the diversity of bird life, bird watching is an important recreational activity.

## Aquatic Resources

The study area consists of both freshwater and marine ecosystems. The Sabine and Neches rivers and their tributaries were dominated by fresh water prior to the late 1800s, before Sabine Lake was opened for navigation. It is likely that Sabine Lake was almost entirely fresh, with the exception of saltwater intrusions that emanated from tidal surges during storms or during severe droughts. Thus, the biological communities have changed significantly within the past century due to the encroachment of saltwater.

The salinity extremes that often occur in Sabine Lake preclude lasting colonization of stenohaline species (tolerating narrow salinity ranges). Most of the tributaries adjacent to Sabine Lake are also influenced by salt water to some extent. A general overview of the freshwater and marine resources is described below. For a more detailed description of the biological resources within the study area, see Section 3.10 of the Final Environmental Impact Statement (FEIS).

### Freshwater Resources

Freshwater fauna typically occur in the tributaries of Sabine Lake including the Sabine and Neches rivers, Taylor, Cow, Adams, and Little Cypress bayous in Texas, Black and Johnson's bayous in Louisiana, as well as numerous other smaller tributaries. In addition, freshwater fauna can be found in the multitude of wetlands, oxbows, ponds, canals, and ditches within the study area.

Due to the variety of habitats and the typical diversity of southeastern U.S. streams, the study area has an exceptionally diverse fish community consisting of approximately 56 freshwater and 25 estuarine species (Hubbs, 1982; USACE, 1975). The Louisiana Department of Wildlife and Fisheries (LDWF), Inland Fisheries Division, monitors fish populations and has identified a variety of freshwater species from this area including largemouth bass, spotted bass, bowfin, black crappie, spotted sucker, golden shiner, sunfish, blue catfish, channel catfish, spotted gar, shad, and striped mullet (LDWF, n.d.).

Both benthic macroinvertebrates and plankton support the food chain in the freshwater zones. Food chains in the larger, slow-moving rivers, bayous, and backwater areas are similar to that found in lakes. In these systems, the food chain consists primarily of plankton, including microscopic algae (phytoplankton) and crustaceans (zooplankton) that are suspended in the water column. Diverse communities of plankton occur throughout the freshwater system, but gradually shift to marine taxa as the water enters the estuarine areas.

### Marine Resources

Sabine Lake, when compared to the other estuarine ecosystems in Texas, covers the smallest surface area (43,978 acres/68.6 square miles) and volume; however, it has the largest surrounding marshland (over 185,000 acres/288.6 square miles) (Armstrong et al., 1987; Blackburn et al., 2001). Phytoplankton (microscopic algae) are the major plant life in the open-bay, taking up carbon through photosynthesis and nutrients for growth. Phytoplankton are fed upon by zooplankton (small crustaceans), fish, and benthic consumers. Zooplankton are most abundant when the salinities are higher. Sabine Lake supports a diverse nekton population including fish, shrimp, and crabs such as Atlantic croaker, white and brown shrimp, Gulf menhaden, bay anchovy, red drum, blue crab, and southern flounder. These species are present all along the Texas and Louisiana coast and are unaffected by changes in salinity. Sabine Lake sustains an important blue crab fishery in Texas and Louisiana. Eastern oyster reefs are located in the southern part of Sabine Lake near Blue Buck Point, in Sabine Pass, and in Keith Lake. Oysters are not commercially harvested from Sabine Lake. The Texas Department of Health (TDH) has prohibited the harvesting of molluscan shellfish from this system since the late 1970s (Heideman, 2002; TDH, 2002). Louisiana has

designated Sabine Lake as a "Public Oyster Area." However, no harvesting is currently allowed due to water quality issues.

### Coastal Wetland Resources

The SNWW study area contains a high concentration of significant coastal wetlands. Approximately 109,175 acres (171 square miles) in Texas and 197,530 acres (309 square miles) in Louisiana were identified as coastal marsh, bottomland hardwood, or cypress-tupelo swamp habitats. Coastal marshes occur in four distinct types within the study area: (1) salt marsh, (2) brackish marsh, (3) intermediate marsh, and (4) freshwater marsh. A summary of the habitat acreage by state is provided in Table I-2, and a distribution of these habitats is presented on Figure I-3.

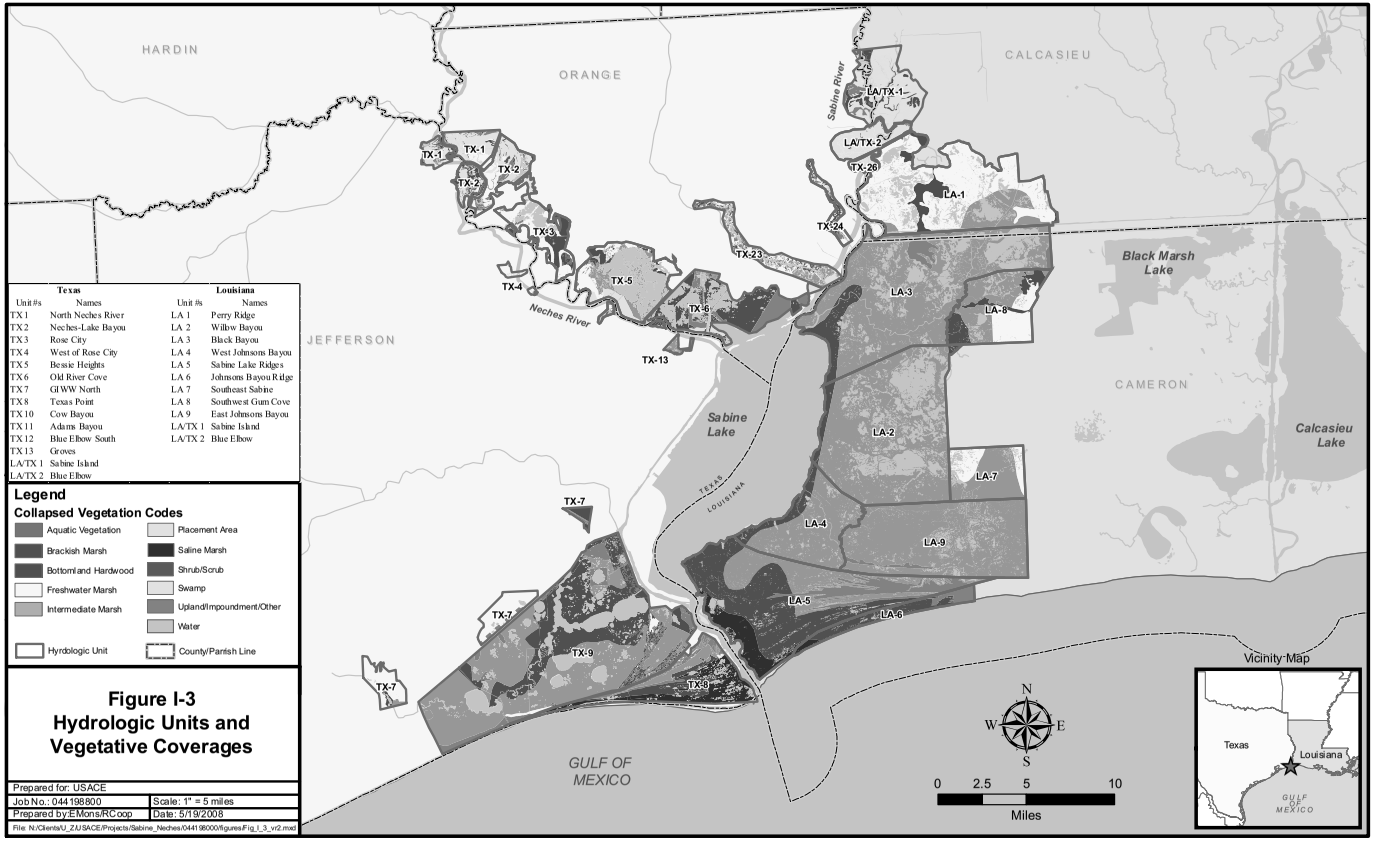
Table I-2
Summary of Habitat Acreages by State, 2004

| | Fresh | Inter-mediate | Brackish | Saline | Total Marsh | Bottomland Hardwood | Swamp | Total Wetlands |
|---|---|---|---|---|---|---|---|---|
| **Texas** | | | | | | | | |
| Acreage | 13,580 | 30,336 | 24,047 | 4,898 | 72,861 | 5,458 | 10,157 | 88,476 |
| Water | 2,117 | 9,240 | 8,254 | 810 | 20,421 | 0 | 0 | 20,421 |
| Totals | 15,697 | 39,576 | 32,301 | 5,708 | 93,282 | 5,458 | 10,157 | 108,897 |
| **Louisiana** | | | | | | | | |
| Acreage | 20,336 | 101,405 | 23,112 | 3,551 | 148,404 | 3,206 | 6,641 | 158,251 |
| Water | 4,772 | 31,872 | 2,049 | 586 | 39,279 | 0 | 0 | 39,279 |
| Totals | 25,108 | 133,277 | 25,161 | 4,137 | 187,683 | 3,206 | 6,641 | 197,530 |
| **Total** | | | | | | | | |
| Acreage | 33,916 | 131,741 | 47,159 | 8,449 | 221,265 | 8,664 | 16,798 | 246,727 |
| Water | 6,889 | 41,112 | 10,303 | 1,396 | 59,700 | 0 | 0 | 59,700 |
| Totals | 40,805 | 172,853 | 57,462 | 9,845 | 280,965 | 8,664 | 16,798 | 306,427 |

**Salt marsh** is located along the Gulf shoreline of Texas and Louisiana, and the shores of Sabine Pass. Subjected to regular tidal inundation, low saline marsh is dominated with smooth cordgrass/oystergrass, seashore saltgrass, and marshbay cordgrass/wiregrass. The dominant species in high salt marsh subject to less frequent tidal inundation is glasswort. Relative to other marsh types, salt marsh typically supports fewer terrestrial vertebrates although some shorebird species are common.

**Brackish marsh** in the study area is located inland from salt marsh along the Gulf shoreline and in the Sabine Pass area, lines the Salt Bayou/Keith Lake watershed south of the GIWW, and fringes the northern and eastern shores of Sabine Lake in Louisiana. The dominant species in high brackish marshes are saltmarsh bulrush, seashore saltgrass, and marshbay cordgrass. Brackish marshes are extremely important as nurseries for fish and shellfish.

**Intermediate marshes** are subjected to periodic pulses of salt water. In the SNWW study area, these areas grade inland from brackish marshes in the Salt Bayou/Keith Lake watershed, are the major marsh type along the lower Neches River, and dominate the interior marshes of Louisiana east of Sabine Lake.


HARDIN
ORANGE
CALCASIEU
JEFFERSON
CAMERON
Sabine River
Neches River
Sabine Lake
Black Marsh Lake
Calcasieu Lake
TEXAS
LOUISIANA
GULF OF MEXICO
TX-1
TX-2
TX-3
TX-4
TX-5
TX-6
TX-7
TX-9
TX-13
TX-23
TX-24
TX-26
LA/TX-1
LA/TX-2
LA-1
LA-2
LA-3
LA-4
LA-5
LA-6
LA-7
LA-8
LA-9
Texas
Unit #s Names
TX 1 North Neches River
TX 2 Neches-Lake Bayou
TX 3 Rose City
TX 4 West of Rose City
TX 5 Bessie Heights
TX 6 Old River Cove
TX 7 GIWW North
TX 8 Texas Point
TX 10 Cow Bayou
TX 11 Adams Bayou
TX 12 Blue Elbow South
TX 13 Groves
LA/TX 1 Sabine Island
LA/TX 2 Blue Elbow
Louisiana
Unit #s Names
LA 1 Perry Ridge
LA 2 Willow Bayou
LA 3 Black Bayou
LA 4 West Johnsons Bayou
LA 5 Sabine Lake Ridges
LA 6 Johnsons Bayou Ridge
LA 7 Southeast Sabine
LA 8 Southwest Gum Cove
LA 9 East Johnsons Bayou
LA/TX 1 Sabine Island
LA/TX 2 Blue Elbow
Legend
Collapsed Vegetation Codes
Aquatic Vegetation
Brackish Marsh
Bottomland Hardwood
Freshwater Marsh
Intermediate Marsh
Placement Area
Saline Marsh
Shrub/Scrub
Swamp
Upland/Impoundment/Other
Water
Hyrdologic Unit
County/Parish Line
Figure I-3
Hydrologic Units and
Vegetative Coverages
Prepared for: USACE
Job No.: 044198800
Scale: 1" = 5 miles
Prepared by: EMons/RCoop
Date: 5/19/2008
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N
W
E
S
0 2.5 5 10
Miles
Vicinity Map
Texas
Louisiana
GULF OF MEXICO

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**Freshwater marshes** are heterogeneous, with local species composition governed by frequency and duration of flooding, topography, substrate, hydrology, and salinity. A large expanse of fresh marsh is located between the GIWW and the Neches River, and in the riparian zone of the Neches and Sabine rivers. Freshwater marsh is also present in most interior portions of the Louisiana marshes east of Sabine Lake. Species range from maidencane, giant cutgrass, and bulltongue in lower areas to squarestem spikerush and marshbay cordgrass in the higher areas.

### Sensitive Areas

Sensitive habitat generally refers to the vulnerability of a habitat. Areal extent, uniqueness, endemic quality, or vulnerability to ongoing pressures or imminent changes may make a habitat environmentally sensitive (e.g., large historical losses as with the coastal prairie or fresh marsh losses due to saltwater intrusions). They may be unique to the region and/or historical losses have made them less common or rare. They may be particularly vulnerable to changes in the landscape. The following areas were identified as part of the vegetative mapping in the study area and are described in more detail in the Wetland Value Assessment (WVA) Ecological Modeling Report found in Appendix C of the FEIS.

In Texas, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area:

- Approximately 10,000 acres of fresh to salt marsh in the chenier plain west of Sabine Pass, the majority of which consists of the Texas Point NWR.
- 55,700 acres of fresh to salt marsh located west of the Sabine River between Texas Point and the mouth of the Neches River. Much of this area is protected by the J.D. Murphree WMA.
- 22,100 acres of fresh, intermediate, and brackish marshes and 2,850 acres of cypress-tupelo swamp and bottomland hardwoods on the Neches River from the mouth of the river where it empties into Sabine Lake to the City of Beaumont.
- 6,490 acres of Neches River cypress-tupelo swamp and bottomland hardwoods and 1,970 acres of fresh marsh between the City of Beaumont and the new Neches River Saltwater Barrier near Pine Island Bayou.
- 4,771 acres of cypress-tupelo swamps, bottomland hardwood, and fresh and intermediate marshes on Cow and Adams bayous.
- 689 acres of cypress-tupelo swamp west of the Sabine River and south of IH 10.
- 2,737 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp.
- 2,277 acres of cypress-tupelo swamp and bottomland hardwoods west of the Sabine River, across from the Sabine Island WMA in Louisiana.
- 6,000 acres of cypress-tupelo swamp, bottomland hardwood forest, and freshwater marshes, acquired by the Big Thicket National Preserve in 2009, located upstream of I 10.

In Louisiana, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area (Louisiana Coastal Wetlands Conservation and Restoration/

Wetlands Conservation and Restoration Authority [LCWCR/WCRA], 1999; U.S. Geological Survey [USGS]-National Wetlands Resource Center, 2004).

- 71,470 acres of saline, brackish, and intermediate marshes in the Louisiana Chenier Plain habitat at Louisiana Point, Blue Buck Point, and Johnson Bayou areas.
- 44,325 acres of brackish, intermediate, and fresh coastal marsh in the western half of the Sabine NWR.
- 46,511 acres of brackish, intermediate, and fresh marsh in the area north of Willow Bayou and south of the GIWW.
- 25,721 acres of fresh and intermediate marsh and bottomland hardwood habitat in the Perry Ridge mapping unit, north of the GIWW and east of the Sabine River.
- 650 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp, east of the Sabine River and north IH 10.
- 7,039 acres of cypress-tupelo swamp and bottomland hardwoods in the Sabine Island WMA, north of the Blue Elbow Swamp and east of the Sabine River.

### Upland Resources

The study area supports a diverse population of wildlife species. According to Blair (1950), at least 47 species of mammals, 29 species of snakes, 10 lizards, 2 land turtles, 17 anurans, and 18 urodeles occur or have occurred there. Common mammals include, but are not limited to rabbits, rats, raccoons, coyotes, mice, bats, armadillos, and bobcats. Virtually all of the original Gulf Coastal Prairies community has been converted to agricultural, industrial, or other uses although some remnants still exist (Smeins et al., 1991). Agricultural areas typically have sparse ground cover and provide poor-quality habitat for wildlife.

## Threatened and Endangered Species

### Plants

There are no Federal or State-listed threatened, endangered, or candidate plant species potentially occurring in Jefferson and Orange counties of Texas, and Cameron and Calcasieu parishes of Louisiana (National Diversity Database, 2005; U.S. Fish and Wildlife Service [USFWS], 2005).

### Wildlife

There are a total of 32 State and/or federally listed threatened and endangered fish and wildlife species, and 9 listed by the U.S. National Marine Fisheries Service (NMFS) as Species of Concern—species that may potentially occur in Orange and Jefferson counties, Texas, and Cameron and Calcasieu parishes, Louisiana. Some of the species listed as threatened and endangered include brown pelican, piping plover, interior least tern, West Indian manatee, black bear, Louisiana black bear, red wolf, hawksbill sea turtle, green sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, and loggerhead sea turtle. The West Indian manatee, black bear, Louisiana black bear, and red wolf formerly occurred along the Gulf Coast; however, it is unlikely that they would occur within the study area. Designated Critical Habitat for the

wintering populations of the piping plover is present in the study area on the Louisiana shoreline beginning at the east jetty and extending eastward into Louisiana beyond our study area.

Essential Fish Habitat (EFH) is present in the study area for adult and juvenile brown and white shrimp, red drum, red snapper, lane snapper, greater amberjack, king mackerel, Spanish mackerel, cobia, Gulf stone crab, gag grouper, scamp, and adult gray snapper. The EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." When referring to estuaries, it is further defined as "all waters and substrates (mud, sand, shell, rock, and associated biological communities) within these estuarine boundaries, including the sub-tidal vegetation (seagrasses and algae) and adjacent tidal vegetation (marshes and mangroves)" (Gulf of Mexico Fisheries Management Council [GMFMC], 2004).

#### Significant Habitats

The State of Louisiana also includes a ranking of natural areas it deems as imperiled or threatened due to one or more reasons. Cameron and Calcasieu parishes contain 10 such habitats. These significant habitats include bottomland hardwood forest, brackish marsh, coastal prairie, coastal dune grassland, coastal live oak-hackberry forest, freshwater marsh, migratory bird staging/stopover sites, waterbird nesting colony, western longleaf pine savannah, and western saline longleaf pine savannah. While none of these habitats are federally designated as threatened or endangered, some of them are significant due to their losses during the past century and their value as habitat to fish and wildlife.

### Cultural Resources

Within the study area, the National Register of Historic Places (NRHP) for Texas and Louisiana identifies 6 NRHP-listed architectural properties for Orange County, 19 such properties for Jefferson County, and 1 property, the Sabine Pass Lighthouse, for Cameron Parish. Two of the National Register-listed sites are located adjacent to the proposed CIP: the Rainbow Bridge and the Sabine Pass Lighthouse. The Rainbow Bridge is the cantilever bridge crossing the Neches River just upstream from Sabine Lake. The Sabine Pass Lighthouse is located on the Louisiana side of Sabine Pass. The lighthouse was constructed in 1856 and began operation in 1857.

These National Register-listed properties represent civic, commercial, religious, and private residential properties that span the history of the study area from the mid-nineteenth century to the mid-twentieth century. In addition to these National Register-listed properties, there are many other eligible, recorded, and reported resources in the study area. Numerous potentially eligible historic sites and shipwrecks are present in the project area. These include the Sabine Pass Battleground Park, Fort Griffin, and shipwrecks associated with important battles during the U.S. Civil War.

### Socioeconomic Considerations

The following counties and parishes were used as units of socioeconomic analysis: Hardin, Jefferson, and Oranges counties in Texas, and Cameron and Calcasieu parishes in Louisiana. The following cities were

reviewed: Beaumont, Port Arthur, Port Neches, Nederland, Vidor, Orange, and Bridge City in Texas and Lake Charles in Louisiana. The study area for the socioeconomic review included areas within a 1-mile-wide corridor of the areas proposed for channel improvement.

### Population

From 1980 to 1990, population growth within the study area was negative largely due to high unemployment rates and economic problems within the region due to the 1980s "oil bust," when manufacturing and construction industries within the study area suffered heavy economic losses and layoffs. From 1990 to 2000, population growth was slow to moderate (at 7.4 percent), with the greatest population growth in Bridge City and Nederland. Population growth from 2000 to 2050 is expected to be slow to moderate if the socioeconomic trends continue as they have over the past 30 years. The greatest population growth rates in the study area during this period are anticipated in Hardin County (average decade growth rate of 8.1 percent) and in Calcasieu Parish (average decade growth rate of 5.9 percent).

### Employment and Income

Total employment in the port, manufacturing, and industrial industries is currently 30,000 with approximately 13.7 percent of the population in port-related jobs (estimated one member per family works in industries directly or indirectly linked to waterborne commerce). Since the "oil bust" in the 1980s, the area relies to a greater extent on industries such as service, Federal, State, and local government, retail and wholesale trade, medical services, education, and Federal and state jails for its livelihood. It is estimated that 25 percent of the study area population depends on these port-related industries.

The highest median family income within the study area is found in Hardin County (at $37,612), while the lowest median family income is found in Cameron Parish (at $34,232). All median family income figures for the study area counties and parishes are higher than that of Louisiana (at $32,566), and lower than that of Texas (at $39,927).

### Commercial and Recreation Fishing

Commercial fishing within the Sabine Lake system and adjacent offshore waters of the Gulf of Mexico is a relatively small contributor to the study area economy. Commercial harvesting of oysters in Sabine Lake and Sabine Pass is prohibited due to public health concerns. A small offshore commercial shrimp fleet operates out of Sabine Pass.

The largest total value for all finfish and shellfish landings was $6.0 million in 1992. Recreational fishing continues to be a major outdoor recreational activity with a large variety of fresh- and saltwater species in the area. Sabine Lake, numerous wetlands, and the Gulf of Mexico are sources of recreational fishing within the study area. Between 1991 and 2001, saltwater fishing increased by 22 percent, and freshwater fishing decreased by 6 percent (USFWS, 2002a). Recreational fishing in this area is a year-round activity. Largemouth bass in the inland waters and speckled trout in the Gulf of Mexico and Sabine Lake are

favorites among anglers in the area. Although most species are commercially exploited, recreational anglers contributed more than $400 million to the local economy in 2005, with more than half a million people involved in this leisure-time activity (USFWS, 2003).

### Outdoor Recreation

One of the benefits of outdoor recreation is the economic impact it has on a state and its region. In Louisiana, over $3.0 billion was spent on wildlife-associated activities (hunting and fishing yielded over $1.4 billion and associated activities yielded over $1.6 billion), and in Texas, almost $9.4 billion was spent on wildlife-related activities (hunting and fishing yielded over $5.3 billion and wildlife-associated activities yielded almost $4.1 billion) (USFWS, 2002a).

The economic impact of hunting in Texas resulted in $1.5 billion spent in Texas in 2001. Hunting within the Louisiana portion of the study area is equally popular, with numerous seasonally occupied camps located primarily on private land, and leased to club members who often travel from metropolitan areas of Louisiana and Texas to hunt waterfowl and deer, among other game.

Wildlife-watching, particularly birding, is an extremely popular activity within the study area and in the nearby vicinity. The Great Coastal Birding Trail is a series of trails that links bird-watching sites and many communities along the entire Gulf Coast. Several sections are located in or nearby the project study area, in both Texas and Louisiana. Participation in the Texas portion of the trail has grown over 33 percent overall between 2001 and 2002 (Scroggs, 2002; USFWS, 2002a).

## I.E NON-FEDERAL SPONSOR AND COORDINATION

The USACE District Engineer, Galveston District is responsible for the overall management of the study and the report preparation. The Sabine Neches Navigation District (SNND) is the Sponsor for the study. The Sponsor was previously known as the Jefferson County Navigation District or the Jefferson County Waterway and Navigation District. In 2007, the SNND name was adopted. An Interagency Coordination Team (ICT) comprised of the Federal and State resource agency representatives from Louisiana and Texas was established to:

1) Involve agencies in scoping and identifying environmental issues and concerns;
2) Evaluate the significance of fish and wildlife resources and select resources to be evaluated;
3) Recommend and review necessary environmental studies;
4) Evaluate anticipated impacts; and
5) Recommend and evaluate potential mitigation measures.

The ICT agencies are listed in Table I-3. Representatives from other local and State agencies or governments also participated in the ICT in an advisory capacity: Jefferson and Orange counties, Texas; Cameron and Calcasieu parishes, Louisiana. While the ICT was a true decision-making body for issues related specifically to the environmental impact review, the USACE did retain final decision-making

authority on issues related to compliance with USACE policy. The USACE ICT members ensured that decisions were made within the framework of the USACE planning process and in compliance with Federal Law and policy, including guidance such as Planning in a Collaborative Environment (Engineering Circular [EC] 1105-2-409) and the Environmental Principles (Engineering Regulations [ER] 200-1-5). Important decisions related to identifying and studying potential ecological impacts and identifying alternatives for compensatory mitigation measures were made by consensus within the ICT. The ICT meetings were open to the public, and public comments were taken either before or after some of the meetings. Technical work addressing specific environmental concerns or planning objectives was performed by several smaller workgroups (whose members were taken from the ICT). Each of the workgroups and their purpose are identified below:

- **Restoration and Beneficial Uses Workgroup** was created to develop ideas for ecosystem restoration and the Beneficial Use (BU) of dredged material in the study area.
- **Hydrodynamic and Salinity Modeling Workgroup (MW)** provided data to assist the hydrodynamic salinity modeling (HS model) and verification process, and reviewed modeling results as part of the impacts evaluation.
- **Contaminants Workgroup** evaluated water and sediment quality associated with the proposed CIP, including characterization of existing conditions in the project area and the results of physical and chemical analyses conducted.
- **Ocean Dredged Material Disposal Sites (ODMDSs) Workgroup** was created to provide advice in the preparation of the Site Designation FEIS for the proposed ODMDSs.
- **Habitat Evaluation Workgroup** reviewed and classified existing habitat, performed field evaluations to document existing conditions, and developed procedures for the prediction of without- and with-project conditions.

Table I-3
Sabine-Neches Waterway Interagency Coordination Team Participants

| | |
|---|---|
| U.S. Army Corps of Engineers | Louisiana Department of Wildlife and Fisheries |
| Sabine Neches Navigation District | Sabine River Authority of Texas |
| U.S. Environmental Protection Agency | Texas General Land Office |
| U.S. Fish and Wildlife Service | Texas Parks and Wildlife Department |
| U.S. Natural Resource Conservation Service | Texas Water Development Board |
| National Marine Fisheries Service | Texas Commission on Environmental Quality |
| Louisiana Department of Natural Resources | Texas Department of Transportation |
| Louisiana Department of Environmental Quality | |

## I.F PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS

Federal involvement in navigation improvements along the SNWW began with the River and Harbor Act (RHA) of 1885. This authorization provided for improvements to the mouth of the Sabine River. On March 3, 1905, the RHA authorized the first major improvement to the waterway, the construction of a

channel 9 feet deep and 100 feet wide through Sabine Lake from the mouth of the Sabine and Neches rivers to the mouth of Taylor Bayou. Major channel improvements continued to occur along the SNWW. Table I-4 shows the congressional authorizations and the authorized channel improvements.

Table I-4
Congressional Authorizations for Sabine-Neches Waterway Channel Improvements

| | |
|---|---|
| RHA 1885 | Improvements to mouth of Sabine River. |
| RHA 1905 | Construction of a channel 9 feet deep and 100 feet wide through Sabine Lake from the mouth of Sabine and Neches rivers to the mouth of Taylor Bayou. |
| RHA 1912 | Construction of a channel 25 feet deep, repair of jetties, enlarge Port Arthur Canal to a depth of 26 feet and a width of 150 feet, and dredge Port Arthur Turning Basin 26 feet deep, 600 feet wide, and 1,700 feet long. |
| RHA 1927 | Enlargement of Sabine Pass and jetty channels to 300-foot width, Port Arthur Canal to a width of 200 feet, and the Sabine-Neches Canal up to the mouth of the Neches River to a width of 150 feet, provide two passing places in the Sabine-Neches Canal. |
| RHA 1935 | Enlargement of the project to depths of 35 feet on the outer bar, 35 to 32 in jetty channel, and 32 feet up to and including turning basins at Port Arthur and Beaumont. Widen to widths of 450 feet on the outer bar, 450 feet to 300 feet through the jetties, 250 feet up to Port Arthur, and 200 feet up to the mouth of the Neches River. |
| RHA 1946 | Deepen Sabine Pass outer bar channel to 37 feet, Sabine Pass jetty channel to 36 feet at the inner end, deepen to 36 feet Sabine Pass Channel, Port Arthur Canal, Port Arthur East and West Turning Basins, and widen to 400 feet the Sabine-Neches Canal from Port Arthur Canal to the mouth of the Neches River, except through Port Arthur Bridge; deepen Neches River channel from mouth to Beaumont Turning Basin to 36 feet, widening to 350 feet from Smith's Bluff to Beaumont Turning Basin, widen Sabine-Neches Canal between Neches and Sabine rivers to 150 feet. |
| RHA 1962 | Deepen Outer Bar Channel to 42 and 40 feet for all inland channels to Port Arthur and Beaumont; width of 500 feet in Port Arthur Canal and 400 feet in Neches River Channel to Beaumont with three turning points in Neches River; a channel, 12 by 125 feet, extending in Sabine River to Echo; Deauthorization of uncompleted portion of channel between Port Arthur West Turning Basin and Taylor Bayou Turning Basin and enlargement of entrance channel to Port Arthur Turning Basins. |

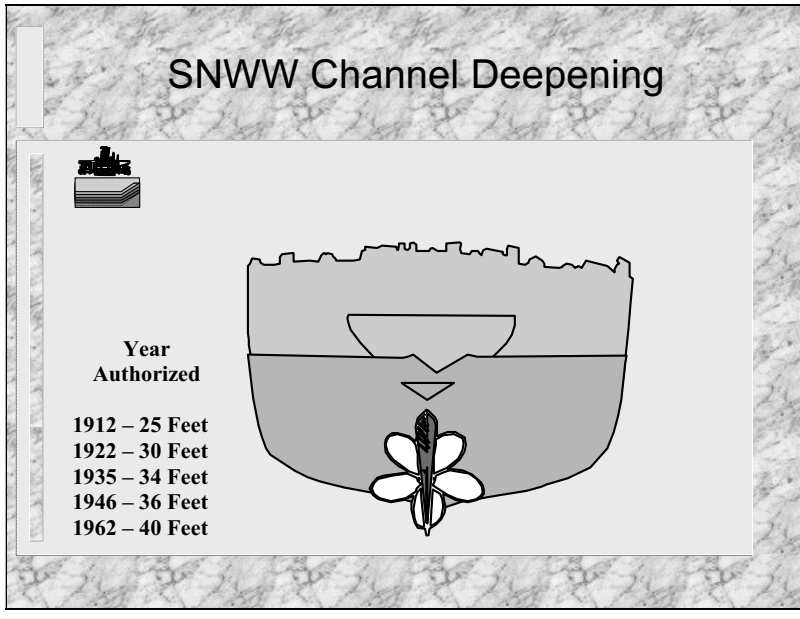
Major deepening efforts on the SNWW were authorized in 1912 resulting in a channel depth of 25 feet. Under the RHA of 1962, the waterway was authorized to be deepened to its current depth of 40 feet (Figure I-4).

On December 11, 1969, the Committee on Public Works House of Representatives adopted a resolution authorizing a review of the SNWW project. The resolution requested review of the report of the Chief of Engineers on the SNWW, published as House Document No. 553, 87th Congress, 2nd Session, and prior reports, with a view to determining whether the existing project should be modified in any way at this time, with particular reference to providing increased depths in the channel and basins.

As a result, a feasibility study was initiated and a Draft Feasibility Report was completed in April 1982. The report determined that it was feasible and advisable to deepen and widen the SNWW. The Recommended Plan recommended a channel depth of 52 feet at the Gulf of Mexico entrance channel and

a channel 50 feet deep for the Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and the lower 12 miles of the Neches River Channel.

Figure I-4. History of Channel Deepening of Sabine-Neches Waterway




The plan also included widening of the Sabine-Neches Canal, located adjacent to Port Arthur, from 400 feet wide to 500 feet in width to reduce traffic congestion and delays in this reach of the waterway, which also serves as part of the GIWW. The Recommended Plan was not implemented because the Sponsor withdrew their support for the project.

## I.G STUDY AND REPORT PROCESS

In September 1998, the USACE completed a Reconnaissance Report for the SNWW. The reconnaissance concluded that deepening and widening of the SNWW offers sufficient opportunity for navigation improvements with potential benefits outweighing the anticipated project costs. Without the increase of channel depths and widths to accommodate the anticipated increase in commodity transportation, more vessels would need to make lighter-drafting trips, increasing vessel delays and decreasing the efficiency of movement of bulk commodities along the waterway.

The USACE planning process involves a six-step, iterative process. This process provided for systematic preparation and evaluation of alternative plans to address problems and opportunities for the SNWW. The feasibility study process involved all of the six functional planning steps:

1) Specification of water and related land resources future without-project (FWOP) problems and opportunities;
2) Inventory, forecast, and analysis of water and related land resources conditions within the study area;
3) Formulation of alternative plans;
4) Evaluation of the effects of the alternative plans;
5) Comparison of the alternative plans; and
6) Selection of the Recommended Plan.

The Reconnaissance Report emphasized problem identification and formulation of alternatives. The emphasis of this Feasibility Report is on the evaluation of alternatives, assessment of impacts, and selection of a Recommended Plan. The goal of a feasibility study is to identify the plan that contributes to the National Economic Development (NED) consistent with protecting the Nation's environment.

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# II. PROBLEMS AND OPPORTUNITIES

## II.A OVERVIEW

This chapter covers the first step of the planning process and identifies the problems with the existing SNWW and potential opportunities available if the existing SNWW channel is deepened and widened. The SNWW continues to play a significant role in the growth and economic development of the Golden Triangle area of Port Arthur, Beaumont, and Orange, Texas. As growth and economic development of the study area continues, the increasing use of the SNWW intensifies the need for more-efficient movement of commodities, particularly crude petroleum, by vessels traveling the waterway.

The amount of the vessel traffic along the waterway also increases concerns for the safety of the users and the local communities and businesses all along the waterway. With the current channel dimensions, the tonnage is not being moved as efficiently due to the size restrictions of the larger tankers utilizing the channel. These tankers are either limited by the current channel depth of 40 feet or by the physical and safety limitations of the channel.

The water resources problems to be solved with this project are the navigational and safety issues that have developed on the SNWW because of the growth in the area. Existing water resource problems and needs in the study area were identified through coordination with Federal, State, and local agencies; area residents; waterway users; and the USACE and SNND. Numerous concerns were raised during the public scoping meetings, letters received in response to those meetings, and a series of workshops with local public agencies and private organizations. The major issues and concerns identified through this process are discussed below. Summaries of the scoping meetings and copies of public comment letters are provided in Appendix A of the FEIS.

## II.B NAVIGATION AND COMMERCE

### General

The SNWW serves the ports of Port Arthur, Beaumont, and Orange. Channel improvements are needed to support the SNWW's critically important role in the Nation's economy. In 2007, the SNWW ranked first in the nation in crude oil imports, importing 56.2 million tons (Institute of Water Resources [IWR], 2007). In 2006, the SNWW (ports of Beaumont, Port Arthur and Orange) was ranked 4th in the nation for domestic and total tonnage with Beaumont (Figure II-1) ranked 5th and Port of Port Arthur (Figure II-2) ranked 28th in the nation (IWR, 2007).

The Port of Beaumont's public docks are located on the Neches River Channel, as well as several crude petroleum and product terminals. Port Arthur's general cargo facilities are located on the Sabine-Neches Canal, and its crude petroleum and product terminals are in the Taylor Bayou Basins. The Taylor Bayou Basins are located immediately south of Port Arthur at the junction of the Sabine-Neches Canal with the GIWW. In addition to its deep-draft traffic, the Sabine-Neches Canal serves as a through channel for

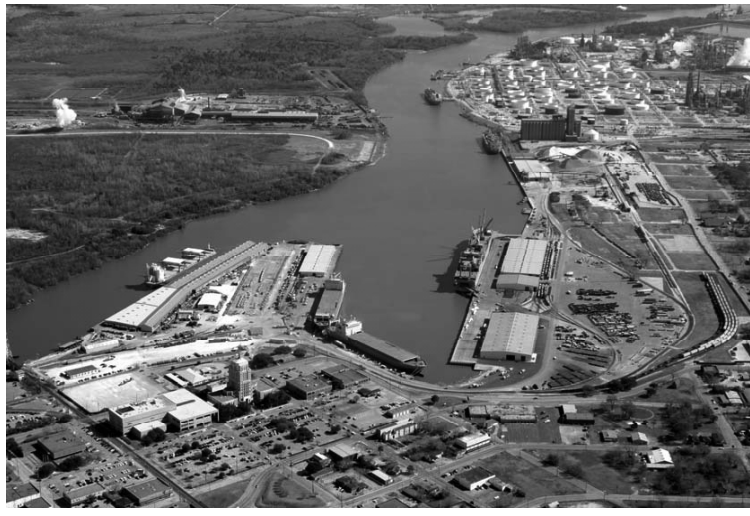

Figure II.1. Port of Beaumont

Figure II.2. Maritime and Petrochemical Use of Sabine-Neches Waterway
near Port Arthur, Texas

shallow-draft barge traffic on the GIWW. The locations of the facilities along the SNWW are identified on Figure II-3.

## Commerce

Sixty percent of the SNWW tonnage total is deep-draft movements, and the remaining 40 percent is shallow-draft GIWW traffic. Crude petroleum imports and petrochemical product imports and exports comprised approximately 95 percent of Beaumont's and 85 percent of Port Arthur's oceangoing tonnage. Other significant commodities and breakbulk cargoes that are handled by the SNWW ports include petroleum coke, ammonia, sulphuric acid, metallic salts, liquid sulphur, grain, manufactured iron and steel products, limestone, sand, and gravel. Twenty percent of 2005–2007 U.S. metallic salts were exported from Port Arthur.

Domestic refineries on the Gulf Coast, the East Coast, and in the Midwest rely on the SNWW for 12–16 percent of waterborne crude oil deliveries (Martin Associates, 2006). The SNWW's four local refineries represent 6 percent of the U.S. total. SNWW refining capacity levels for 2007 are presently 9.4 percent higher than in 2004, and 29 percent higher than in 1994. In 2007, Motiva announced plans for a major refinery expansion in Port Arthur that would make it the largest refinery in the U.S. and one of the largest in the world. The ExxonMobil Beaumont refinery on the Neches River Channel is presently the third largest refinery in the world. As a result of these additions, SNWW's combined capacity would be the largest concentration in the State of Texas. Refined petroleum products are shipped from the SNWW via three major pipeline systems to 21 states east of the Rockies, including states as far away as Delaware, New York, and Pennsylvania (Martin Associates, 2006).

The existing SNWW navigation channel system is congested. The existing 40-foot project depth was designed to efficiently and safely accommodate much smaller vessels than are being used today. The current channel was completed in the late 1960s, and at that time, crude oil tankers averaging 40,000 deadweight tons (DWT) with loaded drafts of 36 feet were common. Vessels over 90,000 DWT are now used routinely for crude oil imports to both Beaumont and Port Arthur. In addition to larger vessels, the amount of vessel traffic on the SNWW has also increased. Both SNWW and U.S. crude oil imports have steadily risen since the 1970s, and this trend is projected to continue into the foreseeable future. The 2005–2007 crude oil import volume is nearly three times the average 1990–1992 levels. In the short term, it is expected that SNWW imports would grow at rates comparable to or higher than regional and national trends, and long-term expectations are for growth equal to regional and national trends. From 2005 to 2007, SNWW volumes of crude petroleum imports exceeded other Texas Gulf Coast ports by nearly 35 percent. Recent increases in SNWW refinery capacity indicate that the region would gain an increasing share of U.S. totals.

In addition to the large base of existing crude oil and petrochemical product facilities on the SNWW, three Liquefied Natural Gas (LNG) terminals have been proposed at Sabine Pass. LNG is expected to play an increasingly important role in the natural gas industry and global energy markets in the next several years and in the long-term future. Construction of the Sabine Pass Terminal is complete, and the

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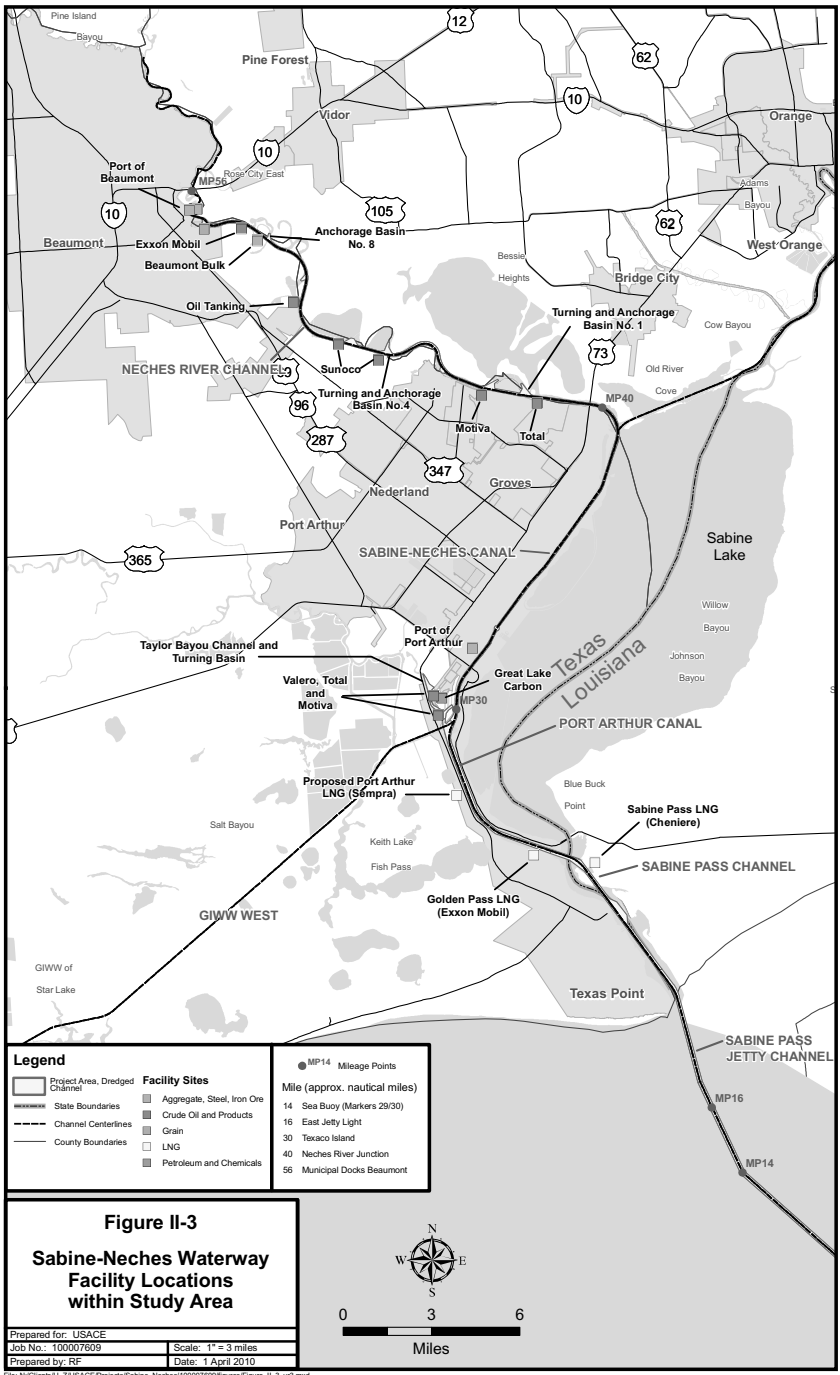


**Figure II-3**

**Sabine-Neches Waterway Facility Locations within Study Area**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 3 miles |
| Prepared by: RF | Date: 1 April 2010 |

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first vessels arrived in April 2008. Construction is ongoing at the Golden Pass Terminal; the Port Arthur Terminal has received regulatory approval. The SNWW LNG facilities are located in the Sabine Pass Channel and Port Arthur Canal; these reaches are presently 500 feet wide and would remain so under the without-project future. LNG vessels using the SNWW would be subject to strict U.S. Coast Guard (USCG) regulations and to local pilot rules, and all LNG vessel movements would be subject to one-way traffic.

With the current channel depth, there are draft restrictions on large vessels currently utilizing the channel. The majority of the tonnage carried on the SNWW is in deep-draft vessels, and the vast majority of the deep-draft traffic is comprised of crude oil and petrochemical products. However, LNG, grain, and aggregate products, such as iron ore, steel slab, limestone, sand, and gravel, are also carried in draft-constrained deep-draft vessels. For the period 2002–2007, 89 percent and 64 percent of crude petroleum imports to Beaumont and Port Arthur, respectively, were transported in vessels with design drafts over 40 feet.

Currently at the SNWW, Very Large Crude Carriers (VLCC) transfer tonnage at an offshore location onto one or more shuttle vessels in a process called lightering. These very large carriers cannot enter the SNWW because of their size and draft. In addition, other large crude tankers presently offload a partial load to a shuttle vessel or vessels and then enter the SNWW with the shuttle vessels as they are small enough to navigate the SNWW with a lighter load. This process is called lightening.

The SNWW experienced strong growth over the past decade, with total tonnage increasing from an average of 108 million short tons for 1995–1997 to 138 million for 2005–2007. As imports have increased, the number of lightered and lightened vessels and product carriers has also increased, adding to shipping delays and congestion. The total number of inbound vessels on the SNWW is projected to increase in the short-term at rates comparable to or higher than regional and national trends. Recent increases in SNWW refinery capacity indicate the region would regain an increasing share of U.S. totals.

Ships are not only requiring deeper drafts, but the sizes of the vessels are wider (Figure II-4). The vessel beams of both Port Arthur's and Beaumont's vessels cause them to be regularly impacted by the present 500-foot width of the Sabine Pass Jetty Channel and Port Arthur Canal. The most common crude oil tankers unloading at the Taylor Bayou Basins have design drafts of 45 feet and beams of approximately 124 feet. Tankers using the Taylor Bayou Basins are smaller than those offloading at terminals on the Neches River Channel because existing width at the mouth of Taylor Bayou and the configuration of the docks within Taylor Bayou limit the allowable vessel size. The maximum size vessels unloading at Port of Beaumont facilities on the Neches River Channel are approximately 900 feet long, with a beam width of 164 feet.

The Sabine Pilots Association (SPA, or Sabine Pilots) has adopted self-imposed transit rules for safety in the narrow channel; these rules result in navigation constraints. These rules are presented in Table V-54 later in this report. These constraints include daylight-only and one-way sailing restrictions in specific reaches. The main restrictions place limitations on the combined beam widths and drafts for vessel

meetings on the waterway. A major restriction is that vessels with combined beam widths in excess of 50 percent of the channel width cannot meet. The effects of these and other navigation restrictions cause significant delays along the waterway.

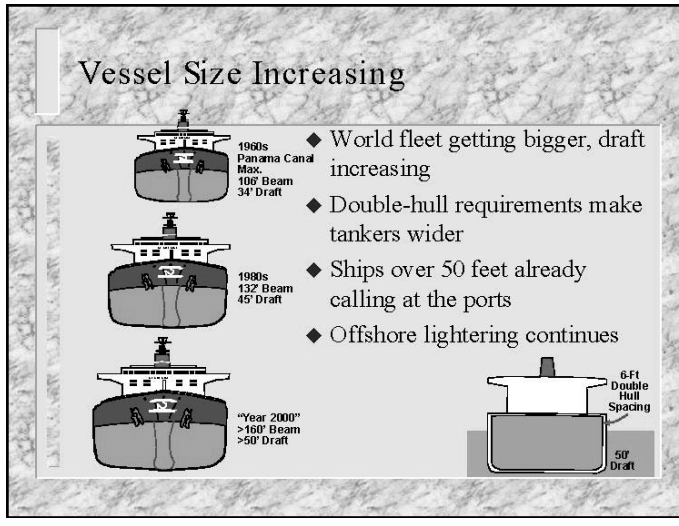


Figure II-4. Increasing Vessel Sizes

As a result of these rules, inbound vessels intending to use a specific dock must wait offshore until the outbound vessel at that dock sets sail, resulting in considerable delays because of the length of the inshore channel. In addition, vessels are now wider due to new double-hull requirements and to industry changes to wider but shorter vessels, which makes vessel-meetings more difficult. The probability of accidents and other safety problems may increase with increases in both inland barge and deep-draft vessel traffic along the waterway. Channel deepening and/or widening could alleviate some of these congestion and safety problems by enhancing the maneuverability and control of deep-draft vessels, and permitting two-way traffic in the widened SNWW reaches and providing additional TB and anchorage basins (AB) on the Neches River Channel.

The CIP would provide benefits by reducing the number of vessel trips needed for crude oil imports. Vessel trips would be reduced since the mother vessels could enter the waterway more-heavily loaded and fewer shuttle vessels would be used for lightening. In addition, shuttle vessels used in lightering the VLCC could be more-heavily loaded, which would reduce the number of shuttle vessels required. Some petroleum products and other commodities would also be able to take advantage of increased channel depths by loading additional tonnage; however, crude oil is expected to be the principal beneficiary of the deeper channel. Widening of the inshore channels below Taylor Bayou would allow more vessels to meet under existing rules, and increase efficient utilization of the channel. Additional TB and anchorages on

the Neches River Channel would allow some vessels to wait at nearby docks rather than waiting offshore, significantly reducing delays associated with one-way traffic restrictions.

## Safety

Navigational safety on the SNWW is a concern given the SNWW's large existing traffic base, the number of crude oil and dangerous cargo transits, and the 2008 introduction of LNG vessels to the vessel mix. Vessels are now wider due to new double-hull requirements and to industry changes to wider but shorter vessels. Wider vessels make meetings more difficult and, therefore, more dangerous (Figure II-5). Historically, however, casualty incidents on the SNWW channel are very low, due in large part to existing pilot rules that minimize the probability of incidents involving deep-draft vessels. A list of the transit rules is provided in Section V.E (see Table V-54.) of this report. The pilot rules would continue to limit the vessel sizes that can meet in each portion of the channel. Recent installation of the Port Arthur Vessel Traffic Service (VTS) would allow the USCG to assist vessel operators in managing their transits in relation to other traffic on the waterway, reducing potential interactions between deep-draft vessels and tows or barges on the congested Sabine-Neches Canal. LNG vessels using the SNWW would be subject to strict USCG regulations and to local pilot rules and, therefore, would not have the opportunity to meet other vessels. Under current pilot rules, the wide beams of LNG tankers would make them subject to one-way traffic restrictions.

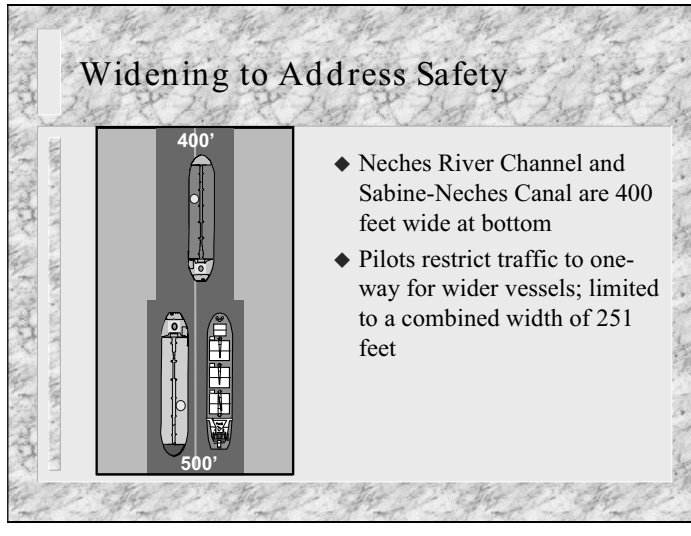


Figure II-5. Widening to Address Safety

Channel improvements would allow more deep-draft cargo to be carried with fewer vessel trips. Associated reductions in deep-draft vessel traffic would thereby serve to reduce the probability of casualties. However, since casualty occurrences in the SNWW are rare, the proposed improvements would not have a discernible effect on casualty rates.

### National Security

Congestion is increased during times when the SNWW serves an important military function. One of the busiest ports for military cargo in the world is located on the SNWW. The Port of Beaumont is the Nation's busiest Strategic Port of Embarkation, and it is the second largest commercial military out-load port worldwide. For the war in Iraq, it has handled approximately one-third of all the military cargo deployed to and from the war, which is more military cargo than any other U.S. port (Military Surface Deployment and Distribution Command, 2004, 2006). The SNWW must accommodate the military's increased use of newer and larger transport ships, which are three times the size of transport ships used in 1990. Improved transportation efficiency on the SNWW is vital in maintaining the Port of Beaumont's ability to provide critical support to U.S. military operations. The SNWW contributes to national security in one other key aspect. Two terminals on the Neches River are connected by pipelines to underground storage facilities of the U.S. Department of Energy's Strategic Petroleum Reserve at Big Hill, Texas, and West Hackberry, Louisiana.

## II.C ENVIRONMENTAL

The most significant trend adversely affecting the study area is the high rate of wetland loss that has occurred over the last century. In Louisiana, a net land loss of 21 percent between 1978 and 2000 has been reported in the Chenier Plain subregion of coastal Louisiana, which includes the Sabine estuary. In Texas, the most extensive losses of interior coastal wetlands in the state have occurred in the Neches River delta, an example of which is shown in Figure II-6. These losses total 12,632 acres between 1930 and 1978. In total, over 90 percent of the emergent marshes in the Lower Neches River delta have been converted to open water, which is more than half of the total wetland loss in the State of Texas.

While the future rate of relative sea level rise (RSLR) at the Sabine-Neches estuary is very uncertain, it must be considered in project planning. RSLR consists of two components: global (eustatic) sea level rise and local subsidence. The uncertainty in the rates of eustatic sea level rise is evident in the variability of the different modeled rates given for the National Research Council (NRC, 1987) projections and the 2007 Intergovernmental Panel on Climate Change (IPCC). A similar degree of uncertainty exists with the rate of local subsidence.

A detailed review of both eustatic and local subsidence rates was performed by the Engineer Research and Development Center (ERDC) in fulfillment of requirements of Circular No. 1165-2-211, Water Resources Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs (USACE, 2009a). This review found the eustatic rate estimates range from 1.8 millimeters per year (mm/year) to 6.45 mm/year for the next 50 years. This study employs an estimate for eustatic rise of

Figure II-6. Rose City Marsh (Historical Cypress Swamp to Open Water)

4.5 mm/year. This estimate is in the middle of the range projected by NRC (1987) and in the high middle range of that predicted by IPCC. In coastal Louisiana, estimates of the local subsidence component of RSLR were found to range from 0.4 to 0.6 mm/year based on basal peat measurements (Törnquist et al., 2006), to 2 to 5 mm/year as averaged from 48 years of tide gage data (Morton et al., 2005), and 10 to 15 mm/year measured from settling rates of established benchmarks (Shinkle and Dokka, 2004). The ERDC's review concluded that the lower rates (0.4 to 0.6 mm/year) were the most technically valid. These lower rates represent long-term trends in the subsidence rate, and seem to be the closest approximation of consensus concerning the local subsidence rate that is currently available.

Adding these to the NRC II projections for eustatic sea level rise yields a value for the RSLR in the SNWW study area over 50 years of 4.9 to 5.1 mm/year. The average of these, 5.0 mm/year, is used for modeling purposes.

Therefore, the "most likely" value of RSLR to be used for the SNWW deepening study's 50-year period of analysis is 0.82 foot. Adjusting this to account for the period of analysis beginning in 2019 and ending in 2069, the period of analysis for the SNWW reformulation, the "most likely" amount of RSLR by the year 2069 is 1.1 feet.

Potential for increased Gulf shoreline erosion is also a concern. In recent years, high shoreline erosion has caused substantial wetland losses on the Gulf of Mexico shoreline from Texas Point westward to the

vicinity of Sea Rim State Park. Inland shoreline erosion due partly from the passage of large vessels occurs along the waterway, especially in the narrow portions of the channel. Inland shoreline erosion results in thousands of dollars being spent every year to provide bank stabilization and maintain roads, some of which are critical for evacuation during hurricanes.

Since the devastating hurricane season in 2005, concerns have increased regarding the potential for channel-deepening projects such as the SNWW CIP to exacerbate the adverse effects of tropical storms like hurricanes Rita and Katrina on environment and infrastructure in the study area. These concerns are also related to recent forecasts of more intense tropical storms in the future due to global climate change.

There is an increasing potential for environmental harm as a result of an increase in the probability of shipping accidents due to predicted increases in vessel traffic. Environmentally sensitive areas that could be affected by spills resulting from shipping actions are located along both sides of Sabine Pass, west of the Port Arthur Canal, and along portions of the Neches River Channel. The need to protect environmental resources in the study area is related to the high concentration of significant coastal wetland habitats (see Figure I-3).

As part of the feasibility study process and as required by the National Environmental Policy Act (NEPA), the public and State and Federal resource agencies were coordinated with to obtain their comments and concerns regarding the proposed project. These comments are summarized in Section XII of this report. Detailed comments are located in Appendix A of the FEIS.

# III. FORMULATION OBJECTIVES, CONSTRAINTS, AND CRITERIA

## III.A OVERVIEW

This chapter addresses the remainder of step one in the planning process by identifying the Federal objectives for the study, identifying public concerns, planning objectives and potential constraints, and developing the criteria to be used for evaluating plan formulation alternatives.

## III.B FEDERAL OBJECTIVES

The fundamental objective of Federal participation in water resource development projects is to assure that an optimum contribution is made to the welfare of all people. The Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, dated March 1983 and the NEPA of 1969 provide the basis for Federal policy for planning Federal water resources projects. These authorities have established the procedures for formulation and evaluation of water resources projects. Additional policies and regulations, derived from executive and legislative authority, further define the criteria for assessment of plan impacts, risk analysis, review and coordination procedures, and project implementation.

Current Federal policy dictates that NED is the primary Federal objective in water resources planning. NED objectives stress increasing the value of the Nation's output of goods and services, and improving economic efficiency on a national level. The NED Plan is the plan that reasonably maximizes net NED benefits. The Federal objective of water and related land resources planning is to contribute to NED in a manner that is consistent with protecting the Nation's environment. Consequently, the resource's condition should be more desirable with the Recommended Plan than under the without-project condition.

## III.C PUBLIC CONCERNS

A number of public concerns have been identified during the course of the study. Input was received through coordination with the Sponsor, coordination with Federal and State agencies, public review of draft and interim products, and public meetings. A discussion of public involvement is included in Section XII of this document. The majority of the concerns/comments from the public that are related to the establishment of planning objectives and planning constraints are:

- Potential saltwater intrusion impacts on the adjacent marshes in Texas and Louisiana;
- Potential increase in water levels, including tidal movements;
- Potential impacts to the eastern shore of Sabine Lake;
- Natural resources (e.g., ducks, freshwater marsh birds, alligators, etc.) that would likely be affected by the proposed project;
- Impact of doing nothing that would result in economic reductions, loss of jobs, and reduction of property values; and

- Utilize the dredged material beneficially to improve the coastal shoreline by increasing vegetative dune structure and replenishing eroding beaches.

## III.D PLANNING OBJECTIVES

The Federal objectives are general statements and not specific enough for direct use in plan formulation. The water and related land resource problems and opportunities identified in this study are stated as specific planning objectives to provide focus for the formulation of alternatives. The primary objective of Federal navigation activities is to contribute to the Nation's economy while protecting the Nation's environmental resources in accordance with existing laws, regulations, and executive orders.

These planning objectives reflect the problems and opportunities expressed by the Sponsor and the public, and represent the desired positive changes to the existing project conditions. The following planning objectives were used in formulation and evaluation of alternative plans:

- Improve the navigational efficiency along the waterway; and
- Maintain the ecological values of coastal and estuarine resources within the project area.

## III.E PLANNING CONSTRAINTS

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. Plans must be formulated with regard to addressing the problems and needs of the area, taking into consideration FWOP conditions. The plans should identify tangible and intangible benefits and costs from economic, environmental, social, and regional perspectives. Institutional implementation constraints should also be identified.

The formulation framework requires the systematic preparation and evaluation of alternative solutions to the recognized water resource–related problems within the study area. The process requires that impacts of the proposed action be measured and results displayed or accounted for in terms of contributions to NED, environmental quality, regional economic development, and other social effects.

Interaction with other interests must be maintained throughout the planning process to avoid duplication of effort, minimize conflicts, obtain consistency, and assure completeness. The following constraints apply to this feasibility study:

- The study process and plans developed must comply with Federal and State laws and policies;
- Fish and wildlife habitat affected by a project plan should be minimized as much as possible and preserved, if possible; and
- Alternative plans that resolve problems in one area should not create or amplify problems in other areas.

Current guidance specifies that the Federal objective of planning is to contribute to NED consistent with protecting the Nation's environment. The following general criteria are applicable to all water resource studies and have generally guided the formulation of the study. Technical, economic, environmental, and social criteria have been established to guide the project development process. These criteria are discussed below.

## III.F TECHNICAL CRITERIA

Technical criteria require the preservation of adequate project dimensions to provide safe passage of commercial navigation traffic through a reach of waterway while minimizing environmental impacts. These criteria require plans to be compatible with navigation needs and consistent with the requirements of the navigational equipment using a portion of the waterway and to provide a long-term plan for the placement of dredged material in order to continue maintenance of the waterway in the future.

The plans must be consistent with specific environmental conditions of the area including soil conditions, topography, and terrestrial and aquatic ecosystems. Formulation of alternative alignments and dredged material placement alternatives and their evaluation was accomplished by analysis of historical and projected shoaling rates, erosion causes and rates, and general structural and nonstructural alternatives applicable for conditions that are specific to this area.

Technical information (both historical data and specific information prepared for this project) and analyses used during the study included, but was not limited to:

- Hydrodynamic/salinity study
- Ship simulation study
- Gulf shoreline study
- Vessel effects study
- Sediment and water quality analyses
- Aerial photography
- Historical dredging records
- Previously published scientific reports related to the project area
- Stability analyses
- 50-year Dredged Material Management Plan (DMMP)
- Pipeline identification and relocation analysis
- Marine and estuarine resource investigations
- Threatened and endangered species assessment.

## III.G VALUE MANAGEMENT

Following the guidance in ER 1110-2-1150 Paragraph 13.14 Value Engineering, "A value engineering study shall be performed on the earliest document available that satisfies the functional requirements of the project and includes a MII cost estimate. The Project Delivery Team (PDT) shall determine if the

initial value engineering study shall occur during the feasibility phase or be delayed until the Pre-Construction Engineering and Design (PED) phase." Galveston District received approval for a delay of the Value Engineering Study until the PED phase is completed from Southwestern Division.

The inherent nature of a feasibility study process involves considerable value analysis and management efforts within all aspects of the study. This section summarizes the value management efforts that were utilized in this phase of the study. Various nonstructural alternatives were investigated throughout the feasibility phase as a means to solve the navigational problems. Some of these nonstructural measures included vessel traffic systems to alleviate transportation inefficiency and safety concerns, changes in pilot rules, and alternative modes of commodity transport. Structural alternatives were evaluated and included channel deepening and widening.

Standard dredging practice utilizes pipeline and hopper dredges, the only applicable method of construction for deepening the channel. Because the type of equipment to be used as part of the construction was limited, the value analysis efforts concentrated on the other construction aspects. These included construction of new placement areas, rehabilitation of existing placement areas, mitigation features, and BU sites. Identifying cost-saving alternatives that used resources more efficiently and decreased project costs, as well as operation and maintenance costs, played a major part in the feasibility study's value management.

Beneficial use of the dredged material, new work, and maintenance material, was investigated to find the most economical and practical placement within the project constraints. The "life-cycle" of the waterway was considered with emphasis on practical placement of new work within the placement areas for use in future levee construction. Additionally maintenance material was used beneficially for marsh creation, which was an economical advantage over standard placement practices.

The public was afforded an opportunity to provide input regarding more-cost-effective alternatives that could be used to accomplish the project purpose. The plan was presented to the public at industry group meetings, public workshops, and public meetings.

During the PED phase, the construction contracts will undergo value management and value techniques following guidance found in the ER 11-1-321- Army Programs Value Engineering.

## III.H ECONOMIC CRITERIA

The economic criteria require that tangible benefits attributable to projects exceed project costs. Project benefits and costs are presented as average annual equivalent values and related in a ratio of benefits to costs (Benefit-to-Cost Ratio or BCR). This ratio must exceed unity to meet the NED objective. Recommended plans, whether structural, nonstructural, or a combination of both, should maximize excess benefits over costs; however, unquantifiable features must be addressed subjectively. These criteria are used to develop plans that achieve the objective of NED and provide a base condition for consideration of economically unquantifiable factors, which may impact on project proposals. The USACE planning guidelines required that the alternative that most reasonably maximizes net economic benefits, consistent

with protecting the Nation's environment, be identified as the NED Plan. This NED Plan may be selected as the Recommended Plan. However, for a navigation project, if a plan with lesser benefits is preferred by the sponsor due to financial constraints, guidance allows for a categorical exemption to be granted and this lesser plan to be selected as the Recommended Plan. This process is addressed in more detail later in this report.

All structural and nonstructural measures for navigation projects should be evaluated using the appropriate period of analysis and the currently applicable interest rate. Total annual costs should include amounts for operation, maintenance, and major replacements, as well as amortization and interest on the investment.

## III.I ENVIRONMENTAL CRITERIA

The general environmental standards for navigation projects are identified in Federal laws, executive orders, and the USACE planning guidance. It is Federal policy that conservation of fish and wildlife resources be given equal consideration with other study purposes in the formulation and evaluation of alternatives. Care must be taken to preserve and protect significant ecological, aesthetic, and cultural values and to conserve natural resources. These efforts should provide the means to maintain and restore, as applicable, the desirable quality of the human and natural environments.

Throughout the study process, the USACE Environmental Operating Principles (EOP) should be considered. The EOP principles ensure conservation, environmental preservation, and restoration are considered at the same level as economic issues. The seven EOP principles are (1) strive for environmental sustainability, (2) consider environmental consequences, (3) seek balance and synergy, (4) accept responsibility, (5) mitigate impacts, (6) understand the environment, and (7) respect other views.

Consistent with laws and policy, alternative plans formulated to improve navigation should avoid damaging the environment to the extent practicable and contain measures to minimize or mitigate unavoidable environmental impacts. The following criteria were used to address environmental impacts during the evaluation of alternatives:

- Protection, preservation, and improvement of the existing fish and wildlife resources along with the protection and preservation of estuarine and wetland habitats and water quality;
- Consideration in the project design of the least disruptive construction techniques and methods;
- Mitigation for project-related impacts by minimizing, rectifying, reducing, or eliminating impacts, or compensating for unavoidable impacts by replacing or substituting resources;
- Protection and preservation of endangered and/or threatened species, Critical Habitat, and EFH; and
- Preservation of significant historical and archeological resources through avoidance, if possible, or data recovery if destruction of the resource is necessary.

## III.J SOCIAL CRITERIA

Plans proposed for implementation should have an overall favorable impact on the social well-being of affected interests (e.g., community impacts, health and safety, displacement, energy conservation, and others) and have an overall public acceptance. Structural and nonstructural alternatives must reflect close coordination with interested Federal and State agencies and the affected public. The effects of these measures on the environment must be carefully identified and compared with technical, economic, and social considerations and evaluated in light of public input.

## III.K OTHER USACE INITIATIVES

### USACE Campaign Plan

In August 2006, as a result of lessons learned from hurricanes Katrina and Rita, the USACE Chief of Engineers initiated the "Actions for Change" in an effort to transform the USACE planning, design, construction, and operation and maintenance principles and decision-making processes. This program has been further developed into the Campaign Plan. The USACE is moving forward with this Campaign Plan to transform the way business is done. The USACE Campaign Plan is available on the internet at: http://www.usace.army.mil/about/campaignplan/Pages/Home.aspx (USACE, 2009b).

The successful achievement of the goals and objectives contained in this Campaign Plan are dependent on actions implemented by the entire USACE team. The Campaign Plan included four goals for the USACE. These goals are:

> **Goal 1: Ready for all Contingencies** – Deliver USACE support to combat, stability, and disaster operations through forward deployed and reachback capabilities.
>
> **Goal 2: Engineering Sustainable Water Resources** - Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders.
>
> **Goal 3: Delivering Effective, Resilient, Sustainable Solutions -** Deliver innovative, resilient, sustainable solutions to the Armed Forces and the Nation.
>
> **Goal 4: Recruit and Retain Strong Teams** – Build and cultivate a competent, disciplined, and resilient team equipped to deliver high quality solutions.

Goals 1 and 4 do not apply directly to the USACE planning process and are not discussed in detail. Goals 2 and 3 pertain to water resources planning and directly to the SNWW study. These goals are described in more detail below.

#### Goal 2: Engineering Sustainable Water Resources

With Goal 2 USACE focuses on comprehensive, sustainable, and integrated solutions to the Nation's water resources challenges through collaboration with stakeholders. This goal refers to not only developing and delivering comprehensive and lasting solutions but also ensuring that these solutions are long lasting, integrated, and holistic to respond to today's and future challenges.

### Goal 3: Delivering Effective, Resilient, Sustainable Solutions

Goal 3 emphasizes that the USACE will provide innovative, resilient, and sustainable infrastructure solutions for the Nation today and in the future. The USACE is the Nation's premier public service engineering and construction organization and can provide infrastructure support to serve both the military and national civilian arenas. This effort will improve resilience and lifecycle investment in critical infrastructure, deliver reliable infrastructure using a risk-informed asset management strategy, and develop and apply innovative approaches to delivering quality infrastructure.

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# IV. FORMULATION AND EVALUATION OF ALTERNATIVES

## IV.A OVERVIEW

Navigational and safety issues that have developed on the SNWW because of the growth in the area are the water resources problems to be solved with this project. The ultimate objective of a feasibility study is to arrive at a recommended plan after a full range of alternatives has been analyzed. This involves a comparison between each alternative and the FWOP condition consequences, considering economic, environmental, and social impacts.

This chapter provides a summary of the screening processes and evaluations conducted on the project alternatives. Structural and nonstructural alternatives were identified based on their ability to address the planning objectives, as well as the project problems, needs, concerns, and opportunities.

## IV.B PLAN FORMULATION PROCESS

The planning framework requires a systematic preparation and evaluation of alternative ways of addressing the project problems, needs, concerns, and opportunities while considering environmental factors. The criteria and planning objectives previously identified form the basis for subsequent plan formulation, alternative screening, and ultimately identification of the Recommended Plan. Planning for Federal water resources projects constructed by the USACE, as well as other agencies, is based on the Principles and Guidelines (P&G) adopted by the Water Resources Council. Based on the Economic and Environmental Principles for Water and Related Land Resources Implementation Studies, there are four accounts that have been established to facilitate evaluation and display of the effects of alternative plans (ER 1105-2-100). The rationale for the Recommended Plan as it relates to these four accounts is presented later in this chapter.

The planning process for this feasibility study has been driven by the overall objective of developing a comprehensive plan that would allow for safe and efficient barge and ship traffic along the SNWW while protecting the Nation's environmental resources. Secondary objectives have been to address other related water resources problems within the study area.

The first phase of the study process was to determine the magnitude and extent of the problems along the SNWW, then to develop and evaluate an array of alternative solutions to meet the existing and long-range future needs of the Sponsor and the public. During the feasibility phase of the project, lines of communication were opened with Federal, State, and local agencies, private groups, and the affected public. Through scoping and other coordination meetings, public involvement occurred throughout the planning process.

The expected FWOP scenario was first developed for comparison with other alternatives. Nonstructural and structural plans were developed to address the planning objectives identified earlier in this report. For the structural plans, a variety of channel modifications and dredged material placement alternatives were developed, evaluated, and screened. The various channel modifications were investigated as to a possible

means to satisfy the objectives of constructing a safer, more-efficient waterway. Through a two-phased (preliminary and detailed) screening process, a recommended channel modification plan for the SNWW was selected. Figure IV-1 presents the process used to identify and evaluate project alternatives.

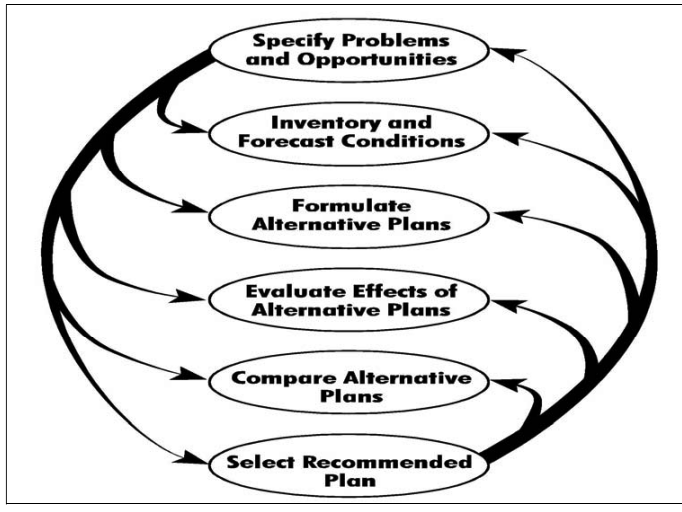



Figure IV-1. Planning Process

## IV.C PRELIMINARY SCREENING OF ALTERNATIVES

During preliminary screening, the expected "No Action" Alternative was developed for comparison with other alternatives. Nonstructural and structural alternatives that could address planning objectives were also developed.

### Future Without-Project Condition (No-Action Alternative)

The USACE is required to consider the option of "No Action" as one of the alternatives in order to comply with ER 1105-2-100 and the requirements of NEPA. With the No-Action Alternative, which is synonymous with the FWOP condition, it is assumed that no project would be implemented by the Federal Government or by local interests to achieve the planning objectives of improving the navigational efficiency and safety of the waterway. The No-Action Alternative forms the basis against which all other alternative plans are measured.

The No-Action Alternative would retain the existing 40-foot-deep SNWW navigation channel with its various widths along the waterway. The current dimensions would continue to limit the efficient

movement of commodities by vessels traveling the waterway and the safety limitations that result in one-way and daylight-only sailing restrictions. Under the FWOP condition, safety would continue to be a concern for the waterway users and the local communities adjacent to the waterway.

The waterway is often congested because of frequent movements of lightered vessels carrying petroleum products from the Gulf to refineries on the Neches River Channel, and because of barge through-traffic using the GIWW. Vessels are now wider, placing limitations on the combined beam widths and drafts for vessel meetings on the waterway. As vessels increase in draft and beam width, the restrictive depth and width in certain reaches of the waterway would prevent some vessels from entering with full loads or prevent larger vessels from even utilizing the waterway. The potential for accidents on the waterway and their effects on users and the local communities adjacent to the waterway would remain the same. The need to lighter products and/or light load vessels would increase, thereby increasing overall project costs and decreasing the efficiency of the vessels using the waterway.

Methods of shipping crude oil are direct, lightered, and lightened. Direct shipment, as the name implies, is the transfer of tonnage by vessel between two coastal ports. Lightering involves the transfer of tonnage at an offshore location from a larger vessel, called a VLCC, onto one or more shuttle vessels. U.S. Gulf Coast lightering occurs in the international waters of the Gulf of Mexico and is extremely cost effective for long-haul bulk freight. With lightering, the VLCC does not enter the coastal receiving port. A frequent alternative to either direct shipment or lightering is lightening. The term lightening describes the process where enough cargo is offloaded from a tanker to permit the light-loaded vessel to enter a confined channel system.

It is expected that imports of crude oil and petroleum products would continue to expand to keep pace with the predicted national need for these products and the projected continuing declines in U.S. production. Vessel trips would increase to accommodate the higher imports, and higher costs associated with the current lightering and vessel movement limitations would continue. In addition to increasing petroleum imports, continued growth of petroleum and chemical exports is expected. The need for dock reinforcement and stabilization necessary to realize project-deepening benefits was recognized in the plan formulation process. The costs associated with berth stabilization necessary due to channel deepening are included in the project construction cost calculations. Crude petroleum refinery expansion was initiated by Motiva in 2007 due to current refinery limitations and future throughput needs. Dock improvements on both the Neches River and Taylor Bayou were recently completed by industry to accommodate larger crude oil vessels. The results of the plan formulation analyses indicated that berth and terminal capacities were not a constraint to realizing benefits from using larger and more-fully loaded vessels.

Increased vessel trips associated with higher tonnage and increasing concentration of larger vessels would exacerbate the existing channel bank erosion caused by vessel wakes in the confined channel reaches of the SNWW. It is projected that the existing trend in wetland losses would continue due to the combined effect of sea level rise and subsidence, and altered hydrology and salinity levels caused by the existing SNWW navigation channels, the GIWW, and canals, levees, and water control structures associated with oil and gas exploration and production, logging, fishing, and hunting lands.

The No-Action Alternative would continue disposal activities for maintenance material from the 40-foot project in conformance with most, but not all, existing practices. In this Final Feasibility Report (FFR), the DMMP for the No-Action Alternative (the FWOP) is referred to as the Base Plan. The Base Plan forecasts disposal facility needs for all material that would be generated by maintenance dredging of the existing 40-foot project over a 50-year period of analysis. The 50-year analysis determined that additional capacity in upland PAs would be required, and it identified a least-cost BU feature that should be adopted as part of the Base Plan.

No differences from existing offshore placement activities were identified for the Base Plan. The offshore channels (Sabine Bank Channel, Sabine Pass Outer Bar, and Sabine Pass Jetty Channel) would be maintained with a hopper dredge, and approximately 162 million cubic yards (mcy) of material would be placed in the four existing ODMDSs (sites 1–4). Bed sediments in the offshore channels vary from 4.3 percent sand and 95.7 percent silt plus clay in the Sabine Pass Outer Bar Channel to 24.3 percent sand and 75.7 percent silt plus clay in the Sabine Bank Channel (Parchure et al., 2005). These ODMDSs have sufficient capacity for the 50-year period of analysis as they are located in a dispersive environment where dredged material does not accumulate.

For the inshore Sabine Pass Channel, a cost analysis of placement alternatives (presented in Chapter VII) resulted in a change from traditional upland placement practices involving PA 5. Rather than placing all of the maintenance material from this channel into upland PA 5, the BU of material from the channel section closest to the coast (Sabine Pass Channel, Section 5) was evaluated to determine whether it could be used to nourish the Gulf shoreline on both sides of Sabine Pass. Material from Sabine Pass Channel would continue to be placed into PA 5 because the longer pumping distance to the coast makes shore nourishment cost prohibitive. The cost analysis determined that the Gulf Shore BU Feature is more cost effective than placing the material in the upland PA 5, and therefore it was adopted as part of the Base Plan.

Under the Base Plan, all of the inshore channels of the existing project (Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and the Neches River Channel) would continue to be maintained by hydraulic pipeline dredge. Material from non-Federal dredging of private mooring and dock facilities would also continue to be placed in upland PAs along with the material from the Federal project. Existing management practices that utilize 16 upland PAs located adjacent to the channel from Sabine Pass to the Beaumont TB would continue. To contain 231.6 mcy of material over the 50-year period of analysis, the heights of existing PAs would be raised on a regular, recurring schedule in accordance with existing SNWW management practices. One new PA in the middle reach of the Neches River Channel (an expansion cell at PA 24A) would be needed to provide sufficient capacity for the period of analysis. On average, bed sediments vary in the inland channels from 38.3 percent sand and 61.7 percent silt plus clay in the Neches River Channel, to 16.2 percent sand and 83.8 percent silt plus clay in the Port Arthur Canal (Parchure et al., 2005). BU features are not included in the Base Plan for the inland channels because the lack of suitable material makes construction and maintenance of containment levees more expensive than placing the material in existing PAs. However, BU of dredged material (Section 204) projects would be

considered on a project-by-project basis if non-Federal sponsors express an interest in paying the incremental cost for such projects.

## Preliminary Screening of Alternatives

Based on the problems and opportunities identified by the Sponsor and the public comments received at the May 2000 public scoping meeting, a wide variety of management measures (alternatives) were identified to address one or more of the planning objectives. A preliminary (first) screening of the alternatives was conducted to eliminate any alternatives that did not meet the study objectives. This screening focused on whether deepening, and perhaps widening, would be cost effective, and whether any nonstructural alternatives to deepening and/or widening could be identified.

In order to evaluate the preliminary alternatives, screening criteria that would likely have the most influence in determining the viability of the alternatives were identified. The following criteria were used to evaluate and screen the alternatives:

- Dredging Quantities
- Cultural Resource Concerns
- Real Estate Issues
- Project Benefits
- Safety Issues
- Environmental Considerations
- Hazardous, Toxic, and Radioactive Waste Concerns
- Construction Costs
- Sponsor's Preferences

Each of the following alternatives was assessed and a determination made regarding whether it should be retained for the second screening of alternative plans. The following is a list of the preliminary alternatives considered:

### Nonstructural Alternatives

- Alternate mode of commodity transport,
- Vessel traffic service, and
- Modification of existing pilot rules on the waterway.

### Structural Alternatives

- Deepening only (43-, 45-, 48-, 50-, 53-, 55-foot depths)
- Widening only, along the entire channel (widths varying from 500 to 700 feet) from Sabine Pass to the Port of Beaumont
- Deepening and widening (combinations of six depths and various widths for entire channel length)
- Selective widening only (widening only certain reaches of the channel)
- Deepening with selective widening (combination of depths and widening options)

- Expansion of existing and construction of new TB and/or AB
- Construction of barge lanes (for passing)

### Plans Eliminated During Preliminary Screening

All of the nonstructural plans were advanced into the second screening because it was determined that these alternatives could potentially meet one or more of the planning objectives, but a more in-depth analysis would be necessary for a full assessment. In addition, most of the structural alternatives were also advanced into the second screening. It was found that deepening and widening the existing 40-foot channel would allow for existing ships to more fully utilize the channel and potentially reduce traffic delays, without prohibitive costs.

Two of the preliminary structural alternatives considered were found to be infeasible due to technical, economic, and environmental constraints, and were therefore not advanced into the second screening:

- Widening the entire existing channel from Sabine Pass to the Port of Beaumont, at widths varying from 500 to 700 feet, was found to be infeasible based upon a number of criteria. The length of the widening would generate a tremendous quantity of dredged material, resulting in greatly increased costs for construction and placement facilities. A number of large commercial docks and berthing facilities are located along the channel, and these would be disrupted or displaced by widening activities. The Martin Luther King (MLK) Bridge that crosses the Port Arthur Canal would need to be relocated as the existing span is not wide enough to accommodate channel widening. The widening would affect a large amount of emergent land, especially along the narrow confined Port Arthur Canal and narrower sections of the Neches River. Landfills containing hazardous materials would be affected by the widening, as well as some wetland areas. And perhaps most pertinent, widening only would not provide the additional draft needed to increase navigation efficiency for the largest number of waterway users.
- Selective widening only (widening only certain reaches of the channel) would reduce or eliminate some of the environmental, real estate, and cost concerns discussed above. However, selective widening would provide even fewer navigation benefits than the widening for the entire channel and also would not increase navigation efficiency for the largest number of waterway users.

## IV.D SECOND SCREENING

The alternatives remaining from the preliminary screening underwent more-detailed analyses. These analyses were conducted on three nonstructural plans and over 120 structural combinations of the alternative depths and widths (including seven TBs and anchorage features). Alternatives were evaluated for a 50-year period of analysis.

### Technical Studies

To evaluate the depth alternatives with selective widening options, TBs, and barge lanes, several technical studies were conducted by the ERDC and IWR. The additional study efforts included:

- Hydrodynamic/Salinity Modeling Study (ERDC)
- Ship Simulation Study (ERDC)
- Sediment Study and Velocity Analysis (ERDC)
- Vessel Effects Study (ERDC)
- Gulf Shoreline Desktop Study (ERDC)
- Harbor Simulation Model (Widening Analysis) (IWR)

The reports from these studies are available upon request from the USACE. The following is a brief overview of each of the studies:

**Hydrodynamic-Salinity Model.** The HS model study was conducted to determine the hydrodynamics (water levels and current velocities) of the SNWW and the potential salinity impacts due to the proposed deepening and widening of the existing channel (Brown and Stokes, 2009). The model was originally developed by Resources Management Associates (King, 1993) and extensively modified by the ERDC staff. The model has been used extensively over the past decade on such projects including the Houston-Galveston Navigation Channels; New York Harbor; St. Johns River, Florida; and Atchafalaya Bay, Louisiana. The model was performed for the 48- and 50-foot channel depths. The 45-foot channel depth was not modeled since the salinity differences between 45-foot and 48-foot depths were expected to be similarly small (FEIS, Section 2.3.2)

**Ship Simulation.** The ship simulation was used to determine navigation and safety impacts due to anticipated changes in vessel sizes as a result of the proposed channel widening (Webb, 2003). The main objective of the study was to determine whether the "design" ship could safely operate within the width and depth of the proposed channel dimensions. The simulation was conducted on a channel depth of 50 feet with varying widths and proposed barge lanes, including simulation of Taylor Bayou. Additional ship simulation was conducted to determine the navigation and safety implications of reducing the offshore entrance channel from its existing 800-foot width to a 700-foot width.

**Sediment Study and Velocity Analysis.** To determine anticipated shoaling rates (sediment build-up) along the waterway and estimate any increases in channel erosion, a sediment study was conducted (Parchure et al., 2005). Erosion concerns along Pleasure Island and East Sabine Lake were also addressed by the analysis. An additional study effort was performed along the Pleasure Island reach and Sabine-Neches Canal to determine whether the channel velocities in these areas would result in increased channel erosion.

**Vessel Effects Study.** A vessel effects study was conducted to determine the potential erosional effects to Pleasure Island from vessel traffic in the Port Arthur and Sabine-Neches canals (Maynord, 2005). Project vessel traffic was modeled with HIVEL2D, a two-dimensional (2-D) finite element model designed specifically to simulate flow in typical high-velocity channels. The model has been used since the mid-1980s and is maintained by the ERDC-Coastal and Hydraulics Laboratory (CHL).

**Gulf Shoreline Study.** This ERDC-CHL study was conducted 10 miles on either side of the SNWW entrance channel to determine potential erosion impacts to the existing shoreline at the Gulf of Mexico, on the Texas and Louisiana sides of the channel (Gravens and King, 2003). The spectral nearshore wave transformation model, Steady State Spectral Wave (STWAVE), was applied to examine wave conditions within a bathymetry grid extending 20 miles along the shoreline. The STWAVE model has been used on studies at Willapa Bay and Grays Harbor, Washington, and Ponce de Leon, Florida.

**Harbor Simulation Model.** The HarborSym model was used to evaluate widening of the entrance channel. HarborSym is a planning-level model developed by the IWR to assist in economic analyses of channel-widening improvements. The model creates an event-driven simulation based on empirical data and includes data from user-specified transit rules that the model processes with each vessel call in order to calculate delays within the system. More-detailed information on the model results can be found in the Economic Appendix of this report.

## Nonstructural Alternatives

The nonstructural alternatives were evaluated during the preliminary screening process to determine their ability to meet some or all of the planning objectives for the project. The nonstructural alternatives evaluated the use of a VTS to alleviate transportation inefficiency and safety concerns, the relaxation of existing pilot rules, and an alternative mode of commodity transport.

### Vessel Traffic Service

The existing VTS along the SNWW was evaluated as a nonstructural alternative. Although this service is managed by the USCG and thus is not within the jurisdiction of the USACE, it was evaluated because it appeared to be a potential alternative to structural plans. The VTS was authorized by certain sections of the Ports and Waterways Safety Act of 1972; the Oil Pollution Act of 1990 made participation mandatory in areas serviced by existing and future VTS (USCG, 2008a). The purpose of VTS is to provide active monitoring and navigational advice for vessels in particularly confined and busy waterways. VTS is designed to expedite ship movements, increase transportation system efficiency, improve all-weather operating capability, and enhance vessel safety and marine environmental protection (USCG, 2007, 2008b).

The VTS Center in Port Arthur monitors every ship, vessel, or boat that attempts to enter or leave the SNWW and the GIWW in the Port Arthur service area. Infrared cameras, along with radar, radio-telephone reports from vessel operators, and satellite surveillance sensors on towers along the SNWW, allow VTS controllers to zoom-in on vessel activity at a moment's notice. The satellite-based Automatic Identification System (AIS), required by the Maritime Transportation Security Act of 2002, assists the VTS by determining exactly what a specific commercial vessel is carrying, along with its speed, dimensions, and destination. Most commercial vessels using the waterway were required to have AIS equipment installed by the end of 2004 (USCG, 2004). These include power-driven vessels 66 feet in length or longer, power-driven vessels of 100 gross tons or more carrying one or more passengers for hire, towing vessels 26 feet or longer while navigating, all dredges and floating plant likely to restrict or

affect the navigation of other vessels, and all vessels required to participate in the Vessel Movement Reporting System. However, not all vessels are required to carry AIS; in particular, pleasure crafts, fishing boats, and warships are exempt.

Currently, the VTS Port Arthur is a voluntary system operated in accordance with existing VTS regulations. Until rules regarding VTS Port Arthur are published, vessels are exempt from all VTS and vessel movement reporting system requirements, except the requirement for AIS continuous broadcasts. When VTS Port Arthur is included in the VTS regulation, participation will become mandatory. At that time, VTS Port Arthur would be authorized to designate temporary reporting points and procedures, impose vessel-operating requirements, or establish vessel traffic routing schemes. During conditions of vessel congestion, restricted visibility, adverse weather, or other hazardous circumstances, VTS may control or manage traffic by specifying times of entry, movement, or departure to, from, or within a VTS area.

While the VTS would help congestion and improve safety to some degree, the USCG's traffic management role is limited to specific circumstances when the SNWW is congested or experiencing hazardous conditions. The VTS assists vessel operators in making independent decisions regarding the safe navigation of their vessels, for which they retain complete responsibility. In this sense, VTS should be considered primarily a navigational aid, a tool for mariners to use along with numerous other tools to facilitate safe navigation (USCG, 2008b), and thus would not improve deep-draft navigation inefficiencies created by the need for lightering and associated vessel delays.

#### Relaxation of Existing Pilot Rules

The SNWW is currently subject to transit rules that are needed for the pilots to safely guide large tankers through the existing, narrow channel. Relaxation of these rules as an alternative to channel improvements was evaluated. These transit rules or restrictions are agreed upon by the shipping industry, supported by the USCG Captain of the Port Orders under the Ports and Waterways Safety Act of 1978, as amended, and administered by the Sabine Pilots (2007). The agreement, dated January 12, 1981, will remain in force until the Sabine shipping industries, SPA, and USCG agree to its revision or modification.

The existing 700-foot-wide reach of the SNWW channel does not have vessel-meeting restrictions; however, in the narrower channel reaches vessel-meeting restrictions are currently imposed. The specific rules posted by the Sabine Pilots are displayed in Table VI-54. A general overview of the transit rules are:

- Daylight-only sailing restrictions applied in specific reaches for vessels that exceed certain DWT, length, and breadth criteria.
- No meeting during nighttime sailing for vessels exceeding a given draft limitation.
- No meeting during either day or night, applied to vessels by DWT, length, breadth, and draft combinations.

Relaxation of the existing pilot rules for the waterway was considered as a nonstructural alternative. However, given concerns about vessel handling and associated safety issues and that vessels utilizing the

waterway are wider than those using the channel even 5 to 10 years ago, the Sabine Pilots would not consider relaxing the rules. The expectation for the with- and without-project future is that pilot rules would continue to limit the possibility of vessel meetings in the Sabine-Neches Canal reach and that both vessel and shallow-draft tow movements would be scheduled through both VTS and communication between vessel pilots. More discussion of the transit rules and coordination with the SPA can be found in Chapter V, Economic Evaluation of Alternatives.

### Alternative Mode of Commodity Transport

Offshore oil terminals were evaluated as an alternative mode of commodity transport to determine whether it was economically more effective for the primary users of the waterway (crude oil tankers) to utilize this mode of transportation than it would be to construct a deeper and wider channel. Two offshore terminal alternatives were considered in the analysis, one existing and one proposed. The decision to use an offshore terminal instead of lightering or constructing a deeper channel is complicated but largely depends on the relative cost per ton, relative market volumes, and facility accessibility.

#### *Louisiana Offshore Oil Port*

Louisiana Offshore Oil Port (LOOP) is America's first and only deepwater (offshore) port and has been operating at capacity since 2005. The LOOP is located offshore of Grande Isle, Louisiana, in 110 feet of water. Grande Isle is 302 miles east of Port Arthur and Beaumont. The LOOP was organized in 1972 as a Delaware corporation and converted to a limited liability company in 1996. Marathon Ashland Pipe Line LLC, Murphy Oil Corporation, and Shell Oil Company are the LOOP's owners. The LOOP is the only port in the U.S. capable of offloading deep-draft tankers known as Ultra Large Crude Carriers and VLCC. Along with offloading crude from VLCC, the LOOP also offloads smaller tankers. The LOOP consists of three single-point mooring buoys used for the offloading of crude tankers and a marine terminal consisting of a two-level pumping platform and a three-level control platform.

Access to the LOOP for the SNWW market would require substantial investment as SNWW crude oil import volume nearly equals LOOP's capacity. The LOOP's design capacity of 1.4 to 1.8 million barrels per day is marginally higher than SNWW 2004–2006 crude petroleum import volume, which ranged from 1.2 to 1.4 million barrels per day (USACE, 2007a). The investment necessary for LOOP to process SNWW's entire crude petroleum throughput would require a doubling of capacity

A 48-inch-diameter pipeline connects the LOOP Marine Terminal located 23 miles offshore in the Gulf of Mexico to the Clovelly, Louisiana, storage facilities. Clovelly is approximately 260 miles east of the SNWW Port Arthur and Beaumont facilities. Four pipelines connect the onshore storage facility to refineries in Louisiana and along the Gulf Coast. The Clovelly facility provides interim storage for crude oil before it is delivered via connecting pipelines to refineries on the Gulf Coast and in the Midwest. The oil is stored in eight underground caverns leached out of a naturally occurring salt dome. In 1996, one cavern was dedicated to the production streams coming in from the deepwater Gulf of Mexico.

The domestic offshore crude oil system uses the same distribution system used by the foreign barrels. The caverns are capable of storing approximately 50 million barrels of crude oil (a barrel of oil is equal to 42 U.S. gallons). In addition, LOOP has an aboveground tank farm consisting of six 600,000-barrel tanks. LOOP operates the 53-mile, 48-inch LOCAP pipeline that connects the LOOP to CAPLINE (Amoco Cushing-Chicago Pipeline Company) at St. James, Louisiana. CAPLINE is a 40-inch pipeline that transports crude oil to several Midwest refineries. St. James is 227 miles east of Port Arthur and Beaumont. LOOP is connected to over 50 percent of the U.S. refinery capacity and has offloaded over 7 billion barrels of foreign crude oil since its inception.

Present users of LOOP consist of Louisiana-based refineries and U.S. Gulf Coast state domestic offshore production interests. In addition to new customers brought on due to infrastructure damages associated with the 2005 hurricanes, recent increase in the LOOP is tied to utilization associated with domestic production in the U.S. Gulf. It was noted that LOOP's existing base of customers uses it as one of several options for delivering crude oil to their Gulf Coast refineries (personal communication with Kathleen Jackson, Exxon, 2007). While all of SNWW's crude oil could not currently transfer to LOOP, additional tonnage could potentially be diverted. SNWW users continue to consider LOOP along with other alternatives; however, continued practices suggest that LOOP is not a cost-effective alternative to the existing SNWW practice of its land-based ports. The large fixed cost of expansion, and associated financing costs, necessitates participation by a consortium of companies. SNWW industries have not found the option of investing in LOOP, and the necessary associated infrastructure expansions, to be a cost-effective alternative to existing practices of either direct shipment or offshore lightering. The lack of incentive has remained since the 1970s. An additional variable pertinent to the current evaluation is that LOOP would appear to be a less-attractive cost option when compared to lower shipping costs that the SNWW improvement project is expected to provide.

LOOP is designed to handle 1.4 million barrels per day, but depending on the sizes of ships being serviced, it can handle 1.8 million barrels per day. The variance relates to the pumping rates of the tankers using the facility. Larger tankers tend to have faster pumping rates with some capable of pumping 80,000 barrels per hour. Smaller tankers may only be able to pump 35,000 barrels per hour. When fully operational, LOOP is generally the largest point of entry for crude oil imports into the U.S. About 13 percent of all waterborne foreign imports pass through LOOP each day. Again, LOOP's design capacity of 1.4 to 1.8 million barrels per day is only marginally higher than SNWW 2004–2006 crude petroleum import volume, which ranged from 1.2 to 1.4 million barrels per day. Of SNWW's approximately 1.3 million barrels per day import volume, terminals on the SNWW transport approximately 400,000 barrels per day of waterborne crude oil via pipelines to inland refineries including refineries in Texas, Louisiana, Oklahoma, Ohio, Arkansas, and Kentucky (Martin Associates, 2006). In total, the SNWW delivers approximately 12 to 16 percent of the crude oil supplied to domestic refineries east of the Rockies. Refineries supplied via the SNWW provide transportation fuels and other products to consumers along the Gulf Coast, East Coast, and Midwest regions. The SNWW ports presently receive about 1 percent of their daily input through LOOP. Additional offshore and landside infrastructure would be necessary for an increase in volume to take place.

Although there are some competing markets, the SNWW and LOOP generally serve parallel markets with LOOP consistently processing very large volumes and SNWW serving relatively smaller parcels. The sizes of the VLCC using LOOP typically exceed 300,000 DWT, whereas the maximum sized vessels using the SNWW are 175,000 DWT. The maximum design draft of these vessels is 55 feet or less. The minimum sized crude oil tankers using SNWW are in the 70,000 to 80,000 DWT range and have design drafts between 40 and 48 feet. LOOP's foreign petroleum imports are from the Middle East, whereas SNWW's market consists of direct shipments from Mexico and Venezuela and lightened mother vessels and shuttles. It has been noted that the cost effectiveness of LOOP lessens for small vessel sizes. The SNWW has the ability to serve a more general market and range of users. In discussions with local port and oil industry personnel, it is noted that LOOP and similar proposals serve crude petroleum but do not serve a full range of petroleum and bulk cargoes that use the SNWW.

The most-immediate obstacle to increased use of LOOP or a new offshore facility is major limitations for direct connection from LOOP to SNWW. A marginal increase in SNWW use of LOOP from its present 1 percent share would require LOOP pipeline connection modifications involving multiple pipelines and multiple companies. Such an investment may generate the necessity for higher throughput charges, which in turn may make access less cost effective than in the past. An industry analyst noted that, to a large extent, the companies demand that each segment, including pipeline transportation, stand on its own economically (Rabinow, 2004). The long-term availability of LOOP since the 1970s and low participation by SNWW companies indicate that LOOP and new offshore terminal proposals have not provided the market utilization incentives for significant shares of SNWW crude oil to shift towards these alternatives. The long-term trend is for domestic refining capacity to become more concentrated in regional centers and for imports of petroleum products to grow. This trend is evident with SNWW with crude oil import tonnage exceeding that of any other U.S. port and being equal to LOOP. Imports of refined products and partial refined crude oil have grown significantly as have the use of draft-constrained vessels for transporting these cargoes.

*Bulk Oil Offshore Transfer System*

Consideration of a Texas offshore oil terminal was also recognized as an alternative. In 2001, construction of a new terminal (called the Bulk Oil Offshore Transfer System, or BOOTS) offshore of Sabine Pass, Texas, was proposed. The relatively long distance from LOOP to SNWW and the need for additional infrastructure suggest that a facility closer to SNWW would be an attractive alternative to LOOP for SNWW channel improvements. However, the BOOTS facility has not yet been constructed and the regulatory permit application is inactive. The USCG has had no update on the proposal and does not expect a submittal. At the present time, the potential user of the proposed project is the terminal proponent. They noted that their participation as sole supporter is not feasible financially. It was specifically noted that their feedstock needs were not sufficient to finance the expansions to LOOP.

The BOOTs project proponent was contacted, and it was found that a new location farther down the Texas Coast near Freeport is presently being considered. The Freeport, Texas, site is about 100 miles southwest of the previous BOOTS location. Access by the SNWW refineries to a Freeport site involves

longer distances than the previous BOOTS location but it has advantages over LOOP. There is an existing pipeline from Freeport to Texas City; however, its connection to Port Arthur would necessitate a new pipeline from Texas City to SNWW, a distance of approximately 95 miles. Construction of a Freeport offshore facility could help serve the Freeport, Houston, and Texas City markets. Freeport's annual crude oil import volumes for the most recent 3-year period equate to approximately 0.4 million barrels per day; Houston's imports equate to about 1.0 million barrels per day; and Texas City's imports equate to about 0.9 million barrels per day. Industry indications are that the use of an offshore Freeport terminal would not serve as the exclusive supplier, just as LOOP is not the exclusive supplier for the Louisiana markets. Foreign imports by vessels into Louisiana and Mississippi are presently about 0.8 million barrels per day.

In a general discussion with industry, a representative noted that offshore oil terminal projects surface periodically, but the cost of these alternatives keeps them from moving beyond the initial planning stage. It is noted that the attractiveness of offshore alternatives over existing use of the SNWW is diminished by its ability to only serve one commodity (i.e., crude petroleum). It was added that the various crude oil blends and grades of oil introduce a range of additional concerns that add to throughput costs. The pipelines and associated infrastructure requirements vary between potential users and mingling of products and grades of crude is complex and difficult to facilitate. The construction of an offshore terminal that can meet the needs of various users is a challenge with the costs to realize multiparty usage creating an impasse to these proposals moving beyond the initial planning stage. Recognition of the cost of multiple pipelines necessary to meet the needs of the large base of customers necessary to finance these project alternatives has resulted in a stalemate in the decision process.

Expansion of LOOP, construction of a new offshore facility such as BOOTS, or an unloading terminal along the Sabine Pass or Port Arthur Canal reaches would reduce the vessel traffic on the Neches River. The reduction in ship traffic resulting from LOOP or BOOTS would reduce the economic viability of the SNWW deepening and widening project. However, past and present trends in infrastructure and fleet investments indicate that industry intends to continue using the Neches River Channel. An increase in the number of specially designed SNWW vessels was recently completed by one company, and another has invested in Neches River dock modifications for the larger "Aframax" and "Suezmax" vessels. The focus of immediate private sector petroleum vessel investments is concentrated on SNWW improvements rather than offshore or on the Sabine Pass Channel or Port Arthur Canal.

SNWW industry evaluation of offshore alternatives remains a reality; however, specific investments and commitments have not been made during a period when industry has invested in construction of new crude petroleum docks on the Neches River and in Port Arthur. Ongoing consultation with industry continues to show that commitments to offshore terminal investment have not materialized. During the 30 years since LOOP has become operational, several Texas Gulf Coast channel improvement projects have been completed and the benefits have been accrued. Offshore terminals would not accommodate products other than crude oil, and a significant proportion of benefits for the SNWW project improvement are from refined petroleum products. The offshore terminal was not found to meet the efficiency objective for all waterway users as it addressed the needs of only one user and commodity (crude oil). For these reasons, this alternative was eliminated from further consideration.

## Structural Alternatives

In order to reach the appropriate depths offshore, all deepening alternatives would involve an increase in the Entrance Channel ranging from 5 to 25 miles in length. Deepening and widening alternatives that were evaluated during this second screening analysis are listed in Table IV- 1.

Table IV-1
Structural Alternatives

| Alternative | Depths (feet) Evaluated | Section/Reach to be Widened | Widths (feet) Evaluated |
|---|---|---|---|
| No Action | 40 | None | Existing – Sabine Bank Channel to Outer Bar Channel – 800<br>Jetty Channel to Port Arthur Canal – 500<br>Sabine-Neches Canal/Neches River Channel – 400 |
| Deepen only | 43, 45, 48, 50, 53, 55 | None | Existing |
| Deepen and Widen | 43, 45, 48, 50, 53, 55 | Sabine-Neches Canal/Neches River Channel to Beaumont | Widen to match lower reach – 500 |
| Deepen and Widen | 43, 45, 48, 50, 53, 55 | Sabine Pass Channel – Sta. 180+00 to Port Arthur Canal – Sta. 275+00 | 600 or 700 |
| Deepen and Widen | 43, 45, 48, 50, 53, 55 | Sabine Pass Channel – Sta. 265+00 to Port Arthur Canal – Sta. 85+00 | 600 or 700 |
| Deepen and Widen | 43, 45, 48, 50, 53, 55 | Sabine Pass Jetty Channel | 600 or 700 |
| Deepen and Widen | 43, 45, 48, 50, 53, 55 | Sabine-Neches Canal | 500, 600, 700, selective widening, or barge lanes |
| Deepen and Widen | 43, 45, 48, 50, 53, 55 | Neches River Channel | 600, 700 or Turning Basins/Anchorages |
| Deepen and Widen | 45, 48, 50 | Sabine Pass Jetty Channel to Port Arthur Canal, selective widening on Taylor Bayou | 700 |

Additional engineering and environmental analyses were conducted to identify the specific channel modifications and environmental impacts for the various depths. Modifications to these alternatives were considered in an effort to decrease costs and identify an economically justified project. As part of the iterative plan formulation process, the following alternatives were added:

- Deepening the SNWW to Beaumont to 48 feet, widening to 700 feet width through the end of the Port Arthur Canal, and deepening and widening the Taylor Bayou Channel and TBs, but with a modification (narrowing) of the Outer Bank and Sabine Bank channels to 700 feet width through the end of the channel.
- Deepening the SNWW to Beaumont to 48 feet, widening to 700 feet width through the end of the Port Arthur Canal, deepening and widening the Taylor Bayou Channel and TBs, and tapering Sabine Bank Channel from 800 feet wide (Station 23+300) to 700 feet wide (Station 25+800 through end of the channel).

- Deepening the SNWW to Beaumont to 47 feet, widening to 700 feet width through the end of the Port Arthur Canal, deepening and widening the Taylor Bayou Channel and TBs, and narrowing of the Outer Bar and Sabine Bank channels to 700 feet width through the end of the channel. The 47-foot depth alternative was considered later in plan formulation phase in an attempt to reduce project costs and find an economically justified project. This alternative was later dropped since a modification to the original 48-foot depth alternative was found to be economically justified.

## Evaluation of Alternatives

As a result of the second screening, detailed evaluations were conducted on channel depths of 45, 48, and 50 feet in order to identify the optimal depth. Analysis of additional depths of 46, 47, and 49 feet were conducted later in the study to further optimize the NED depth. Along with these above-mentioned studies, various analyses including benefit and cost analyses, were conducted on the three alternative depths including the selective widening and TB/anchorage area options.

Incremental analyses of separable elements were also performed to determine if each was economically justified on its own. These separable elements included deepening to Port Arthur, deepening to Beaumont, and deepening Taylor Bayou with selective widening to ease navigation problems.

Second screening costs for the three depths were revised to include additional estimates developed for dock modifications, dock dredging, bridge pier replacement, costs for TBs and AB, and operations and maintenance (O&M) (including extension of the channel into the Gulf of Mexico to reach the proposed depth alternatives). Mitigation costs were assumed to be the same for each alternative for the reasons described below. Throughout this detailed analysis, environmental coordination and evaluation efforts were being conducted with the State and Federal resource agencies to identify mitigation requirements and BU locations for the estimated new work and maintenance material for the 50-year period of analysis.

Ecological mitigation costs for the six depth alternatives were estimated using the HS model salinity projection for the 40-, 45-, and 48-foot channel depths. Salinity was chosen as the best factor on which to base interpolation of mitigation costs because it is the primary driver in the ecological modeling that was used to determine the compensatory mitigation plan. The cost interpolation assumed that there would be a linear relationship between predicted salinities for each channel depth at the end of the period of analysis and the cost of mitigation.

Direct ecological effects associated with the navigation channel improvements under all proposed alternatives and the placement of dredged material consist of:

- Impacts to benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats would be similar for all alternatives. Benthic organisms are expected to quickly rebound from the short-term impacts of channel dredging, the use of offshore PAs, and the Sabine Lake borrow trench/access channel associated with compensatory mitigation in Louisiana.
- Dredging impacts to bottom-feeding and pelagic organisms such as sea turtles may occur with hopper dredging of offshore channel reaches for all alternatives; reasonable and prudent measures to avoid impacts would be instituted with an avoidance plan.

- Impacts to marsh would result from the enlargement of one PA under the No-Action Alternative, and two PAs under all other alternatives. The new PAs would be small and the incremental cost associated with one additional PA are too small to affect alternative selection. Most PAs would be enlarged by raising levee heights, which means that the footprint of the PA impacts would be similar for all alternatives.
- Impacts to shorebirds and their habitat would result from the regular placement of maintenance material on the Gulf shoreline under all alternatives, including the No-Action Alternative. Birds would be temporarily displaced to nearby habitat during each placement episode. These impacts would be minor and temporary, and the number and footprint of each placement episode would be the same for each alternative.

Indirect effects provide the primary ecological impacts of all structural alternatives. Although the SNWW channel is located primarily in Texas, large indirect impacts may occur in both Texas and Louisiana due to small increases in salinity levels causing an increase in wetland loss rates and a decrease in biological productivity in aquatic habitats of the study area. HS modeling indicates that none of the depth alternatives would result in significant impacts to swamp and fresh marsh habitats in the upper reaches of the Sabine and Neches rivers. Salinity impacts of the six depth alternatives to the vast saline through intermediate marshes would be similar, with an average difference between the 45- and 50-foot alternatives of less than 0.5 ppt.

### Second Screening Costs

Second screening costs were prepared for the existing channel width (500 feet) at the six alternative depths. These costs are included in Table IV-2. These estimates included costs for relocations (including utility relocations), dredging, levee construction, engineering and design, and construction management. Costs for selective widening to 700-foot widths were determined for two channel reaches for all six alternative depths and the existing 40-foot depth. Costs for O&M for each of the structural alternatives were not included in this second screening evaluation of the alternatives, but would be considered later in the screening process. Costs for real estate lands and damages, mitigation, and BU features were not calculated for the 120 plus variations during this screening. Project benefits were based on reductions in transportation costs generated from more-efficient vessel loading and from reduction in vessel delays for the channels to Port Arthur and Beaumont. With the high number of alternatives to be screened, the results of the economic analysis, specifically the BCRs and the net excess benefits, were used as the main screening tool.

Ecological benefits and mitigation costs were not calculated for the nonstructural and 120-plus variations of structural alternatives for channel improvements during the screening process. However, all alternatives, including the No-Action Alternative, were informally reviewed for potential effects to the environment in a nonquantitative manner, and this information was evaluated along with cost data in determining which plans would advance into detailed evaluation.

Table IV-2
SNWW (including Taylor Bayou and Neches River Channels)
Alternative First Cost
(2002 Calculations)

| Channel Depth (feet) | First Cost Deepening ($) |
|---|---|
| 43 | 134,295,000 |
| 45 | 191,843,000 |
| 48 | 297,787,000 |
| 50 | 373,275,000 |
| 53 | 496,691,000 |
| 55 | 575,436,000 |

## Second Screening Economic Analysis

*Project Benefits*

An economic evaluation of various deepening and widening alternatives was conducted to identify alternatives that maximized NED benefits. This evaluation is presented in detail in Chapter V of this report. Benefits were calculated for Port Arthur and Beaumont depth alternatives of 43, 45, 48, 50, 53, and 55 feet, and for other separable elements of the proposed CIP. Based on the BCRs, the screening analyses indicated that the improvements through the Neches River Channel to Beaumont were economically justified. It was found that 65 percent of the project benefits were associated with the upstream Beaumont area and 35 percent with the Port Arthur area; therefore, continuing improvements up the Neches River to Beaumont was economically justified. Alternative depths of 45 feet and greater had higher net excess benefits than depths less than 45 feet. In addition, the non-Federal sponsor did not wish to pursue depths less than 45 feet; therefore, depth alternatives less than 45 feet were dropped from further analysis.

Preliminary benefit calculations prepared for the early screenings were limited to crude petroleum and refined petroleum products. These groups represent over 88 percent of 2000–2006 total deep-draft tonnage. Tables IV-3 to IV-5 display the transportation savings benefits calculated for the second screening. The benefits for the Neches River Channel to Beaumont deepening are shown in Table IV-3, and the benefits for the Taylor Bayou reach are shown in tables IV-4 and IV-5. The benefits presented in Table IV-4 assume deepening Taylor Bayou, widening at the mouth of the Bayou and the west TB bottleneck curve, and placement of a structural wall that would protect local railroad tracks. The widening associated with the Table IV-4 scenario would facilitate the existing fleet and reduce the level of maneuvering necessary. The second set of Taylor Bayou benefits (Table IV-5) assumes major reconfiguration of the Taylor Bayou channel so that larger Aframax and Suezmax vessels (i.e., 120,000 to 175,000 DWT) could access the facilities. Facilitating the full range of Aframax and Suezmax vessels would require moving the railroad tracks rather than just constructing a retaining wall. The maximum sized tankers presently using the Taylor Bayou channel are in the 80,000 to 115,000 DWT range.

Table IV-3
Average Annual Benefits ($), Neches River Channel
(2002 Calculations at 6.375%, 50-Year Period)

| Channel Depth (feet) | Crude Oil Imports | Petroleum Products | | Total Benefits |
|---|---|---|---|---|
| | | Imports | Exports | |
| 43 | 11,192,741 | 2,673,782 | 1,034,112 | 14,900,635 |
| 45 | 13,905,184 | 3,429,983 | 1,327,696 | 18,662,863 |
| 48 | 21,048,641 | 5,396,346 | 2,090,369 | 28,535,356 |
| 50 | 23,182,977 | 6,448,183 | 2,497,512 | 32,128,672 |
| 53 | 26,816,688 | 7,580,793 | 2,929,141 | 37,326,622 |
| 55 | 29,047,523 | 8,067,929 | 3,114,431 | 40,229,883 |

Table IV-4
Average Annual Benefits ($), Taylor Bayou Channel and Basin
Accommodates Limited Range of Aframax Vessels
(2002 Calculations at 6.375%, 50-Year Period)

| Channel Depth (feet) | Crude Oil Imports | Petroleum Products | | Total Benefits |
|---|---|---|---|---|
| | | Imports | Exports | |
| 43 | 5,415,881 | 653,569 | 855,527 | 6,924,977 |
| 45 | 6,715,426 | 836,923 | 1,096,613 | 8,648,962 |
| 48 | 10,147,206 | 1,314,065 | 1,723,108 | 13,184,379 |
| 50 | 10,918,029 | 1,567,326 | 2,035,245 | 14,520,600 |
| 53 | 11,216,492 | 1,567,326 | 2,035,245 | 14,819,063 |
| 55 | 11,216,492 | 1,567,326 | 2,035,245 | 14,819,063 |

Table IV-5
Average Annual Benefits ($), Taylor Bayou Channel and Basin
Accommodates Limited Range of Aframax and Suezmax Vessels
(2002 Calculations at 6.375%, 50-Year Period)

| Channel Depth (feet) | Crude Oil Imports | Petroleum Products | | Total Benefits |
|---|---|---|---|---|
| | | Imports | Exports | |
| 43 | 6,546,410 | 789,997 | 1,034,112 | 8,370,519 |
| 45 | 9,130,533 | 1,013,283 | 1,327,696 | 10,471,512 |
| 48 | 12,309,970 | 1,594,143 | 2,090,369 | 15,994,482 |
| 50 | 13,526,683 | 1,904,115 | 2,497,512 | 17,928,310 |
| 53 | 15,641,626 | 2,255,707 | 2,929,141 | 20,826,474 |
| 55 | 18,999,767 | 2,398,070 | 3,114,431 | 24,512,268 |

Table IV-6 summarizes the results of the screening depth optimization. The Taylor Bayou construction cost contained in Table IV-6 assumes deepening of the existing channel framework and limited widening. The widening associated with the cost shown would facilitate the upper end of the existing fleet and reduce the level of maneuvering necessary but it would not accommodate the full range of Aframax and Suezmax tankers.

Table IV-6
SNWW (Taylor Bayou and Neches River Channels)
First Cost and Average Annual Costs and Benefits
(2002 Calculations at 6.375%, 50 Years)

| Channel Depth (feet) | First Cost Deepening ($) | Average Annual Cost ($) | Average Annual Benefits ($) | Net Excess Benefits ($) | BCR |
|---|---|---|---|---|---|
| **SNWW Total** | | | | | |
| 43 | 134,295,000 | 8,969,424 | 21,825,612 | 12,856,188 | 2.4 |
| 45 | 191,843,000 | 12,812,996 | 27,311,825 | 14,498,829 | 2.1 |
| 48 | 297,787,000 | 19,888,886 | 41,719,734 | 21,830,848 | 2.1 |
| 50 | 373,275,000 | 24,930,652 | 46,599,463 | 21,668,811 | 1.9 |
| 53 | 496,691,000 | 33,173,479 | 51,797,413 | 18,623,934 | 1.6 |
| 55 | 575,436,000 | 38,432,776 | 54,700,674 | 16,267,898 | 1.4 |
| **Deepening to Neches River (No Improvements to Taylor Bayou)** | | | | | |
| 43 | 128,073,368 | 8,553,888 | 14,900,635 | 6,346,747 | 1.7 |
| 45 | 184,192,994 | 12,302,060 | 18,662,863 | 6,360,803 | 1.5 |
| 48 | 287,681,639 | 19,213,960 | 28,535,356 | 9,321,396 | 1.5 |
| 50 | 360,546,301 | 24,080,515 | 32,128,672 | 8,048,157 | 1.3 |
| 53 | 480,142,477 | 32,068,220 | 37,326,622 | 5,258,402 | 1.2 |
| 55 | 556,384,575 | 37,160,351 | 40,229,883 | 3,069,532 | 1.1 |
| **Taylor Bayou Deepening Increment (Limited Aframax, no Suezmax)** | | | | | |
| 43 | 6,221,632 | 415,536 | 6,924,977 | 6,509,441 | 16.7 |
| 45 | 7,650,006 | 510,936 | 8,648,962 | 8,138,026 | 16.9 |
| 48 | 10,105,361 | 674,927 | 13,184,378 | 12,509,451 | 19.5 |
| 50 | 12,728,699 | 850,137 | 14,520,600 | 13,670,463 | 17.1 |
| 53 | 16,548,523 | 1,105,259 | 14,819,063 | 13,713,534 | 13.4 |
| 55 | 19,051,425 | 1,272,425 | 14,819,063 | 13,546,638 | 11.6 |

*Second Screening Net Excess Benefits*

As indicated in Table IV-6, the results of the initial formulation showed that the 48- to 50-foot channel depth produced the highest net excess benefits. While additional commodities, specifically aggregate, grain, chemicals, and LNG, were not included in the initial formulation, it was anticipated, based on analyses conducted for other studies, that inclusion of these additional groups would push the formulation closer to 48 feet rather than 50 feet. Consideration of LNG came later in the plan formulation process after the Federal Energy Regulatory Commission (FERC) approval and construction commencement. However, its inclusion also had the effect of pushing the depth optimization below 50 feet.

Consideration of relatively flat net excess benefits between the 48- and 50-foot depth, as well as the anticipated effects on the formulation from additional commodities as discussed above, and the Sponsor's interest in minimizing the construction costs suggested that the focus of the detailed formulation should be on depths between 45 and 50 feet. The NED plan is the plan that reasonably maximizes net NED benefits. This second screening analyses indicated that the 48-foot depth had the highest net excess benefits and would be the probable NED depth. More-detailed analysis was conducted to confirm the identification of the NED depth. Analysis of additional depths, such as 46, 47, and 49 feet, was conducted

later in the study in order to determine potential changes to NED depth optimization based on 1-foot depth increments.

### Evaluation of Structural Alternatives

*Deepening and Widening*

Interest in the project was driven by two factors: (1) allow the existing fleet to carry additional cargo, and (2) reduce congestion and associated risk along the waterway. For a given volume of traffic, channel deepening results in fewer trips and reduces congestion. With this in mind, the optimization initially focused on depth and then looked for widening options. Determination of channel width alternatives was driven by pilot input and followed up with the ERDC vessel (ship) simulation modeling. During the screening, channel widening was evaluated for all of the channel reaches from Sabine Pass Channel, inland through the Neches River Channel. With the exception of the Entrance Channel reaches, widening alternatives were limited because of physical structures, including docks on the Neches River and Sabine-Neches Canal reaches and the Port Arthur Hurricane Protection Levee in the Sabine-Neches Canal reach. The widening alternatives were subsequently screened based on comparison of associated vessel delay costs and initial project construction cost estimates.

The ERDC model results, transportation cost outputs, project construction costs, and anticipated environmental effects helped in identifying the optimal choice of plans. The results of the ERDC ship simulation showed that a channel width of 700 feet through the Sabine Pass Channel and Port Arthur Canal would be necessary for the Suezmax and Aframax vessels to meet smaller vessels in these channel reaches. The project design vessel is 899 feet long and 164 feet wide. These dimensions correspond to a 158,000 DWT Suezmax crude petroleum tanker. A loaded and a ballast design vessel could not successfully meet in the ERDC test of the 600-foot channel, nor could the design vessel and a smaller 110,000 DWT tanker meet.

As noted, the ERDC ship simulation showed that a width of 700 feet was necessary for the largest combinations of vessels. While the results of the ERDC ship simulation modeling showed that a minimum width of 700 feet was necessary for inbound and outbound vessel meeting for many vessels in the existing and future fleet, economic analysis of alternative widths was also included as part of the HarborSym economic widening model. Preliminary estimates of the widening benefits were calculated during the preliminary screening; however, a width optimization analysis was not performed until the second screening.

Numerous widening scenarios were evaluated in the various alternatives in the second screening. Narrowing of the entrance channel from the existing 800-foot width to a 700-foot width was investigated in the phase for cost reduction purposes. The Ship Simulation studies verified that these channels could be narrowed from 800 to 700 feet, with the exception of the Sabine Pass Outer Bar Channel where the 800-foot width was necessary because of crosscurrents in that area. Based on the analysis, the Sabine Outer Bar Channel would maintain the existing 800-foot width. For the Sabine Bank Channel and Extension, the channel would taper down to a 700-foot width after the first ½ mile. The Sabine Pass Jetty Channel

would transition from 800-foot to 500-foot width going upstream through the jetties. No impacts to the existing jetties would occur as a result of the modifications. The Sabine Pass Channel and the Port Arthur Canal would remain 500 feet wide with the Sabine-Neches Canal remaining 400 feet wide. The Neches River Channel would maintain the 400-foot width with new and existing TBs/AB. Pilots expressed concern that widening the Neches River Channel would prove too costly and would raise numerous environmental issues that would prevent completion of the widening project. They preferred the use of TBs and AB to help traffic efficiency. Ship simulation confirmed that no widening was necessary and TBs and AB were acceptable navigation modifications to improve navigation efficiency.

*Turning Basins and Anchorage Basins*

As an additional structural alternative, modifications to existing TBs and AB or creation of new TBs and/or AB along the waterway were considered, coordinated with the SPA, and modeled by the ERDC. The proposed Neches River TB anchorages were identified as a less costly alternative to channel widening. The anchorages would be used to facilitate vessel passing. Preliminary estimates of the TB and AB benefits were not calculated during the preliminary screening but later in the study process.

*Barge Lanes*

Another structural alternative evaluated was the construction of a barge shelf in a portion of the Sabine-Neches Canal. Interest in the barge shelf was prompted by the large volume of tow-barges using the Sabine-Neches Canal reach, along with a high flow of deep-draft traffic. The mix of deep- and shallow-draft traffic in this reach raised safety concerns and prompted interest in evaluation of a barge shelf through the canal reach between the east and west junctions with the GIWW. Initial responses to the barge shelf alternative revealed large variances in expectations about potential effects, with some tow operators questioning the usefulness and safety of the proposed project feature. For these reasons, in 2005 the Gulf Intracoastal Canal Association (GICA) withdrew their support for the barge shelf. The GICA is an organization created to ensure that the GIWW is maintained, operated, and improved to provide the safest, most efficient, economical, and environmentally sound water transportation route in our Nation. Part of their mission is to identify existing physical hazards and other opportunities to improve the safety and efficiency of the GIWW (GICA, 2008).

The initial indication from some of the deep-draft and shallow-draft operators was that a barge shelf could provide an increased degree of safety; however, benefits from casualty reductions were not calculated because the without-project condition is “avoidance behavior” in the form of pilot rules, radio, VTS communication, and transit delays. The indication from some vessel operators was that if a barge shelf was available, vessel operators would only use it in an emergency but that avoidance of tow-vessel and tow-tow meetings in the Sabine-Neches Canal would continue as the most likely future.

Anticipated and continued success of the VTS, as a nonstructural alternative, contributed to the vessel operators’ decision to forgo the barge shelf. Overall, improved deep-draft and barge vessel communication was initiated by the USCG and user safety board that resulted in questions concerning the need for the barge shelf. Ongoing improvements to the VTS system are expected to result in accelerated

safety and communication improvements. The VTS nonstructural initiative made by the USCG, SPA, and GICA represent alternatives to the barge shelf proposal.

## Plans Eliminated During Second Screening

For evaluation of the nonstructural alternatives, the alternative mode of commodity transport (LOOP and BOOTS) and the VTS alternatives would help with improving safety along the existing channel (by reducing vessel traffic or better managing the traffic). However, these alternatives do not address the navigational efficiency of the waterway and would not allow the vessels utilizing the channel to load more fully. The potential relaxation of the current transit rules by the pilots was evaluated but screened out as not implementable because the pilots do not support this course of action. Therefore, all nonstructural alternatives were eliminated from further consideration.

The widening alternatives included widening of the Sabine Pass Channel and Port Arthur Canal from 500 to 700 feet. Although the widening in combination with the deepening of the channel was economically justified, the widening alone resulted in a BCR of 0.4. The economic summary of this channel widening is included in Table IV-7. Therefore, the widening alternative for this reach was not an incrementally justified feature and was eliminated from further evaluation.

Table IV-7
Sabine Pass Channel and Port Arthur Canal
Widening Only (700 feet)
Economic Summary Data (2008 Dollars at 4.375%)

| Item | Sabine Pass and Port Arthur Canal ($) |
|---|---|
| First Cost | 78,448,000 |
| Mitigation Cost | 48,484,500 |
| Interest During Construction | 36,282,311 |
| Total First Cost | 163,241,841 |
| Average Annual Construction Cost | 8,091,727 |
| Incremental Average Annual O&M Cost | 9,587,005 |
| Total Average Annual Cost | 17,678,732 |
| | |
| Average Annual Benefits | 6,379,579 |
| BCR | 0.4 |

As previous shown in Table IV-6, net excess benefits were relatively flat from depths of 48 to 50 feet. However, construction costs increased significantly between those depths. The results of this screening analysis indicated that NED depth was between 48 and 50 feet, with the highest net excess benefits being at the 48-foot depth. Due to cost-sharing requirements for deep-draft channels (depths greater than 45 feet) and the Sponsor's uncertainty of the preferred depth, the 45-foot depth alternative was also carried forward for further analysis. Continuous widening of the Sabine-Neches Canal and Neches River Channel to 500 feet throughout their lengths was eliminated when the ship simulation determined that a 700-foot width was necessary for safe two-way traffic.

In summary, since structural alternatives (e.g., deepening the channel) were the only alternatives that would fully address the project objective of navigational efficiency, only the No-Action Alternative and some structural alternatives for improvements to the SNWW navigation system were carried forward for detailed analysis. Among all of the structural alternatives, only six depths (45, 46, 47, 48, 49, and 50 feet) were carried forward into detailed evaluation.

## IV.E FINAL SCREENING OF ALTERNATIVES

During detailed evaluation of screened alternatives, the identification of the Recommended Plan was based upon technical, economic, and environmental factors. Operation and maintenance costs for extending the entrance channel for the deeper depth alternatives were developed to better estimate project costs of each proposed depth.

### Final Screened Alternatives

Based on additional information from the traffic analysis, the revised BCRs, net excess benefits, and the Sponsor's lack of support for depths greater than 50 feet, the deepening alternatives were screened to a 5-foot range from 45 to 50 feet, focusing on those depths with the highest net excess benefits. Selective widening and TBs were also carried forward for more-detailed analysis and formulation with the deepening alternatives.

This selective widening included sections in the Sabine-Neches Canal and the Neches River Channel. The Sabine-Neches Canal included realignment in the section adjacent to Port of Port Arthur to place the centerline directly in the center of the channel width. This change shifted the channel over approximately 10 feet while keeping the same bottom width. This allowed for additional berthing space in the area while avoiding impacts to the Hurricane Protection Levee and Pleasure Island properties. Additionally, bend easings were included to improve ship maneuverability and eliminate a wiggle in the alignment. The Neches River Channel was widened at the mouth of the Neches River prior to the State Highway (SH) 87 twin bridges. Additional TB/AB or enlargement of existing TB/AB on the Neches River Channel were also included in the final screening.

The structural alternatives evaluated during this final screening phase of the study are listed in Table IV-8.

Since the deepening alternatives would result in the existing project channel extending in the Gulf of Mexico (potentially an additional 17 miles), consideration of O&M costs, in addition to other detailed evaluations and analyses, was deemed necessary in conducting the further screening.

The identification of the Recommended Plan from the various alternatives was based upon economic and environmental factors. Costs were estimated for all of the alternatives and compared to the project benefits. Included in the costs were dredging, levee construction, relocations (including utility relocations), and O&M costs for the 50-year period of analysis. Costs for ecosystem mitigation were estimated using HS model salinity projections.

Table IV-8
Alternatives for Final Screening

| Alternative | Depths (feet) | Sections | Width (feet) |
|---|---|---|---|
| Deepening | 45, 46, 47, 48, 49, 50 | Extension Channel | 700 |
| | | Sabine Bank Channel | 700 (tapers to 800) |
| | | Sabine Pass Outer Bar Channel | 800 (existing) |
| | | Sabine Pass Jetty Channel | 500 (existing) |
| | | Sabine Pass Channel | 500 (existing) |
| | | Port Arthur Canal | 500 (existing) |
| | | Taylor Bayou | selective widening |
| | | Sabine-Neches Canal | 400 (existing) |
| | | Neches River Channel | 400 (existing) |
| Turning Basins/ Anchorage Basins (various combinations) | 48 | Neches River Channel | |

Table IV-9 presents the economic summary of the final screening of alternatives and includes BCRs and net excess benefits for the 45- to 50-foot plans, including TBs and AB. From these data, the 49-foot depth produced the most net excess benefits compared to the cost of the proposed project modifications. Therefore, the 49-foot alternative was identified as the NED Plan. The sponsor has indicated a preference for the 48-foot project because of cost savings. Therefore, the 48-foot project is the locally preferred plan (LPP).

Table IV-9
SNWW Economic Summary Data
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction ($) | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Total Annual Cost ($) | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Average Annual Benefits ($) | 83,844 | 95,856 | 104,303 | 115,074 | 122,875 | 127,696 |
| Net Excess Benefits ($) | 13,627 | 18,598 | 20,004 | 23,733 | 26,249 | 25,785 |
| BCR | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 |

Finally, the abbreviated array of alternatives was compared against the four primary evaluation criteria specified in the P&G: acceptability, completeness, efficiency, and effectiveness (Table IV-10). To meet the first criterion, plans should be acceptable to State and Federal resource agencies and local governments; they should also be able to show evidence of broad-based public support. To be considered complete, plans must provide and account for all investments necessary to implement the plan. For the third criteria, plans must be cost effective. For the final criterion, effectiveness, the plan must make a significant contribution to addressing the specific planning objectives addressed by the study.

Table IV-10
Comparison of P&G Evaluation Criteria

| Item | No Action | 45 feet | NED – 49 feet | LPP – 48 feet |
|---|---|---|---|---|
| **Criteria** | Maintain existing 40-foot-deep x 800-foot-wide x 22-mile-long Sabine Bank and Outer Bar channels, transitioning to 500 feet wide in the Sabine Pass Jetty Channel, and 400-foot x 40-foot-deep channel to Beaumont | 45-foot-deep x 8.45-foot-deep x 8.3-mile-long x 800-foot-wide Extension, Sabine Bank, and Outer Bar channels, transitioning to 500-foot-wide channel to end of Port Arthur Canal, and 400-foot x 45-foot-deep channel to Beaumont; deepening and widening of Taylor Bayou Channels and Basins | 4- foot-deep x 16.5-mile-long x 800-foot-wide Extension, Sabine Bank, and Outer Bar channels, transitioning to 500-foot-wide channel to end of Port Arthur Canal, and 400-foot x 49-foot-deep channel to Beaumont; deepening and widening of Taylor Bayou Channels and Basins | 48-foot-deep x 13.2-mile-long x 700-foot-wide Extension and Sabine Bank channels, 800-foot-wide Outer Bar Channel, then 500-foot-wide channel to end of Port Arthur Canal, and 400-foot x 48-foot-deep channel to Beaumont; deepening and widening of Taylor Bayou Channels and Basins |
| **Acceptability** (meets all laws, regulations and guidance) | Acceptable | Acceptable | Acceptable | Acceptable |
| **Completeness** (provides and accounts for all necessary investments or other actions to ensure the realization of the planning objectives) | No Action is an incomplete solution to all planning objectives | Plan is an incomplete solution; it provides some improvement in navigation efficiency over No Action but does not maximize transportation benefits | Plan is a complete solution; it maximizes navigation efficiency over other plans; no impacts to bridges and Hurricane Flood Protection (HFP) Plan | Plan is more complete than others, but does not maximize transportation benefits, no impacts to bridges and HFP Plan |
| **Efficiency** (extent to which an alternative plan is the most cost effective means of achieving the objectives) | No Action does not address the planning objectives | Less costly than Recommended Plan but does not address objectives as effectively; net excess benefits are not maximized | More costly than Recommended Plan; achieves all objectives; net excess benefits are maximized | Cost-effective; achieves all objectives; net excess benefits are not maximized; Sponsor indicated this plan is LPP |
| **Effectiveness** (extent to which the alternative plans contribute to achieve the planning objectives) | Ineffective for improving navigational efficiencies | Not as effective as Recommended Plan for improving navigation efficiency or maintaining environmental quality | Most effective plan for improving navigation efficiency and maintaining environmental quality; Sponsor has indicated this plan is not affordable | Not as effective as NED Plan for improving navigation efficiency; Sponsor has indicated this plan is LPP |

## IV.F IDENTIFICATION OF THE RECOMMENDED PLAN

The detailed evaluation of screened alternatives concluded with the identification of a Recommended Plan. The identification of the Recommended Plan was based upon a comparison of economic, engineering, environmental, and socioeconomic factors, as well as the Sponsor's preference. The alternative described below has been identified as the Recommended Plan:

> *Deepening of the SNWW to Beaumont to 48 feet with an extension of the Entrance Channel 13.2 miles in length, deepening and widening of Taylor Bayou Channel and turning basins, and tapering the Sabine Bank Channel from 800 feet wide (Station 23+300) to 500 feet wide (Station 25+800 through the end of Sabine Bank Channel). Turning and anchorage basins would be added and/or enlarged along the Neches River Channel and bend easing performed on the Sabine-Neches Canal and Neches River Channel.*

Detailed evaluations of alternatives for the management of dredged material and the mitigation of ecological impacts were then performed for the Recommended Plan. This evaluation concluded with the development of a DMMP and a mitigation plan. The DMMP includes measures in which dredged material is used to restore wetland habitat, offsetting impacts of the Recommended Plan. The evaluation of alternatives for the management of dredged material and the recommended placement plan are described in Chapter VII of this report and in Section 2.5 of the FEIS. The evaluation of mitigation alternatives that compensate for remaining unavoidable impacts to significant habitats and resources and the recommended mitigation plan are described in Chapter 5 of the FEIS. Least cost analyses of dredged material placement and an incremental cost analysis of mitigation alternatives were conducted to select recommended placement and mitigation measures. These analyses are presented in Chapter VIII of this report.

## IV.G PRINCIPLES AND GUIDELINES EVALUATION ACCOUNTS

The four P&G evaluation accounts were used throughout the planning process to evaluate the effects of the project alternatives. Each of the four accounts is identified below as well as an explanation of how the Recommended Plan complies with these evaluation accounts.

### National Economic Development

The NED account shows the changes in the economic value of the national output of goods and services. The main economic benefit from a navigation project is the reduction in the value of the resources required to transport the various commodities associated with the waterway. National benefits can result from any of the following: increased efficiency of moving commodities resulting in cost reductions in commodities, savings from using a more-cost-effective mode of transportation (alternate mode of transportation), a shift in origin and destination of commodities thereby reducing the costs of transport, new

movements of commodities, and/or commodities delivered either at less cost or additional commodities being transported due to lower transportation costs.

The Recommended Plan is the culmination of the various benefit analyses mentioned above. The 49-foot depth including TBs and AB was found to produce the most net excess benefits compared to the cost of the proposed project modifications. Therefore, the 49-foot alternative was identified as the NED Plan. However, the Sponsor has indicated that the 48-foot plan is preferred because the cost of the NED and deeper plans would make the project unaffordable. The 48-foot plan is the LPP, the plan preferred by the sponsor.

The USACE guidance requires that the NED plan be recommended unless there are believed to be overriding reasons favoring the selection of another alternative. Planning guidance (ER 1105-2-100) states that if the non-Federal sponsor identifies a financial constraint due to limited resources, and if net benefits are increasing as the constraint is reached, a categorical exemption may be granted and the constrained plan recommended. Categorical exemptions for plans that are lesser projects than the NED plan are cost shared on the same basis as the NED and become a federally supportable plan.

In this study's selection of the Recommended Plan, the sponsor has indicated a preference of the 48-foot LPP due to cost restraints. This plan is a justified plan that is less costly that the NED plan. This LPP still meets the policies for the high-priority outputs and has greater benefits than the smaller scale plans (see Table IV-9). Since the 48-foot plan is the Sponsor's preference due to financial constraints and fits all of the criteria regarding categorical exemptions for navigation projects, this plan has been identified as the Recommended Plan. This LPP is less costly than the NED plan; therefore, cost sharing will be the same as the NED plan.

## Effects on Environmental Quality

The Environmental Quality account identifies the nonmonetary effects on significant natural and cultural resources (ER 1105-2-100). The primary impact of the Recommended Plan is an indirect impact associated with an increase in salinity intrusion and an associated reduction in biological productivity over 182,000 acres of intertidal marsh and swamps within the area of tidal influence in the Sabine-Neches study area. As quantified by the WVA model, the net decrease in productivity for the project as a whole is –843 average annualized habitat units, or AAHUs, after application of benefits from the Recommended Plan. Later in this report, Table VIII-2 summarizes the calculations made resulting in these –843 AAHUs. Minor impacts to cypress-tupelo swamp or bottomland hardwood productivity are projected. The ICT considered this to be acceptable since the loss in function is negligible. No adverse impacts to threatened or endangered species or Critical Habitat would result from the indirect effects of salinity increases or land losses.

Most of the direct effects of the Recommended Plan on ecological systems and resources are minor and temporary. These impacts are associated with navigation channel improvements and the placement of dredged material. They include (1) impacts to benthic organisms and their Gulf, estuarine, and riverine

water-bottom habitats resulting from dredging to construct the navigation improvements, offshore PAs, borrow areas for mitigation measures, and marsh restoration in shallow, open-water areas; (2) potential dredging impacts to bottom-feeding and pelagic organisms such as sea turtles; and (3) impacts to shoreline birds and their habitat from the placement of maintenance material on the Gulf shoreline.

The Recommended Plan would have no long-term adverse environmental effects, after benefits of the DMMP and compensatory mitigation are taken into account. The Recommended Plan is expected to produce beneficial effects that would contribute to the long-term sustainability of valuable habitat in the SNWW area as described below. A detailed discussion of the effects of the Recommended Plan and the mitigation plan are presented in the FEIS.

BU features of the DMMP (Neches River and Gulf Shore BU Features) would minimize and offset all direct and indirect marsh impacts in Texas by creating 2,853 acres of emergent marsh vegetation, improving 871 acres of open water habitat, and nourishing 1,234 acres of existing marsh in Texas. Benefits of the Neches River BU Feature also more than offset the direct impact of conversion of 86 acres of fresh marsh to a confined PA (PA 24A) and the indirect impact of the increase in salinity over 39,000 wetland acres in Texas. The Gulf Shore BU Feature offsets minor erosion impacts by periodically nourishing 6 miles of Texas and Louisiana Gulf shorelines.

Since the DMMP offsets all impacts of the Recommended Plan in Texas, no compensating mitigation would be required for Recommended Plan effects in this state. It is important to note that the impacts presented here do not include all impacts of the Preferred Alternative in Texas as future with project (FWP) impacts in Texas's Salt Bayou (TX 9) hydro-unit are not included. Jefferson County, Texas, and USACE, with support from the Texas Parks and Wildlife Department (TPWD), GLO, and Texas Water Development Board (TWDB), have been studying ways to reduce the amount of saltwater intrusion, decrease high-energy inflows, and minimize impacts to larval fish access in an on-going Section 1135 Continuing Authorities Project (CAP) study for the Salt Bayou hydrologic unit. When the Keith Lake Section 1135 CAP study was begun in 2003, it seemed likely that the CAP study and construction would be completed before the SNWW CIP could be authorized and constructed. The Keith Lake Section 1135 study was therefore considered separable from the SNWW CIP, and for planning purposes, it was assumed that a water control structure at the Fish Pass would be part of the future without-project condition for the SNWW CIP. Incremental impacts of the SNWW CIP will be calculated for the Salt Bayou unit of the SNWW study area when WVA modeling is completed for the Keith Lake Section 1135 study. It is possible that the excess DMMP benefits (316 AAHUs) of the SNWW CIP will cover all incremental project impacts. However, if it is determined that additional mitigation is needed, then USACE and the non-Federal sponsor of the SNWW CIP will initiate consultation with resource agencies, identify and incrementally justify additional compensatory mitigation for the Salt Bayou unit, and prepare a supplemental environmental impact statement (EIS).

Unavoidable losses to marshes in Louisiana, which remain after application of all DMMP benefits, are fully mitigated by marsh creation in the Willow Bayou and Black Bayou watersheds east of Sabine Lake.

Potential adverse effects to threatened and endangered sea turtles from the use of hopper dredges to construct the Entrance Channel in the Gulf of Mexico would be avoided by the adoption of reasonable and prudent measures recommended by the USFWS Biological Opinion. No long-term impacts to air quality or noise levels are expected, and temporary impacts to air quality during construction have been determined to be in general conformity with the Texas State Implementation Plan. No impacts to historic properties have been identified at this time. However, should adverse effects to historic properties be identified in the future, mitigation plans would be developed and implemented in accordance with the Historic Properties Programmatic Agreement for the Treatment of Historic Properties (FEIS, Appendix H).

DMMP BU features on the Neches River and compensatory mitigation east of Sabine Lake are expected to have long-term beneficial effects on water quality and terrestrial and aquatic habitats. Both entail the restoration of large-scale areas of degraded marsh. Restored marshes would filter runoff from surrounding uplands, and improved shallow-water habitat would encourage the growth of additional submerged aquatic vegetation. The restored marshes would increase available habitat for bird and wildlife species, and the improved shallow-water habitat would provide additional nursery areas and nutrients for aquatic organisms. Gulf shore nourishment is expected to have a long-term beneficial effect on piping plover Critical Habitat at Louisiana Point, by replacing shoreline habitat predicted to be lost as a result of plan implementation.

## Regional Economic Development (RED)

The RED account identifies changes in the distribution of regional economic activity. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population (ER 1105-2-100). With the value of the current 40-foot SNWW channel to the region, it is expected that the Recommended Plan of deepening the channel for navigational efficiency and safety would increase benefits to the region. Even with the implementation of the Recommended Plan, the study area would continue to have large industrial facilities and would not result in negative impacts to the local economy. During project construction, the study area may have a slight increase in construction employment and local purchases of construction materials but would be temporary, if any change at all. The primary economic bases of the study area include petrochemical processing, construction, mineral extraction, tourism, commercial fishing, and agriculture. As a result of the Recommended Plan, the positive economic effects to the study area would be moderate at the least and substantial at best. A detailed overview of RED is included in the Economic Appendix.

## Other Social Effects

The other social effects account identifies the plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts (ER 1105-2-100). The Recommended Plan would likely not have an effect on population growth trends within the study area. As a result of the Recommended Plan, demand for community facilities, services, and housing would not increase in the study area. The population living within the study area is primarily composed of White persons (59.6 percent), followed by Black or African American persons (26.7 percent), and Hispanic or Latino

persons (9.6 percent). The proposed project would not be located within a minority area. The minority and low-income populations living within the study area would likely experience no adverse changes to the demographic, economic, or community cohesion characteristics within their respective neighborhoods as a result of the Recommended Plan.

The construction of the Recommended Plan would have minimal negative effects on recreation within the study area, and proposed BU of dredged material from the construction of the Recommended Plan are expected to have beneficial impacts to recreational activities by providing additional habitats important to current sportfishing, recreational fishing, wildlife watching, and hunting.

# V. ECONOMIC EVALUATION OF ALTERNATIVES

## V.A OVERVIEW

This chapter presents the economic analysis for proposed project modifications to the existing 40-foot SNWW channel. The project benefits were evaluated for deepening and widening the channels to Port Arthur and Beaumont and are based on reductions in transportation costs generated from more-efficient vessel loading and from reductions in vessel delays. Improvements to the 30-foot Sabine River Channel to Orange were not evaluated at this time due to the expectation of continued low utilization of the existing project depth.

## V.B SCREENING PROCESS

Deepening benefits were calculated for SNWW depth alternatives of 45, 46, 47, 48, 49, and 50 feet. Determination of the depths evaluated was based on the cost-benefit results of the alternative screening and input from the Sponsor. Widening benefits for deep-draft traffic were also evaluated. Evaluation of widening alternatives was based on data obtained from vessel simulation modeling conducted by the ERDC. The alternatives were subsequently screened based on comparison of associated vessel delay costs and the initial project construction cost estimates. The ERDC model results, transportation cost outputs, project construction costs, and anticipated environmental effects identified the optimal choice of plans. Benefits were calculated for incremental widening and for holding area alternatives and are based on comparison of transit times between project alternatives. The calculations were made using the HarborSym economic traffic model.

### Total Tonnage

The SNWW experienced strong growth over the past decade, with total tonnage increasing from an average of 108 million short tons for 1995–1997 to 138 million for 2005–2007. In 2007, the SNWW ranked 4th in the U.S. in terms of total tonnage. As individual ports, Beaumont ranked 5th with 81.4 million short tons. Port Arthur's 2007 tonnage totaled 29.3 million short tons with a ranking of 28th. Channel to Orange tonnage totaled 682,000 in 2007. Table V-1 presents SNWW 1970–2007 total tonnage and principal deep-draft movements. Approximately 60 percent of the SNWW tonnage total consists of deep-draft movements. The remaining 40 percent consists of shallow-draft GIWW-related traffic. Table V-2 displays Sabine-Neches Canal 1970–2007 shallow-draft GIWW tonnage and the relative percentage of shallow-draft to total tonnage. For 2007, nearly 30 million short tons of the 59.7 million shallow-draft total (Table V-2) were transported through SNWW facilities. Beaumont's shallow-draft barge tonnage totaled 21.2 million short tons with Port Arthur's 8.3 million, Orange's 0.7 million, and Sabine Pass 0.9 million. The remaining 30.3 million short tons of 2007 shallow-draft barge traffic consisted of "through movements" between the Lower Mississippi River and Houston and points westward. In reviewing trends for commodities presently or anticipated to be constrained, the initial focus was on the commodity groups displayed in Table V-1.

Table V-1
SNWW Total Tonnage and Major Commodity Tonnage
(1,000s of Short Tons)

| Year | Total Tonnage | Total Deep-Draft Tonnage* | Principal Deep-Draft Commodities | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Crude Petroleum | | Petroleum Products | | Chemical Products | | Bulk Grain Exports |
| | | | Imports | Coastwise | Imports | Exports | Imports | Exports | |
| 1970 | 79,291 | 35,696 | 9 | 9,217 | 280 | 827 | 72 | 336 | 1,786 |
| 1975 | 79,296 | 41,134 | 13,820 | 3,102 | 177 | 256 | 42 | 310 | 2,926 |
| 1980 | 108,124 | 52,560 | 28,640 | 3,082 | 715 | 2,359 | 648 | 634 | 1,843 |
| 1985 | 70,239 | 39,169 | 22,627 | 1,835 | 2,516 | 1,514 | 267 | 707 | 1,642 |
| 1990 | 90,819 | 36,175 | 20,348 | 2,921 | 2,198 | 1,635 | 34 | 546 | 2,090 |
| 1993 | 95,418 | 46,990 | 32,639 | 81 | 2,656 | 3,260 | 25 | 537 | 3,471 |
| 1994 | 99,675 | 49,775 | 37,226 | 225 | 1,859 | 3,092 | 49 | 577 | 2,303 |
| 1995 | 103,254 | 52,959 | 38,743 | 187 | 1,304 | 4,258 | 33 | 725 | 1,712 |
| 1996 | 103,262 | 54,863 | 40,930 | 971 | 1,473 | 3,930 | 48 | 777 | 1,038 |
| 1997 | 116,012 | 67,553 | 51,142 | 81 | 2,470 | 4,595 | 33 | 1,101 | 1,370 |
| 1998 | 115,935 | 70,351 | 53,877 | 38 | 3,491 | 4,329 | 140 | 966 | 910 |
| 1999 | 114,393 | 69,259 | 53,834 | 86 | 3,627 | 3,307 | 449 | 753 | 936 |
| 2000 | 126,285 | 83,385 | 67,187 | 149 | 3,051 | 4,043 | 619 | 1,469 | 894 |
| 2001 | 128,944 | 80,950 | 64,226 | 127 | 2,734 | 5,120 | 754 | 1,296 | 858 |
| 2002 | 135,088 | 87,081 | 66,383 | 133 | 5,028 | 5,635 | 683 | 1,587 | 835 |
| 2003 | 143,923 | 92,563 | 70,158 | 195 | 5,187 | 6,573 | 434 | 1,555 | 1,125 |
| 2004 | 150,297 | 94,823 | 69,875 | 134 | 6,002 | 7,152 | 656 | 2,104 | 1,329 |
| 2005 | 134,695 | 82,925 | 59,691 | 165 | 5,349 | 6,354 | 1,084 | 1,891 | 1,081 |
| 2006 | 138,065 | 81,640 | 57,616 | 139 | 3,819 | 6,823 | 1,244 | 2,904 | 1,214 |
| 2007 | 140,967 | 81,282 | 56,088 | 217 | 3,744 | 6,608 | 955 | 3,169 | 1,632 |

Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1970–2007 (USACE, 2007a).
*Includes commodities in addition to what is shown.

Table V-2
SNWW Shallow-Draft Port and GIWW Through Tonnage,
Deep-Draft Total Tonnage, and Shallow-Draft Percentage of Total Tonnage
(1,000s of short tons)*

| Year | Shallow-Draft Port Tonnage and GIWW Through Tonnage | Deep-Draft Tonnage | SNWW Total | Shallow-Draft Percent of Total Tonnage (%) |
|---|---|---|---|---|
| 1970 | 43,595 | 35,696 | 79,291 | 55 |
| 1975 | 38,162 | 41,134 | 79,296 | 48 |
| 1980 | 55,564 | 52,560 | 108,124 | 51 |
| 1985 | 31,070 | 39,169 | 70,239 | 44 |
| 1990 | 54,644 | 36,175 | 90,819 | 60 |
| 1995 | 50,295 | 52,959 | 103,254 | 49 |
| 1996 | 48,399 | 54,863 | 103,262 | 47 |
| 1997 | 48,459 | 67,553 | 116,012 | 42 |
| 1998 | 45,584 | 70,351 | 115,935 | 39 |
| 1999 | 45,134 | 69,259 | 114,393 | 39 |
| 2000 | 42,900 | 83,385 | 126,285 | 34 |
| 2001 | 47,902 | 81,998 | 128,944 | 37 |
| 2002 | 48,007 | 87,081 | 135,088 | 36 |
| 2003 | 51,360 | 92,563 | 143,923 | 36 |
| 2004 | 55,474 | 94,823 | 150,297 | 37 |
| 2005 | 51,770 | 82,925 | 134,695 | 38 |
| 2006 | 56,646 | 81,421 | 138,067 | 41 |
| 2007 | 59,685 | 81,282 | 140,967 | 42 |

Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1970–2007 (USACE, 2007a).
*Includes intraport movements.

### Crude Petroleum

SNWW's 2002–2006 crude petroleum waterborne imports comprised 12 percent of U.S. and 18 percent of Petroleum Administration Defense District (PADD III) imports. The SNWW is contained in the U.S. Gulf Coast (PADD III), which includes the states of Texas, Louisiana, Arkansas, Mississippi, Alabama, and New Mexico. The U.S. Gulf Coast leads the Nation in refinery capacity, with 41 percent of the Nation's crude oil distillation capacity, and one-half of the Gulf Coast refinery capacity is in Texas and the remainder is in Louisiana. The Gulf Coast is also the Nation's leading supplier of refined products. Table V-3 displays SNWW 1985–2007 crude petroleum imports and its share of the national and regional totals.

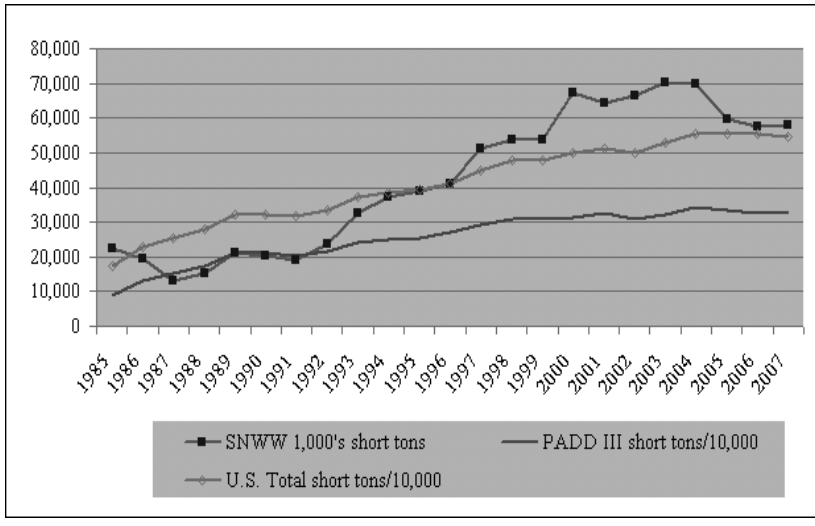
Table V-3
Comparison of SNWW and Regional and
National Totals, Crude Petroleum Imports
(1,000s of short tons)

| Year | SNWW Imports | PADD III Imports | U.S. Total Imports | SNWW Percentage of PADD III | SNWW Percentage of U.S. Total |
|---|---|---|---|---|---|
| 1985 | 22,627 | 90,372 | 175,095 | 25.0 | 12.9 |
| 1986 | 19,576 | 133,107 | 228,552 | 14.7 | 8.6 |
| 1987 | 13,119 | 153,901 | 255,670 | 8.5 | 5.1 |
| 1988 | 15,173 | 172,256 | 280,112 | 8.8 | 5.4 |
| 1989 | 21,224 | 209,622 | 319,641 | 10.1 | 6.6 |
| 1990 | 20,348 | 212,613 | 322,433 | 9.6 | 6.3 |
| 1991 | 19,245 | 203,992 | 316,310 | 9.4 | 6.1 |
| 1992 | 23,613 | 216,745 | 333,666 | 10.9 | 7.1 |
| 1993 | 32,639 | 241,614 | 371,267 | 13.5 | 8.8 |
| 1994 | 37,226 | 251,394 | 386,381 | 14.8 | 9.6 |
| 1995 | 38,743 | 253,200 | 395,484 | 15.3 | 9.8 |
| 1996 | 40,930 | 272,769 | 411,824 | 15.0 | 9.9 |
| 1997 | 51,142 | 292,282 | 449,961 | 17.5 | 11.4 |
| 1998 | 53,877 | 309,147 | 476,231 | 17.4 | 11.3 |
| 1999 | 53,834 | 308,707 | 477,592 | 17.4 | 11.3 |
| 2000 | 67,187 | 312,288 | 497,547 | 21.5 | 13.5 |
| 2001 | 64,226 | 324,094 | 510,298 | 19.8 | 12.6 |
| 2002 | 66,383 | 310,218 | 499,999 | 21.4 | 13.3 |
| 2003 | 70,158 | 323,123 | 528,703 | 21.7 | 13.3 |
| 2004 | 69,875 | 342,238 | 553,337 | 20.4 | 12.7 |
| 2005 | 59,691 | 335,075 | 553,923 | 17.8 | 10.8 |
| 2006 | 57,615 | 327,715 | 553,489 | 17.6 | 10.4 |
| 2007 | 56,078 | 305,732 | 548,742 | 18.3 | 10.2 |

Source: USACE (2007a) and Energy Information Administration (EIA, 2008). The U.S., PADD III, and SNWW percentages were compiled from EIA 2008.

Although SNWW tonnage exhibits more variance than the region and the Nation, short-term expectations are that SNWW imports would grow at rates comparable to or higher than regional and national trends. Long-term expectations are that SNWW imports would grow at rates comparable to the regional and national trends. These expectations are based on analysis of long-term historical trends and the study area's established infrastructure of regional and national pipeline distribution links. While SNWW 2005–2007 import volumes are down, Figure V-1 shows that SNWW imports from 1992 through 2007 grew at higher rates than the region or the Nation. In comparison to other Texas Gulf Coast ports, SNWW 2000–2007 crude petroleum imports volumes exceeded other ports by nearly 35 percent. Additionally, recent increases in SNWW refinery capacity indicate the region would regain an increasing share of U.S. and PADD III totals.

Figure V-1
U.S. and Sabine-Neches Crude Oil Imports, 1980–2007




SNWW refinery capacity presently represents 6 percent of the U.S. total. Specific capacities are 572,000 barrels per calendar day for Port Arthur and 577,000 for Beaumont (Table V-4). SNWW capacity levels for 2009 are presently 12 percent higher than in 2004, and 31 percent higher than in 1994. In December 2007, Motiva announced plans for a 325,000-barrel-per-day refinery expansion in Port Arthur. The expansion would increase the refinery's crude oil throughput capacity to 600,000 barrels per day, making it the largest refinery in the U.S. and one of the largest in the world. The ExxonMobil Beaumont refinery is presently the third largest refinery in the world. As a result of these additions, SNWW's combined capacity would represent the largest concentration in the State of Texas

The SNWW terminals transport 400,000 barrels per day of waterborne crude oil via pipelines to inland refineries including refineries in Texas, Louisiana, Oklahoma, Ohio, Arkansas, and Kentucky (Martin Associates, 2006). Colonial Pipeline delivers over two million barrels per day of refined products via pipeline serving Louisiana, Alabama, Mississippi, Georgia, Tennessee, South Carolina, North Carolina, Virginia, Maryland, Delaware, and New Jersey. Explorer Pipeline delivers 650,000 barrels per day of refined products via pipeline serving Texas, Oklahoma, Missouri, Illinois, and Indiana. Products, such as gasoline, heating oil, diesel, and jet fuel, are transported from the Gulf Coast to the East Coast and the Midwest through existing pipeline networks. Product traffic also moves between U.S. ports by coastwise tankers and inland waterway barges. The SNWW refineries supply 15 percent of the product on Colonial's system and 13 percent of the product on Explorer's system.

Table V-4
SNWW Atmospheric Crude Oil Distillation Capacity
(1,000s of Barrels per Calendar Day)

| Period | Beaumont | Port Arthur | Percent of Texas | Percent of U.S. | U.S. Total |
|---|---|---|---|---|---|
| 1994 | 420.5 | 454.0 | 19.6 | 5.8 | 15,034 |
| 1999 | 438.5 | 513.5 | 22.7 | 5.9 | 16,261 |
| 2000 | 450.0 | 523.0 | 23.0 | 5.9 | 16,512 |
| 2001 | 500.0 | 521.0 | 23.8 | 6.2 | 16,595 |
| 2002 | 500.0 | 527.0 | 22.9 | 6.1 | 16,785 |
| 2003 | 510.0 | 523.6 | 23.8 | 6.1 | 16,757 |
| 2004 | 505.0 | 523.6 | 22.9 | 6.1 | 16,974 |
| 2005 | 540.0 | 582.0 | 24.2 | 6.5 | 17,196 |
| 2006 | 545.0 | 580.5 | 24.0 | 6.5 | 17,383 |
| 2007 | 545.0 | 590.5 | 24.0 | 6.5 | 17,436 |
| 2008 | 574.0 | 576.5 | 24.0 | 6.5 | 17,436 |
| 2009 | 572.0 | 576.5 | 24.0 | 6.5 | 17,436 |

Source: USACE (2007a) and EIA (2008).
*Variations occur in annual volumes due to temporary shutdowns and routine maintenance

## Port Arthur and Beaumont Tonnage Bases

Distributions of Port Arthur's and Beaumont's 1999–2007 deep-draft tonnages are displayed in tables V-5 and V-6. Port specific data for years prior to 1999 are not included in these tables due to Navigation Data Center (NDC) reporting problems which resulted in a portion of Beaumont tonnage being attributed to Port Arthur. Crude petroleum imports and petroleum and chemical product imports and exports comprised 80 percent of Port Arthur's 2007 total oceangoing tonnage. The 1999–2007 average was 83 percent. The remaining percent of tonnage consisted of imports of crude material and manufactured goods and domestic coastwise shipment of gasoline and chemical shipments.

As shown in Table V-5, Port Arthur's highest growth rates were for product exports and domestic coastwise. Analysis of the commodity-specific data showed that 81 percent of Port Arthur's 2005–2007 petroleum product exports were comprised of petroleum coke. Port Arthur's petroleum coke exports make up 11 percent of the U.S. total.[1] Plans for a new 45,000 barrels-per-day "delayed coker" in Port Arthur were announced in February 2008, with construction anticipated to be complete by 2011 (*Port Arthur News*, 2008). Delayed cokers are used to convert residual oils into gasoline and diesel oil. Delayed coker feed originates from the crude oil, and the effect of new construction would be used to produce residual fuel and other products. Demand for petroleum coke has been noted to be increasing due to growing use of heavy crude oil.

[1] EIA website data shows Port Arthur's 2007 annual petroleum coke imports exceeding 250,000 short tons.

Table V-5
Port Arthur Total Tonnage and Major Commodity Tonnage, 1999–2007
(1,000s of short tons)

| Year | Total | Total Deep-Draft | Total Coastwise | Crude Petroleum Imports | Petroleum Products | | Chemical Products | | Crude Materials Except Fuels | | Primary Manufactured Goods | | Major Group Total | % of Deep-Draft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Imports | Exports | Imports | Exports | Imports | Exports | Imports | Exports | | |
| 1999 | 18,308 | 12,073 | 659 | 7,977 | 604 | 1,136 | 5 | 349 | 566 | 21 | 617 | 107 | 12,041 | 100 |
| 2000 | 21,387 | 13,730 | 817 | 8,862 | 1,121 | 1,502 | 0 | 307 | 206 | 7 | 743 | 107 | 13,672 | 100 |
| 2001 | 22,802 | 16,173 | 1,043 | 11,064 | 641 | 2,327 | 25 | 136 | 131 | 0 | 665 | 101 | 16,133 | 100 |
| 2002 | 22,676 | 16,640 | 1,422 | 9,013 | 997 | 3,143 | 89 | 176 | 919 | 2 | 641 | 194 | 16,596 | 100 |
| 2003 | 27,170 | 21,044 | 2,577 | 11,987 | 1,152 | 3,734 | 60 | 210 | 481 | 20 | 557 | 128 | 20,906 | 99 |
| 2004 | 27,570 | 20,758 | 1,804 | 10,015 | 2,150 | 4,255 | 225 | 889 | 531 | 41 | 564 | 106 | 20,580 | 99 |
| 2005 | 26,385 | 19,856 | 1,803 | 9,320 | 2,205 | 3,858 | 194 | 998 | 558 | 14 | 710 | 84 | 19,744 | 99 |
| 2006 | 28,403 | 21,209 | 2,323 | 10,627 | 1,144 | 4,391 | 111 | 1,330 | 566 | 54 | 542 | 46 | 21,134 | 100 |
| 2007 | 29,067 | 20,977 | 3,330 | 10,334 | 792 | 3,978 | 97 | 1,525 | 513 | 64 | 122 | 35 | 20,790 | 99 |
| Average Annual Growth Rate (1999–2007) | | | | | | | | | | | | | | |
| | 5.9% | 7.1% | 22.4% | 3.3% | 3.4% | 17.0% | 44.9% | 20.2% | –1.2% | 14.9% | –18.3% | –13.0% | 7.1% | –0.1% |

Source: USACE (2007a).

Table V-6
Beaumont Total Tonnage and Major Commodity Tonnage, 1999–2007
(1,000s of short tons)

| Year | Total Tonnage | Deep-Draft | Coastwise | Crude Petroleum Imports | Petroleum Products Imports | Petroleum Products Exports | Chemical Products Imports | Chemical Products Exports | Crude Materials, Except Fuels Imports | Crude Materials, Except Fuels Exports | Primary Manufactured Goods Imports | Primary Manufactured Goods Exports | Grain Exports | Major Group Total | % of Deep Draft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 69,406 | 57,186 | 3,330 | 45,857 | 3,023 | 2,170 | 444 | 404 | 115 | 446 | 281 | 8 | 936 | 57,014 | 100 |
| 2000 | 76,894 | 69,655 | 3,046 | 58,325 | 1,930 | 2,541 | 619 | 1,162 | 413 | 410 | 133 | 1 | 894 | 69,474 | 100 |
| 2001 | 79,131 | 64,777 | 2,793 | 53,162 | 2,093 | 2,793 | 729 | 1,160 | 622 | 165 | 103 | 6 | 858 | 64,484 | 100 |
| 2002 | 85,911 | 70,441 | 2,712 | 57,370 | 4,031 | 2,492 | 594 | 1,411 | 394 | 14 | 204 | 14 | 835 | 70,071 | 99 |
| 2003 | 87,541 | 71,519 | 2,732 | 58,171 | 4,035 | 2,839 | 374 | 1,345 | 583 | 73 | 115 | 36 | 1,125 | 71,428 | 100 |
| 2004 | 91,968 | 74,065 | 3,191 | 59,860 | 3,852 | 2,897 | 431 | 1,215 | 559 | 104 | 420 | 1 | 1,329 | 73,859 | 100 |
| 2005 | 78,887 | 63,069 | 2,967 | 50,371 | 3,144 | 2,496 | 890 | 893 | 624 | 106 | 471 | 12 | 1,082 | 63,056 | 100 |
| 2006 | 79,486 | 60,431 | 3,115 | 46,988 | 2,676 | 2,432 | 1,133 | 1,574 | 550 | 243 | 364 | 8 | 1,214 | 60,296 | 100 |
| 2007 | 80,062 | 60,305 | 3,261 | 45,776 | 2,952 | 2,713 | 858 | 1,644 | 617 | 421 | 173 | 86 | 1,632 | 60,133 | 100 |
| Average Annual Growth Rate (1998–2007) | | | | | | | | | | | | | | | |
| | 1.8% | 0.7% | –0.3% | 0.0% | –0.3% | 2.8% | 8.6% | 19.2% | 23.4% | –0.7% | –5.9% | 34.5% | 7.2% | 0.7% | 0.0% |

Source: USACE (2007a).

Analysis of Port Arthur tonnage also shows significant increases in chemical imports and exports. Import growth is associated with ammonia and sulphuric acid. Increases in exports are associated with metallic salts and hydrocarbons. Twenty percent of 2005–2007 U.S. metallic salts export tonnage was exported from Port Arthur. Metallic salts and organic compounds are used in the production of paints and solvents, paper and wood products, cleaning products, and various chemical products, and more recently in the production of nylon in Latin America and China. The increase in Port Arthur's metallic salt exports experienced since 2004 is associated with the completion of a 266,000-metric-ton-per-year cyclohexane facility in the Taylor Bayou section of Port Arthur in early 2004. Port Arthur's steady volume of coastwise tonnage shown in Table V-5 is associated with continuing shipments of gasoline, distillate fuel oil, and petroleum coke between Port Arthur and other deep-draft U.S. ports.

Port Arthur's crude petroleum imports remained relatively flat since 2001 but steady. In 2009, Port Arthur's refinery capacity was nearly 13 percent higher than in 2004. Additionally, Motiva announced plans for a 325,000 barrels-per-day refinery expansion in Port Arthur in December 2007. Port Arthur's other commodity movements include imports of crude materials and primary manufactured goods. In 2007, crude material imports consisted of 513,000 short tons of limestone, sand, and gravel. For the most recent 10-year period, crude material volumes averaged nearly 500,000 short tons annually. In 2007, imports of primary manufactured goods were down from 1999–2006 annual volumes that exceeded 500,000. Port Arthur's crude material and primary manufacturing facilities are located on the Sabine-Neches Canal near mile 32, and its crude petroleum and product terminals are in the Taylor Bayou basin.

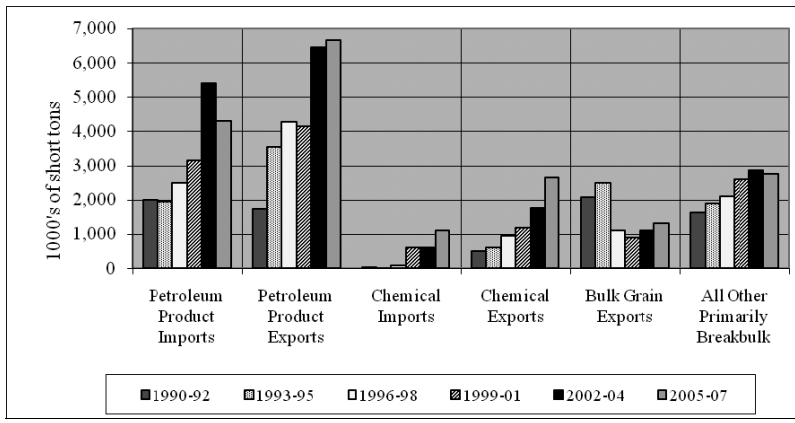
Examination of Beaumont's tonnage showed that crude petroleum imports and imports and exports of petrochemical products comprised 89 percent of Beaumont's 2007 total oceangoing tonnage. For 2005–2007, 4 percent of U.S. nitrogenous, potassic, and fertilizer mixes were exported from Beaumont. For 2005–2007, the Beaumont share of fertilizer exports increased to 12.5 percent. Beaumont's other commodity movements include grain exports, gasoline and liquid sulphur coastwise shipments, and imports and exports of crude material and manufactured goods. Beaumont's crude material imports, which include limestone, sand, and gravel, comprised 1 percent of the 2005–2007 U.S. total. Beaumont's imports of manufactured goods for 2005–2007 consisted of 336,000 short tons of iron and steel products, representing 1 percent of the U.S. total. Coastwise shipments for 2005–2007 averaged 2.4 million short tons and included 1.3 million short tons of gasoline and 720,000 short tons of chemicals. Liquid sulphur comprised 85 percent of coastwise chemical shipments. For the period 1999–2007, sulphur shipments ranged from a low of 506,000 short tons in 2004 to a high of 679,000 in 2001. In 2007, Beaumont's sulphur shipments totaled 553,000 short tons.

While crude petroleum growth dominates SNWW total tonnage, significant increases in other commodities are notable. Figure V-2 displays comparison of SNWW 1990–1992 through 2005–2007 volumes by major commodity group.[2] Petroleum and chemical product imports and exports, breakbulk

[2] Data for the years prior to 1999 are not presented for the individual ports. The Bureau of Census data contained in the *Waterborne Commerce of the United States* does not reflect correct allocation of Port Arthur and Beaumont traffic between the ports. Some of Beaumont's traffic was recorded under Port Arthur due to a Bureau of Census error. Total tonnage values were found to be correct for the SNWW, but the individual counts for years prior to 1999 were found to be unreliable.

imports and exports, and bulk grain exports are shown. Tonnage increased for all groups except grain. In spite of declines, grain exports have increased marginally since the middle 1990s, and Beaumont's 2005–2007 wheat exports represent 5 percent of total U.S. wheat exports. The U.S. Department of Agriculture (USDA) forecast shows a constant export level of 1,075 million bushels for 2014–2015 through 2018–2019, with the forecast volume down by 17 percent from the 2007/2008 high of 1,264 million bushels.

Figure V-2
SNWW Foreign Imports and Exports by Major Group (Excluding Crude Petroleum),
1990–1992 to 2005–2007 Distribution




## Expansion of the Deep-Draft Traffic Historical Base

In addition to its large existing base of crude petroleum, petroleum and chemical products, and dry bulk deep-draft cargoes, the without-project future condition includes operation of three LNG terminals. LNG is expected to play an increasingly important role in the natural gas industry and global energy markets in the next several years and in the long-term future. The combination of higher natural gas prices, lower LNG costs, rising gas import demand, and the desire of gas producers to monetize their gas reserves is setting the stage for increased global LNG trade. *The Global Liquefied Natural Gas Market: Status & Outlook*, which characterizes the global LNG market, recent trends, and future prospects in the LNG market, was evaluated in relationship to national trends and anticipated market shares.

### Liquefied Natural Gas Traffic

LNG will play an increasingly important role in the natural gas industry and global energy markets in the next several years. In 2007, the U.S. imported an estimated 771 billion cubic feet (Bcf) or 21.2 million short tons of LNG. Shipments to existing U.S. facilities in 2006–2008 came from Trinidad (64 percent), North Africa (22 percent), Western Africa (11 percent), Norway (2 percent), and Middle East (1 percent).

During the early 2000s, LNG permits were approved for the Sabine Pass, Golden Pass, and Port Arthur terminals. The SNWW LNG facilities are located in the Sabine Pass Channel and Port Arthur Canal reaches; these reaches are presently 500 feet and would remain so under the without-project future. LNG vessels using the SNWW would be subject to strict USCG regulations and to local pilot rules and, therefore, would not have the opportunity to meet other vessels or barges. The USCG regulations require that a safety zone is in place 2 miles ahead of a loaded LNG vessel and 1 mile astern of the vessel while transiting. LNG vessels using the SNWW would be subject to this rule. Even in the absence of the safety concerns inherent to LNG, the beams of LNG tankers would result in vessel meeting restrictions; however, all LNG vessel movements would be subject to one-way traffic. Operation of the LNG terminals is part of the without-project future condition.

Phase I of the Sabine Pass terminal, which is operated by Cheniere, is complete and the first vessels arrived in April 2008. Phase 1 consists of 10.1 Bcf of LNG storage in three tanks, each with an LNG capacity of 160,000 cubic meters, and a maximum continuous regasification rate of 2.6 billion cubic feet per day (Bcf/d). Phase 2 will be built in stages. The first stage of Phase 2 includes the addition of a fourth and fifth storage tank, additional vaporizers that would bring the maximum continuous regasification rate up to 4.0 Bcf/d with a peak sendout capacity of 4.3 Bcf/d. In the future stages of Phase 2, a sixth storage tank may be added and related facilities would bring the total LNG storage volume to 20.2 Bcf.

Construction of the Golden Pass LNG terminal is currently in progress and is scheduled for completion by 2011. The Golden Pass facility, which is being constructed by ExxonMobil and Conoco Phillips, will consists of a dock and unloading facilities, five LNG storage tanks (≈17 Bcf), and vaporization capacity of 2.7 Bcf/d. The Port Arthur project consists of two ship berths, three to six storage tanks (160,000 cubic meters), and vaporization capacity of 1.5–3 Bcf/d. The LNG for the Golden Pass terminal is anticipated to be supplied primarily from the Ras Laffan 3 and the Qatargas 3 projects in Qatar, which will produce and process natural gas from Qatar's offshore North Field.

Construction of the Port Arthur terminal has not started but is anticipated after 2012. The Port Arthur LNG terminal, constructed and operated by Sempra Energy, would be capable of delivering between 1.5 and 3 Bcf/d of natural gas. The terminal will include two unloading docks for ships and three to six full containment storage tanks and associated equipment in order to transform the LNG back to its gaseous state. As noted, construction of this third facility is planned for after 2012. At full utilization, Sabine Pass and Golden Pass could handle 2.05 trillion cubic feet (Tcf) annually. The Port Arthur terminal annual capacity would increase regional capacity by 2.97 Tcf without pushing peak capacity. Table V-7 shows SNWW current and future capacity volumes.

Table V-7
SNWW Economic Analysis, U.S. Liquefied Natural Gas
Facility Expansions and New Construction
(Given Current FERC Approval and Existing Facility Status)

| Facility | Storage Capacity (Bcf) | Output Capacity (Bcf/d) | Completion Date |
|---|---|---|---|
| Sabine Pass | | | |
| Phase I | 10.1 | 2.6 | 2008 |
| Phase II | 10.1 | 1.4 | - |
| Total | 20.2 | 4.0 | |
| Golden Pass | 17.0 | 2.7 | 2010 |
| Port Arthur | 20.0 | 3.0 | 2012 |
| Total SNWW | 57.2 | 9.7 | |

There are about 40 LNG terminals that are before the FERC being discussed by the LNG industry for North America. Six terminals are already operating on the East Coast, Puerto Rico, and Alaska. There are seven onshore LNG terminals in the continental U.S. These are located in Everett, Massachusetts; Lake Charles, Louisiana; Elba Island, Georgia; Cove Point, Maryland; Cameron, Louisiana; Sabine, Texas; and Freeport, Texas. The Cameron, Sabine, and Freeport terminals are new. In addition to these three terminals, the Northeast Gateway port offshore Massachusetts received its first supplies in 2008. With these four terminals now operational, U.S. capacity to receive LNG imports has increased from approximately 5.0 Bcf/d at the end of 2007 to 14.5 Bcf/d per day at the end of 2008. The Sabine Pass facility adds 2.6 Bcf and about 18 percent to U.S. Bcf capacity. Table V-8 displays 2007–2008 U.S. LNG capacity and shows 2003–2009 imports. The Energy Information Administration (EIA) reported total LNG import shipments of 771 Bcf in 2007 to these terminals, with each importing similar volumes – each between 20 and 30 percent of the total. Imports in 2008 only reached 351 Bcf.

Despite declines in 2008, the EIA expects U.S. LNG imports to increase to about 500 Bcf in 2009, up from 352 Bcf in 2008, and rise to about 740 Bcf in 2010. The 2008 fall in imported natural gas to the U.S. reflects the increased need for natural gas in other countries willing to compete for available global supplies. While U.S. imports increased in 2009 over 2008 levels, U.S. LNG import growth this year has been constrained because of increased LNG demand in Europe and delays and maintenance to new and existing LNG liquefaction capacity. With limited natural gas storage availability, recent data suggest that European inventory levels are now nearing capacity. The expectation is that LNG shipments may be redirected to U.S. ports in the coming months as prices in the European market become less attractive to LNG suppliers.

The *2009 Annual Energy Outlook* (AEO2009) forecast shows U.S. LNG imports reaching 2007 levels again in 2014 and peaking at 1,380 Bcf in 2020. Between 2020 and 2030, imports are forecasted to turn down once again. Figure V-3 shows the Department of Energy's 2006–2030 U.S. LNG import forecast. Identification of the region's future share of the LNG market is obviously subject to uncertainty. The SNWW facilities have the advantage of the FERC approval, relatively high levels of public and political

support, and locational advances in terms of access to the U.S. Gulf. For the analysis, 25 percent of U.S. waterborne LNG imports market was used for SNWW. The SNWW forecast is included in Table V-9.

Table V-8
LNG Existing and Under Construction Terminals

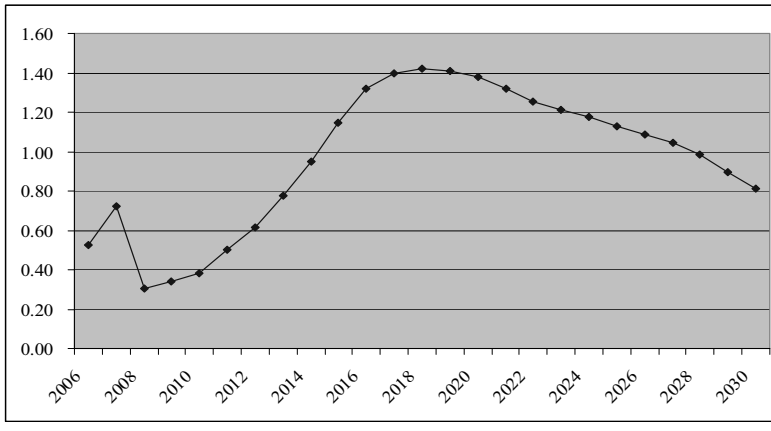
| | Total Capacity (Bcf/d) | | | Total Throughput (Imports Bcf) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location | 2007 | 2008 | 2012 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
| Everett | | 0.7 | | 158.3 | 173.8 | 168.5 | 176.1 | 183.6 | 165.3 |
| Cove Point | | 1.8 | | 66.1 | 209.3 | 221.7 | 116.6 | 148.2 | 25.9 |
| Elba Island | | 0.8 | | 43.9 | 105.2 | 132.1 | 146.8 | 170.2 | 135.7 |
| Lake Charles | | 1.8 | | 238.2 | 163.7 | 103.8 | 143.6 | 251.5 | 8.9 |
| NE Gateway | | 0.4 | | – | – | 5.2 | 0.5 | 17.3 | – |
| Gulf Gateway | | 0.4 | | – | – | – | – | – | 0.9 |
| Altamira | | 0.7 | | – | – | – | – | – | – |
| Sabine Pass | | 2.6 | 4.0 | – | – | – | – | – | 9.2 |
| Cameron | | 1.8 | | – | – | – | – | – | – |
| Freeport | | 1.5 | | – | – | – | – | – | – |
| Golden Pass | | – | 2 | – | – | – | – | – | – |
| Gulf LNG | | – | 1.5 | – | – | – | – | – | – |
| Neptune | | – | 0.5 | – | – | – | – | – | – |
| Canaport | | 1.0 | | – | – | – | – | – | – |
| Costa Azul | | 1.0 | 2.6 | – | – | – | – | – | – |
| Total | | 14.5 | 21.5* | 506.5 | 652.0 | 631.3 | 583.5 | 770.8 | 345.9 |
| Short Tons (millions) | | n/a | n/a | 15.6 | 22.2 | 16.6 | 18.6 | 21.2 | 10.7 |

Source: Compiled from U.S. Department of Energy data.
*Reflects inclusion of 2008 capacity.

## V.C COMMODITY AND FLEET FORECASTS

Commodity and fleet forecasts were prepared for SNWW crude petroleum, petroleum and chemical products, grain, iron and steel products, limestone and building materials, and LNG. The crude petroleum, petroleum, and chemical products forecasts are presented first, followed by discussion of the new LNG market and its tonnage forecast. Finally the grain, iron, metal products, and aggregate are presented. The remaining oceangoing commodity groups, which were found either not to be transported in draft constrained vessels at the current time or were of limited volumes, were analyzed in the aggregate. Estimation of total traffic was needed for the widening analysis and also provided critical input for the shore erosion effects evaluation performed by the ERDC.

Figure V-3
U.S. LNG Imports 2006–2030
Trillion of Cubic Feet




Source: U.S. Department of Energy (2009a).

Table V-9
U.S. and SNWW Liquefied Natural Gas Imports, 2005–2030
Updated June 2009

| | U.S. Total LNG Imports | | SNWW |
|---|---|---|---|
| Year | Trillion Cubic Feet | Waterborne Short Tons | LNG Forecast Short Tons |
| 2005 | 0.5661 | 16,566,000 | – |
| 2006 | 0.5840 | 18,617,000 | – |
| 2007 | 0.7708 | 21,238,000 | – |
| 2015 | 1.1460 | 31,575,957 | 3,157,596 |
| 2019 | 1.4101 | 38,852,755 | 5,827,913 |
| 2020 | 1.3808 | 38,045,447 | 9,511,362 |
| 2025 | 1.1269 | 31,049,691 | 7,008,843 |
| 2029 | 0.8964 | 24,698,681 | 6,174,670 |
| 2030 | 0.8097 | 22,309,819 | 6,174,670 |
| 2039 | n/a | n/a | 6,174,670 |
| 2049 | n/a | n/a | 6,174,670 |
| 2059 | n/a | n/a | 6,174,670 |
| 2069 | n/a | n/a | 6,174,670 |

Source for U.S. Imports: U.S. Department of Energy (2009b).

National crude petroleum and petrochemical forecast data and general indicators were assessed in relationship to the study area's historical commodity-specific tonnage flows for the purpose of evaluating the relationship between historical U.S. tonnage volumes and study area tonnage. Assessment of the statistical variables associated with the U.S. and study area tonnage provides the analytical support needed to determine which forecasts furnish the best long-term estimation of future study area tonnage flows. The vessel fleet forecasts incorporate recent historical practices, which reflect continued and increased utilization of draft-constrained vessels, regardless of the proposed channel enlargement alternatives.

The outputs of the commodity and fleet projections were based on forecasts published in the EIA AEO2008 and AEO2009; Global Insight, *The U.S. Economy, The 30-Year Focus*, First Quarter 2008 and Second Quarter 2009; USDA *Agricultural Baseline Projection Tables, USDA Baseline Projections Report to 2019*, February 2009; and from indices developed from historical trend data. The forecasting methodologies, the distribution of tonnage by vessel class, and the determination of the number of vessel trips are discussed in the sections that follow.

Tables V-10 and V-11 summarize the forecasts for the major commodity groups evaluated for channel deepening. The Port Arthur forecast is shown in Table V-10 and Beaumont's forecast in Table V-11. Detailed discussions of the commodity forecasts are presented in the Economic Appendix. The following section presents SNWW vessel fleet data.

## Vessel Utilization Trends

The existing 40-foot project depth was designed to efficiently and safely accommodate vessels of approximately 40,000 DWT with loaded drafts of 36 feet. Since the authorization of the existing project, the size and draft of vessels using the waterway increased to meet the competitive demand for more-efficient movements. Table V-1 displays SNWW 1970–2007 total tonnage and principal deep-draft movements by major commodity group. Examination of SNWW historic traffic data showed that if deeper depths were available, a significant share of the vessels used in the transport of crude petroleum and petroleum products could be loaded to drafts over 40 feet. In addition, but to a lesser extent, examination of the 1995–2007 vessel sizes, loaded drafts, design drafts, and parcel sizes revealed that some of the vessels used to transport grain, chemical products, and breakbulk cargo, such as iron ore, metal products, and limestone and other aggregate, warranted additional analysis.

Analysis of the vessel fleets and utilization, and existing and future constraints associated with crude petroleum; petrochemical products, including LNG; grain; and aggregate products, such as iron ore, steel slab, limestone, and sand and gravel, provided the basis for identifying the commodities expected to be transported in vessels loaded to channel depths over 40 feet and estimating specific percentage utilization for channel depths over 40 feet. Additional considerations were foreign port depths and constraints such as the Panama Canal. Completion of the Panama Canal expansion, from its present width restriction of 106 feet and approximate loaded draft limit of 39.6 feet, in the year 2014 would allow for more fully loaded vessel movements from deepwater ports in Western Mexico, South America, and the Far East. The

canal expansion would accommodate maximum loaded drafts of 48 feet. Port depth, trade route, and historical vessel utilization data were used to identify the percentage of tonnage anticipated to benefit from the proposed SNWW depth increases.

Table V-10
Port Arthur Tonnage Evaluated for Channel Deepening*
(1,000s of short tons)

| Year | Crude Petroleum Imports | Petrochemicals | | | | | Breakbulk | | Liquefied Natural Gas Imports |
|---|---|---|---|---|---|---|---|---|---|
| | | Petroleum Products | | Chemical Products | | Coastwise* | Crude | Primary Manuf. | |
| | | Imports | Exports | Imports | Exports | Products | Materials | Goods | |
| 2001 | 11,064 | 641 | 2,327 | 25 | 136 | 1,043 | 131 | 665 | 0 |
| 2002 | 9,013 | 997 | 3,143 | 89 | 176 | 1,422 | 921 | 641 | 0 |
| 2003 | 11,987 | 1,152 | 3,734 | 60 | 210 | 2,577 | 501 | 557 | 0 |
| 2004 | 10,015 | 2,150 | 4,255 | 225 | 889 | 1,804 | 572 | 564 | 0 |
| 2005 | 9,320 | 2,205 | 3,858 | 194 | 998 | 1,803 | 572 | 710 | 0 |
| 2006 | 10,627 | 1,144 | 4,391 | 111 | 1,330 | 2,323 | 620 | 542 | 0 |
| 2007 | 10,334 | 772 | 3,978 | 97 | 1,525 | 3,330 | 577 | 122 | 0 |
| Port Arthur Tonnage Forecast** | | | | | | | | | |
| 2019 | 12,248 | 1,811 | 6,879 | 223 | 1,462 | 3,002 | 751 | 524 | 5,828 |
| 2029 | 13,663 | 2,027 | 9,013 | 246 | 1,872 | 3,754 | 873 | 608 | 6,175 |
| 2039 | 14,509 | 2,312 | 10,255 | 272 | 2,396 | 4,506 | 1,016 | 705 | 6,175 |
| 2040 | 14,800 | 2,589 | 11,619 | 301 | 2,647 | 4,977 | 1,181 | 818 | 6,175 |
| 2059 | 15,100 | 2,901 | 13,124 | 332 | 2,924 | 5,498 | 1,374 | 949 | 6,175 |
| 2069 | 15,469 | 3,250 | 14,850 | 367 | 3,229 | 6,073 | 1,598 | 1,102 | 6,175 |

*Includes coastwise crude petroleum shipments and receipts.

**Deepening benefits were calculated for a percentage of the tonnage presented in this table.
Discussion of the commodity-specific percentages is contained in the Economic Appendix (Appendix 2).

### Crude Petroleum Fleet

Crude petroleum growth dominates total tonnage for both Beaumont and Port Arthur. In a comparison of the relative port statistics, a greater percentage of crude tonnage is loaded to drafts of 38 feet or more for Port Arthur than for Beaumont. This is due to Port Arthur receiving a higher share of direct shipments from Mexico than Beaumont does. Generally, vessels would be loaded to deeper drafts for longer distance direct routes. In comparison, Beaumont receives a higher share of lightered tonnage from both lightened mother vessels and shuttles. While there are obvious cost incentives to load to the maximum allowable depth, in looking at average loaded drafts, the lightened mother vessels and shuttles were lighter than vessels associated with direct shipments. Port Arthur's petroleum refineries are located inside the Taylor Bayou complex. The maximum size using the Taylor Bayou facilities are in the 110,000 to 116,000 DWT range. While Port Arthur vessels are loaded to deeper draft, the Port Arthur fleet is smaller than Beaumont's in terms of DWT because the existing width at the mouth of Taylor Bayou and the configuration of the docks within Taylor Bayou limit the allowable vessel size.

Table V-11
Beaumont Tonnage Evaluated for Channel Deepening
(1,000s of short tons)

| | | Petrochemicals | | | | | | Breakbulk | |
|---|---|---|---|---|---|---|---|---|---|
| | | Petroleum Products | | Chemical Products | | | | | |
| Year | Crude Petroleum Imports | Imports | Exports | Imports | Exports | Coastwise* Products | Grain Exports | Crude Materials | Primary Manuf. Goods |
| 2001 | 53,162 | 2,093 | 2,793 | 729 | 1,160 | 2,793 | 858 | 787 | 103 |
| 2002 | 57,370 | 4,031 | 2,492 | 594 | 1,411 | 2,712 | 835 | 408 | 204 |
| 2003 | 58,171 | 4,035 | 2,839 | 374 | 1,345 | 2,732 | 1,125 | 656 | 115 |
| 2004 | 59,860 | 3,852 | 2,897 | 431 | 1,215 | 3,191 | 1,329 | 663 | 420 |
| 2005 | 50,371 | 3,144 | 2,496 | 890 | 893 | 2,967 | 1,082 | 730 | 471 |
| 2006 | 46.988 | 2,676 | 2,432 | 1,133 | 1,574 | 3,115 | 1,214 | 793 | 364 |
| 2007 | 47,776 | 2,948 | 2,713 | 858 | 1,644 | 3,261 | 1,632 | 1,038 | 173 |
| Beaumont Tonnage Forecast** | | | | | | | | | |
| 2019 | 81,980 | 3,362 | 4,586 | 967 | 1,787 | 4,899 | 2,129 | 1,106 | 428 |
| 2029 | 91,463 | 3,765 | 6,008 | 1,068 | 2,288 | 6,125 | 2,351 | 1,285 | 498 |
| 2039 | 97,152 | 4,293 | 7,458 | 1,180 | 2,928 | 7,351 | 2,597 | 1,495 | 579 |
| 2049 | 99,136 | 4,809 | 8,450 | 1,303 | 3,235 | 8,120 | 2,869 | 1,738 | 674 |
| 2059 | 101,149 | 5,387 | 10,738 | 1,439 | 3,573 | 8,970 | 3,169 | 2,022 | 784 |
| 2069 | 103,189 | 6,036 | 12,150 | 1,590 | 3,947 | 9,908 | 3,501 | 2,352 | 911 |

*Includes coastwise crude petroleum shipments and receipts.

**Deepening benefits were calculated for a percentage of the tonnage presented in this table.

Discussion of the commodity-specific percentages is contained in the Economic Appendix (Appendix 2).

Widening of the mouth of the entrance to Taylor Bayou would occur under the with-project future condition and this would allow better vessel maneuverability. Widening of the mouth was recommended as a result of the ERDC vessel simulation modeling. Port Arthur's breakbulk docks and new LNG facilities are located outside of the Taylor Bayou complex and are not subject to similar vessel beam and length restrictions. The maximum sized vessels using the Channel to Beaumont are in the 150,000 to 175,000 DWT class. The maximum length for that group is approximately 900 feet, with a corresponding beam width of 164 feet. Five percent of Beaumont's 2006 crude petroleum imports are associated with this group. Table V-12 displays Port Arthur's and Beaumont's 2002–2006 port-specific distributions by loaded draft. Distributions of Port Arthur and Beaumont crude oil imports by vessel DWT range are shown in tables V-13 and V-14.

Table V-12
SNWW Crude Petroleum Imports by Loaded Draft, 2002–2007

| Loaded Draft (feet) | Port Arthur Crude Petroleum Imports (%) | | | | | |
|---|---|---|---|---|---|---|
| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| <35 | 7.6 | 2.6 | 0.3 | 9.5 | 5.0 | 4.6 |
| 35–37 | 10.5 | 8.6 | 0.0 | 47.6 | 56.7 | 3.2 |
| >37 | 81.9 | 88.8 | 99.7 | 42.9 | 38.3 | 92.2 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | Beaumont Crude Petroleum Imports (%) | | | | | |
| <35 | 10.5 | 10.5 | 12.7 | 10.3 | 17.2 | 7.3 |
| 35–37 | 27.3 | 27.0 | 23.5 | 19.1 | 19.3 | 22.6 |
| >37 | 62.2 | 62.5 | 63.8 | 70.6 | 63.5 | 70.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE (2007a). The Lloyd's Register-Fairplay was used to obtain the vessel DWT and associated characteristics.

Table V-13
Port Arthur Crude Petroleum Imports 2002–2007, Percentage of Imports
by Vessel DWT and Design Draft and Year Built

| DWT | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| ≤50,000 | 0.1 | 0.7 | 0.7 | 1.5 | 0.0 | 0.9 |
| 50,000–74,500 | 55.5 | 6.2 | 3.0 | 3.1 | 4.5 | 7.9 |
| 75,000–84,900 | 14.5 | 75.8 | 93.7 | 66.0 | 93.1 | 82.2 |
| 85,000–89,900 | 5.3 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| 90,000–119,900 | 21.9 | 15.2 | 2.6 | 26.0 | 2.4 | 4.4 |
| 120,000–149,900 | 0.8 | 0.0 | 0.0 | 0.8 | 0.0 | 1.0 |
| 150,000–175,000 | 1.9 | 1.4 | 0.0 | 2.6 | 0.0 | 3.6 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE (2007a). The Lloyd's Register-Fairplay was used to obtain the vessel DWT and associated characteristics.

Table V-14
Beaumont Crude Petroleum Imports 2002–2007, Percentage of Imports
by Vessel DWT and Design Draft and Year Built

| DWT | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| ≤50,000 | 0.6 | 0.4 | 0.8 | 1.6 | 1.1 | 0.7 |
| 50,000–74,500 | 2.3 | 2.5 | 1.5 | 1.6 | 3.2 | 2.8 |
| 75,000–84,900 | 8.1 | 6.2 | 8.2 | 9.1 | 9.6 | 9.7 |
| 85,000–89,900 | 9.8 | 5.4 | 0.5 | 0.0 | 0.4 | 0.0 |
| 90,000–119,900 | 71.2 | 76.2 | 78.8 | 80.2 | 77.6 | 80.2 |
| 120,000–149,900 | 2.9 | 3.3 | 3.9 | 3.5 | 2.5 | 1.9 |
| 150,000–175,000 | 5.2 | 6.1 | 6.5 | 4.0 | 5.7 | 4.7 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE (2007a). The Lloyd's Register-Fairplay was used to obtain the vessel DWT and associated characteristics.

### Petroleum Product Carriers

Examination of the vessel characteristics and geographic routings associated with SNWW products indicates that some vessels could be more fully loaded. Table V-15 presents a percentage distribution of SNWW petroleum product imports and exports by vessel DWT class. This table shows that 32 to 54 percent of 1998–2007 imports and 5 to 27 percent of exports were transported in vessels of 60,000 DWT or more.

Table V-15
SNWW Petroleum Product Import Tonnage by Vessel DWT

| SNWW Percentage of Imports by DWT Range | | | | | | |
|---|---|---|---|---|---|---|
| DWT Range | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 |
| <10,000 | 4.3 | 0.0 | 0.4 | 0.0 | 0.4 | 1.3 |
| 10,000 to 29,999 | 12.1 | 6.2 | 2.8 | 4.4 | 1.1 | 4.4 |
| 30,000 to 49,999 | 45.8 | 48.9 | 41.3 | 48.7 | 58.1 | 45.6 |
| 50,000 to 59,999 | 5.5 | 3.0 | 1.4 | 1.1 | 2.2 | 7.1 |
| 60,000 to 69,999 | 3.8 | 15.1 | 16.7 | 9.3 | 12.8 | 6.9 |
| 70,000 to 79,999 | 2.7 | 0.0 | 15.2 | 18.4 | 17.0 | 21.2 |
| 80,000 to 89,999 | 4.0 | 8.9 | 5.4 | 7.3 | 0.0 | 0.0 |
| 90,000 to 99,999 | 15.8 | 5.4 | 3.7 | 3.3 | 2.1 | 0.5 |
| 100,000 to 116,000 | 6.0 | 12.6 | 13.2 | 7.5 | 6.4 | 13.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| SNWW Percentage of Exports by DWT Range | | | | | | |
| DWT Range | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 |
| <10,000 | 2.9 | 2.5 | 3.0 | 1.0 | 1.4 | 1.7 |
| 10,000 to 29,999 | 14.3 | 11.9 | 9.5 | 15.5 | 7.2 | 8.6 |
| 30,000 to 49,999 | 67.3 | 57.0 | 69.0 | 72.9 | 77.6 | 61.2 |
| 50,000 to 59,999 | 7.2 | 1.4 | 10.0 | 4.2 | 8.7 | 14.5 |
| 60,000 to 69,999 | 4.1 | 12.1 | 4.4 | 1.7 | 2.7 | 5.5 |
| 70,000 to 79,999 | 1.9 | 11.4 | 4.0 | 4.7 | 0.6 | 8.5 |
| 80,000 to 89,999 | 2.2 | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 |
| 90,000 to 99,999 | 0.1 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| 100,000 to 116,000 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE (2007a).
The Lloyd's Register-Fairplay was used to obtain the vessel DWT and associated characteristics.

Table V-16 presents the percentage of Port Arthur and Beaumont tonnage for design drafts greater than and less than 40 feet and shows that in 2007, an average of 59 percent of Port Arthur and 46 percent of Beaumont petroleum product imports were transported in vessels with design drafts over 40 feet. For exports, the 38 percent of Port Arthur and 20 percent of Beaumont tonnage were transported in vessels with design drafts over 40 feet. Comparison of the 2002–2007 statistics shows that the percentage of Port

Arthur and Beaumont exports transported in vessels with design drafts over 40 feet experienced relatively large increases; however, the annual rates are subject to variability based on annual changes in trade routes and commodity mixes.

Tables V-17 and V-18 show product totals by commodity and the corresponding percentage of imports and exports shipped in vessels of 60,000 DWT or more. As shown, the annual percentages vary greatly and discernible patterns are not apparent. As also shown in Table V-17, higher percentages of imports are associated with vessels of 60,000 DWT than are exports.

Table V-16
SNWW Petroleum Products 2002–2007 Imports and Exports by Vessel Design Draft

| Design Draft (feet) | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2002–2007 Average Annual Growth Rate |
|---|---|---|---|---|---|---|---|
| **Port Arthur Percentage of Petroleum Product Imports** | | | | | | | |
| ≤40 | 60 | 62 | 62 | 54 | 40 | 41 | –7.3 |
| >40 | 40 | 38 | 38 | 46 | 60 | 59 | 8.1 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | n/a |
| **Beaumont Percentage of Petroleum Product Imports** | | | | | | | |
| ≤40 | 49 | 45 | 48 | 66 | 63 | 54 | 2.0 |
| >40 | 51 | 55 | 52 | 34 | 37 | 46 | –2.0 |
| **Port Arthur Percentage of Petroleum Product Exports** | | | | | | | |
| ≤40 | 94 | 70 | 89 | 91 | 92 | 62 | –8.0 |
| >40 | 6 | 30 | 11 | 9 | 8 | 44.7 | 44.7 |
| Total | 100 | 100 | 100 | 100 | 100 | n/a | n/a |
| **Beaumont Percentage of Petroleum Product Exports** | | | | | | | |
| ≤40 | 89 | 83 | 83 | 85 | 86 | 80 | –2.1 |
| >40 | 11 | 17 | 17 | 15 | 14 | 20 | 12.7 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | n/a |

Source: USACE (2007a). The Lloyd's Register-Fairplay was used to obtain the vessel DWT and associated characteristics.

While it is anticipated that this variance would continue to remain high, the use of draft-constrained vessels for several markets served by the SNWW is also anticipated to continue. While published forecasts of specific trade routes are not available, the SNWW presently serves markets that can accommodate more fully loaded product carriers, and it was assumed that some cargo movements would transition to more fully loaded vessels based on the economics of scale of loading to increased depths and availability of channel depths in excess of 40 feet at some trading ports. As shown in tables V-16 and V-17, larger product carriers are used for high volume commodities such as distillate and residual fuel imports and petroleum coke exports

Table V-17
Percentage of Imports and Exports Shipped in Vessels of 60,000 DWT or Larger
SNWW Petroleum Product Imports
1998–2007 (select years)

| Major Commodity Group | Total Imports by Commodity Group (1,000s of short tons) | | | | | | Percent of Imports Transported in Vessels ≥60,000 DWT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | – | 33 | 1,613 | 2,213 | 1,678 | 1,096 | – | 0 | 6 | 14 | 8 | 15 |
| Distillate Fuel | 102 | 572 | 728 | 1,286 | 1,267 | 1,872 | 40 | 75 | 73 | 73 | 78 | 67 |
| Residual Fuel | 57 | 25 | 810 | 804 | 351 | 355 | 100 | 100 | 59 | 94 | 74 | 16 |
| Lube Oil and Greases | 2,140 | 700 | 619 | 50 | 71 | 2 | 83 | 90 | 80 | 0 | 39 | 39 |
| Naphtha and Solvents | 808 | 1,138 | 1,977 | 595 | 368 | 719 | 21 | 5 | 81 | 49 | 16 | 16 |
| Asphalt, Tar, and Pitch | 11 | – | – | 7 | – | – | – | – | – | – | – | – |
| Petroleum Coke | 250 | 266 | 255 | 365 | 84 | 276 | 10 | – | 21 | 48 | – | 10 |
| Other | 124 | – | – | 29 | – | – | 6 | – | – | – | – | – |
| Total Imports | 3,492 | 2,734 | 6,003 | 5,349 | 3,819 | 3,744 | 58 | 42 | 54 | 46 | 39 | 40 |

Table V-18
SNWW Petroleum Product Exports
1998–2007 (select years)

| Major Commodity Group | Total Exports by Commodity Group (1,000s of short tons) | | | | | | Percent of Exports Transported in Vessels ≥60,000 DWT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 1,376 | 1,258 | 1,949 | 1,778 | 1,777 | 1,970 | 1 | – | 3 | – | 1 | 10 |
| Distillate Fuel | 602 | 179 | 449 | 371 | 371 | 345 | 42 | – | – | 11 | 9 | 58 |
| Residual Fuel | 206 | 12 | 0 | 51 | 68 | – | 12 | – | – | – | 50 | – |
| Lube Oil and Greases | 41 | 63 | 57 | 99 | 117 | 60 | 10 | – | – | – | 10 | 10 |
| Naphtha and Solvents | 0 | 146 | 8 | 58 | 94 | 22 | 4 | – | – | – | 4 | – |
| Petroleum Coke | 1,622 | 3,447 | 4,688 | 4,362 | 4,362 | 4,210 | 13 | 35 | 13 | 14 | 6 | 9 |
| Other | 463 | 17 | 0 | 104 | 33 | – | – | – | – | – | – | – |
| Total Imports | 4,328 | 5,122 | 7,151 | 6,823 | 6,822 | 6,607 | 8 | 23 | 9 | 9 | 5 | 15 |

Source (Tables 40–41): USACE (2007a).

The Lloyd's Register-Fairplay was used to obtain the vessel DWT and associated characteristic

Examination of the data in tables V-13 through V-17 shows that there are large annual variances in the percentage of annual tonnage associated with the draft and parcel criteria, and, therefore, depths at trading ports and comparable operations at similar ports were also evaluated. Examination of petroleum product imports and exports through other U.S. Gulf Coast ports with channel depths over 40 feet shows that 34 percent of distillate imports from Russia, North Africa, and Venezuela were shipped in vessels with loaded drafts of 42 feet or more.

The use of the Panama Canal for all of the Far East and over half of the South America destinations would limit the sizes of vessels used for that trade until the Panama Canal expansions are complete. Completion of the Panama Canal deepening and widening is expected to occur before 2014. In addition to foreign flag product carriers, a steady volume of domestic coastwise product tankers use Port Arthur and Beaumont. Domestic coastwise movements primarily consist of gasoline and distillate and residual fuel shipments. These products are refined at the SNWW ports and shipped to the U.S. East Coast, specifically eastern Florida. In 2006, coastwise shipments totaled 3.6 million short tons. Coastwise receipts totaled 978,000 short tons. Examination of vessel specifics showed that approximately 10 percent of outbound coastwise shipments were transported in draft-restricted tankers. These product carriers generally are between 60,000 and 70,000 DWT with design drafts in the 41- to 43-foot range.

### Chemical Product Carriers

For the period 2002–2007, chemical imports represented approximately 3 percent of both SNWW and U.S. total foreign tonnage. Both U.S. and SNWW imports exhibited consistent upward growth from the mid-1990s through 2007, with SNWW overall rates increasing at nearly five times the U.S. rate but also exhibiting higher annual variances. As with imports, SNWW chemical exports exhibited significantly higher overall growth than the national rates, with overall rates increasing at nearly five times the U.S. rate. Chemical product growth can be attributed to diversification of the SNWW product base and the development of new markets. Table V-19 shows SNWW and U.S. total tonnage for 1990–2007, with recent tonnage representing record highs.

Evaluation of 1998–2007 chemical product exports showed that the percentage of tonnage associated with design drafts between 40 and 44 feet ranged from zero to 14 percent, averaging 4 percent annually. An average of 16 percent of 1998–2006 export tonnage was transported in loaded drafts between 36 and 40 feet. In 2007, 18 percent of SNWW chemical exports were transported in vessels with loaded drafts between 36 and 40 feet. Approximately two-thirds of 2002–2007 exports were shipped from Beaumont and the remainder from Port Arthur. Seventy-nine percent of 2002–2007 imports were shipped into Beaumont and the remainder to Port Arthur.

Review of the Lloyd's Register-Fairplay showed that 21.6 percent of the chemical tankers on order in 2009 have design drafts of 43 feet or more and 1.6 percent of chemical tankers on order have design drafts of 47 feet or more. Table V-20 presents the distribution of the world chemical carrier fleet as of January 2009.

Table V-19
SNWW and U.S. Chemical Products (1,000s of short tons)
Foreign Imports and Exports

| | Chemical Product Imports | | Chemical Product Exports | |
|---|---|---|---|---|
| Year | SNWW | U.S. | SNWW | U.S. |
| 1990 | 34 | 15,943 | 547 | 40,419 |
| 1991 | 35 | 15,293 | 455 | 44,418 |
| 1992 | 46 | 16,404 | 489 | 42,216 |
| 1993 | 25 | 18,954 | 537 | 39,781 |
| 1994 | 49 | 23,479 | 577 | 44,934 |
| 1995 | 33 | 24,069 | 724 | 49,466 |
| 1996 | 48 | 24,597 | 777 | 47,476 |
| 1997 | 33 | 25,054 | 1,101 | 50,538 |
| 1998 | 140 | 27,443 | 979 | 51,343 |
| 1999 | 449 | 28,141 | 753 | 52,199 |
| 2000 | 619 | 38,477 | 1,469 | 57,886 |
| 2001 | 754 | 43,833 | 1,296 | 54,746 |
| 2002 | 683 | 39,572 | 1,587 | 54,961 |
| 2003 | 434 | 42,010 | 1,555 | 53,575 |
| 2004 | 656 | 43,810 | 2,104 | 60,734 |
| 2005 | 1,084 | 45,517 | 1,891 | 56,684 |
| 2006 | 1,133 | 48,013 | 2,904 | 58,699 |
| 2007 | 955 | 46,881 | 3,169 | 60,188 |
| 1990–1998 Average | 49 | 21,248 | 686 | 45,626 |
| 1999–2007 Average | 752 | 41,806 | 1,859 | 56,630 |
| Average Annual Growth % Rate | 35.4 | 7.8 | 11.7 | 2.4 |

Source: USACE (2007a).

Table V-20
Chemical Product Carrier Fleet
World Fleet as of January 2009

| | | Percentage of Total DWT | |
|---|---|---|---|
| Design Draft (feet) | Median DWT | Built 1985–2004 | On Order as of January 2009 |
| <36 | 13,000 | 36.1 | 34.1 |
| 36–38 | 38,500 | 23.6 | 18.6 |
| 39–40 | 46,000 | 24.2 | 17.7 |
| 41–42 | 47,000 | 6.6 | 6.2 |
| 43–44 | 50,000 | 3.5 | 21.8 |
| 45–46 | 85,000 | 0.9 | – |
| 47–49 | 95,000 | 5.1 | 1.6 |
| 50–51 | n/a | – | – |
| | Total | 100 | 100 |

Source: Lloyd's' Register-Fairplay (2009).

Current vessel usage and general indicators, such as depths at trading ports, overall tonnage, and the design drafts for the current fleet of vessels, suggest that some future chemical movements would benefit from channel depths up to 48 feet. Of the vessels on order, 1.8 percent of vessels have design drafts of 48 feet. Review of existing cargo loads suggests that the draft-constrained tonnage would likely consist of metallic salt exports and acyclic hydrocarbon exports. Project benefits were calculated assuming that 5 to 10 percent of future chemical export tonnage would be transported in vessels with loaded drafts between 40 and 49 feet. Eight percent of 2019–2069 chemical export tonnage was assumed to be loaded to drafts over 40 feet. Deepening benefits were not calculated for chemical imports due to current limited utilization of larger vessels and loaded drafts over 36 feet and uncertainty about future trends towards the use of either larger or more fully loaded vessels.

### Grain Carriers

Grain is exported from the Beaumont elevator located just below the Port of Beaumont main TB. While exports have exceeded 1 million short tons since 2003, recent volumes are less than one-half the 1993 peak volume of 3.5 million short tons. In 2007, Beaumont's wheat exports totaled 1.6 million short tons. While relatively low in comparison to the Pacific Northwest and the Lower Mississippi, Beaumont has maintained a 1.4 to 1.7 percent share of the U.S. waterborne bulk grain export market. Table V-21 displays Beaumont's 2001–2007 grain export tonnage by grain type and loaded draft. Wheat presently comprises 100 percent of Beaumont's grain exports for the most recent 5-year period. Beaumont's 2007 wheat exports composed 5 percent of the U.S. wheat export total. Figure V-4 provides a comparison of Beaumont and U.S. wheat exports. During earlier years, wheat represented 85 percent, sorghum 10 percent, and corn 5 percent.

The maximum DWT presently used for grain exports is in the 60,000 to 70,000 DWT range. These vessels have design drafts between 42 and 43 feet. The specific type of bulk carriers used for grain is "load-on/load off" or "LoLo" vessels. Table V-22 displays the existing fleet of "LoLo" vessels in the world fleet and LoLo vessels on order. The median year of construction for the range of vessels transporting grain from Beaumont is 1985, which is older than the median of 1998 associated with the world fleet. Review of the distribution of vessels on order and the port depths at receiving ports indicates that some transition in the average DWT range from the existing 60,000 to 70,000 DWT into the 80,000 to 94,000 DWT range is reasonable to expect.

The USDA's February 2009 forecast shows modest growth in wheat exports between 2006 and 2018/2019. U.S. 2006–2018/2019 exports are forecasted to increase from approximately 990 million bushels in 2006 to 1,075 million bushels by 2014/2015 and remain constant at that level through the end of the forecast period in 2018/2019.

Table V-21
Beaumont Bulk Grain Export
Distribution of Tonnage by Grain Type and Loaded Vessel Draft

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|
| **Bulk Grain Export Totals by Year (1,000s of Short Tons)** | | | | | | | |
| Total Exports | 831 | 835 | 1,125 | 1,329 | 1,080, | 1,214 | 1,632 |
| **% by Grain Type** | | | | | | | |
| Wheat | 79.0 | 88.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Corn | 6.5 | 8.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sorghum | 14.5 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **% by Loaded Draft (feet)** | | | | | | | |
| ≤35 | 56.8 | 65.8 | 65.3 | 67.8 | 62.8 | 35.5 | 50.8 |
| 36–37 | 6.7 | 5.5 | 11.6 | 9.0 | 15.2 | 25.7 | 18.5 |
| 38–40 | 36.5 | 28.7 | 23.1 | 23.2 | 22.0 | 38.8 | 30.7 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE (2007a).

Figure V-4. U.S. and Beaumont Bulk Grain Exports, 1990–2007 (Short Tons)

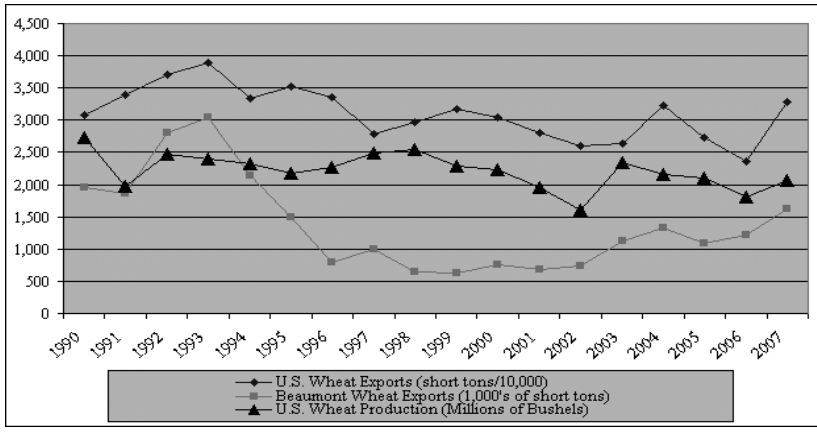


Table V-22
LoLo Bulk Dry Cargo Carriers (World Fleet)

| Vessels in Operation | | | | | |
|---|---|---|---|---|---|
| DWT Range | Total DWT | Percent DWT | Median DWT | Design Draft (feet) | Year Built |
| <25,000 | 5,825,500 | 3 | 20,035 | 30 | 1996 |
| 25,000 to 44,000 | 31,009,518 | 14 | 32,755 | 34 | 1994 |
| 45,000 to 64,000 | 33,235,975 | 15 | 49,061 | 39 | 2000 |
| 65,000 to 79,000 | 58,832,687 | 27 | 73,445 | 45 | 1998 |
| 80,000 to 94,000 | 3,716,652 | 2 | 88,405 | 43 | 2000 |
| 95,000 to 106,999 | 414,221 | 0 | 105,712 | 50 | 2001 |
| 107,000 to 169,999 | 38,252,170 | 18 | 151,257 | 57 | 1994 |
| 170,000 to 260,000 | 45,324,613 | 21 | 172,964 | 58 | 2000 |
| Total | 216,611,336 | 100 | | | |

| Vessels on Order | | | | |
|---|---|---|---|---|
| DWT Range | Total DWT | Percent DWT | Median DWT | Design Draft (feet) |
| <25,000 | 775,191 | 2 | 18,500 | 28 |
| 25,000 to 44,000 | 4,430,571 | 8 | 34,525 | 34 |
| 45,000 to 64,000 | 11,825,398 | 21 | 54,500 | 41 |
| 65,000 to 79,000 | 9,044,747 | 16 | 75,750 | 46 |
| 80,000 to 94,000 | 9,382,833 | 17 | 82,788 | 47 |
| 95,000 to 106,999 | 815,150 | 2 | 100,000 | 44 |
| 170,000 to 199,999 | 18,990,990 | 34 | 177,015 | 59 |
| Total | 55,264,880 | 100 | | |

Source: Tables 47 and 48: Lloyd's Register-Fairplay (2006).

### Steel Slab and Iron Ore Carriers

For the period, 2002–2006, an average of 2.5 percent of U.S. iron ore and steel slab imports were transported through the SNWW ports. For the period 2002–2007, imports ranged from a low of 240,000 short tons in 2007 and a high of 1,136,000 short tons in 2005. In 2006, SNWW imports totaled 859,000 short tons. The 2002–2006 average annual import volume of 783,000 short tons is over 100 percent higher than 1990–1993 average levels.

Steel slab is transported in LoLo bulkers in the 45,000 to 53,000 DWT range, with a maximum vessel size of 78,000 DWT. Review of the Lloyd's Register-Fairplay (2003) showed that 23 percent of bulk carriers constructed over the past decade are in the 66,000 to 78,000 DWT range. This is same vessel type used for grain; however, the specific vessels are different with each cargo having dedicated carriers.

Examination of the foreign ports of call for 1998–2007 SNWW tonnage showed that an average of 8 percent of tonnage was transported through world ports with channel depths of 44 to 47 feet. Current

vessel usage and general indicators, such as depths at trading ports and the design drafts for new vessel orders, suggests that, in the short term, a minimum of 10 percent of present iron ore movements would utilize channel depths over 40 feet. Expansion of the Panama Canal is expected to increase the percentage to 50 percent by the year 2014. Project benefits were calculated assuming that 10 percent of 2015–2020 tonnage and 50 percent of 2020–2069 would be transported in vessels with loaded drafts between 40 and 49 feet.

### Limestone and Rock Carriers

SNWW aggregate tonnage primarily consists of imports of limestone, rock, and other raw building materials. For the period 2005–2007, 3 percent of U.S. limestone and rock imports were transported through the SNWW ports. Table V-23 displays SNWW aggregate tonnage. Presently, the most common carriers used on the SNWW are in the 46,000 to 77,000 DWT range. Table V-24 displays the fleet used for SNWW 2002–2007 aggregate imports. Presently, nearly all tonnage is transported in vessels with design drafts over 40 feet. Current vessel usage and general indicators, such as depths at trading ports and the design drafts for new vessel orders, suggests that some 50 percent of iron ore movements would utilize channel depths over 40 feet due to the expansion of the Panama Canal. The shipments of clay and refractory materials are associated with vessels with loaded drafts over 37 feet and design drafts over 40 feet.

Table V-23
SNWW Building Material Imports
(1,000s of short tons)

| | Sand, Gravel, and Limestone Imports (Total Imports and Estimated Port Share) | | | Sulphur and Refractory Material Exports (Total Imports and Estimated Port Share) | | | Estimated Percentage of Tonnage Transported in Vessels with Design Drafts ≅40 feet | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Total | Port Arthur (%) | Beaumont (%) | Total | Port Arthur (%) | Beaumont (%) | Sand and Gravel | Limestone | Sulphur and Refractory Materials |
| 1999 | 617 | 90 | 10 | 0 | 0 | 0 | 100 | 0 | 0 |
| 2000 | 495 | 36 | 64 | 13 | 0 | 100 | 99 | 60 | 0 |
| 2001 | 635 | 18 | 82 | 40 | 0 | 100 | 99 | 37 | 0 |
| 2002 | 1,117 | 20 | 80 | 16 | 12 | 88 | 99 | 78 | 0 |
| 2003 | 658 | 40 | 60 | 46 | 2 | 100 | 99 | 57 | 0 |
| 2004 | 642 | 35 | 65 | 104 | 28 | 72 | 99 | 100 | 0 |
| 2005 | 815 | 36 | 64 | 91 | 12 | 88 | 100 | 100 | 21 |
| 2006 | 816 | 44 | 56 | 261 | 18 | 82 | 99 | 100 | 0 |
| 2007 | 829 | 41 | 59 | 463 | 12 | 88 | 99 | 99 | 11 |

Source: USACE (2007a).

Table V-24
SNWW Aggregate Tonnage Fleet, 2002–2007

| Vessel DWT | Loaded Draft (feet) | Estimated % of 2002–2006 Imports | Vessel Characteristics | | | |
|---|---|---|---|---|---|---|
| | | | Length (feet) | Beam (feet) | Design Draft (feet) | Year Built |
| 46,606 | 33 | 11 | 615 | 106 | 37 | 1995 |
| 62,594 | 40 | 4 | 747 | 106 | 44 | 1982 |
| 67,044 | 35–40 | 54 | 753 | 106 | 43 | 1984 |
| 77,499 | 40 | 26 | 804 | 106 | 46 | 1991 |
| <40,000 | n/a | 5 | n/a | n/a | n/a | n/a |
| | Total | 100 | | | | |

Source: USACE (2007a).

### Wood Product Carriers

For the period 1998–2006, approximately 1 percent of U.S. wood product tonnage was transported through the SNWW ports. Wood products also represent 1 percent of the SNWW 1998–2006 foreign total. The largest wood product carriers used on the SNWW are in the 50,000 to 60,000 DWT range. The design drafts of these ships are right at 40 feet; and it was found that wood chip carriers, like container vessels, characteristically reach capacity in terms of volume before they reach their design drafts. Review of 2002–2006 data showed that the load patterns were the same as for 1998–2001. The nature of wood chip cargo suggests it is unlikely that the current fleet could be loaded to depths greater than 40 feet, and therefore, deepening benefits were not calculated for wood products. Discussion with industry representatives confirmed this.

### Liquefied Natural Gas Fleet

Discussion with industry representatives and review of the vessels on order revealed that LNG vessels with design drafts of 40 feet or more are being constructed. Table V-25 displays the world LNG fleet, including vessels on order.

## V.D CHANNEL DEEPENING BENEFITS

The transportation costs and the savings associated with the proposed project depth increase were calculated using commodity-specific vessel class and trade route distributions. Transportation costs were calculated based on the channel depth alternatives and variables associated with vessel design drafts, maximum feet of light-loading, underkeel clearance, mileage traveled, and the number of hours to load and unload. Maximum vessel cargo capacities for crude oil and petroleum products were estimated based on review of the range of load factors obtained based on review from IWR Report 91-R-13, *National Economic Development Procedures Manual Deep-draft Navigation* (1991) and consultation with SNWW industry and pilots association. The IWR (1991) cargo capacity factors published in the deep-draft manual

for dry bulk carriers and tankers are shown in Table V-26. Consultation with industry and the pilots revealed that these estimates are reasonable. Table V-27 presents representative round trip mileage for the trade routes or junction points used for the transportation savings computations.

Table V-25
World Liquefied Natural Gas Fleet

| Year Built | DWT Total | Percent of DWT | DWT | Length of Ship (feet) | Beam (feet) | Design Draft feet) |
|---|---|---|---|---|---|---|
| Constructed Between 1980–2002 (Average Vessel Dimensions) | | | | | | |
| 1980–1990 | 1,742,877 | 25.6 | 69,715 | 910 | 142 | 38 |
| 1991–2002 | 5,064,932 | 74.4 | 67,532 | 889 | 144 | 37 |
| Total | 6,807,809 | 100.0 | | | | |
| Vessels Constructed After 2002 (Average Vessel Dimensions) | | | | | | |
| Design Draft Range (feet) | Total DWT | Percent of DWT | DWT | Length of Ship (feet) | Beam (feet) | Design Draft (feet) |
| 36.6 to 39.9 | 2,868,168 | 66 | 74,852 | 927 | 147 | 38 |
| 40.0 to 41.1 | 1,453,796 | 34 | 77,750 | 930 | 144 | 41 |
| Total | 4,321,964 | 100.0 | | | | |
| Vessels on Order 2007 (Average Vessel Dimensions) | | | | | | |
| Design Draft Range (feet) | Total DWT | Percent of DWT | DWT | Length of Ship (feet) | Beam (feet) | Design Draft (feet) |
| 21 to 30 | 83,242 | 0.7 | 8,200 | 450 | 98 | 24 |
| 35 to 41 | 230,250 | 1.8 | 58,900 | 825 | 127 | 38 |
| 37 to 41 | 5,516,514 | 43.9 | 74,400 | 945 | 145 | 39 |
| 37 to 40 | 2,102,350 | 16.7 | 83,000 | 928 | 142 | 38 |
| 39 to 45 | 3,129,719 | 24.9 | 100,000 | 1,033 | 164 | 45 |
| 39 to 45 | 1,499,200 | 11.9 | 125,600 | 1,132 | 176 | 39 |
| Total | 12,561,275 | 100.0 | | | | |

Table V-26
Adjustments for Estimating Actual Vessel Capacity

| Vessel DWT | Dry Bulk | Tanker |
|---|---|---|
| <20,000 | 0.90 | 0.90 |
| 20,000–70,000 | 0.92 | 0.92 |
| 70,000–120,000 | 0.95 | 0.95 |
| 120,000 | 0.97 | 0.97 |

Source: USACE (1991).

Table V-27
Representative Round Trip Mileage to SNWW

| Location | Total Miles |
|---|---|
| Coatzacoalcos, Mexico | 1,376 |
| U.S. Gulf Coast Lightering/Lightening Zone | 160 |
| Venezuela | 3,612 |
| Panama Canal | 3,120 |
| Brazil (Maceio/Sao Paulo weighted average) | 9,422 |
| Rotterdam, Netherlands | 10,040 |
| Sture, Norway | 10,528 |
| North Africa, Algiers | 10,294 |
| West Africa (Nigeria and Angola) | 12,500 |
| Persian Gulf and Indian Subcontinent via Suez Canal | 19,704 |
| Persian Gulf and Indian Subcontinent via Cape of Good Hope | 25,112 |
| Singapore via Panama Canal | 24,248 |
| Singapore via Cape of Good Hope | 26,304 |

## Vessel Operating Costs

The vessel operating costs are shown in tables V-28 through V-30. Table V-28 displays the hourly operating costs for tankers. The hourly operating costs include fuel, labor, and maintenance. The costs used were obtained from deep-draft vessel operating cost Economic Guidance Memorandum (EGM) December 2008 update (USACE, 2008a). The tanker costs were used for the crude petroleum, petroleum product, and chemical product transportation cost calculations. The maximum sized vessels using the channel to Beaumont on a regular basis are in the 150,000 DWT class. The maximum size using the Taylor Bayou Port Arthur facilities are in the 110,000 to 116,000 DWT range. As previously noted, the Port Arthur fleet is smaller, in terms of DWT, because the existing width at the mouth of Taylor Bayou limits the allowable vessel size. The U.S. flag tanker costs contained in Table V-28 were used for U.S. coastwise product movements. Table V-29 displays the foreign flag bulk carrier operating costs that were used for the grain exports and imports of iron ore, metal products, limestone, and rock. Table V-30 displays the LNG vessel operating costs. The LNG costs were estimated in consultation with the IWR.

The LNG design vessel used by the ERDC for the ship simulations consisted of a 140,000 cubic meter spherical-tank-type vessel 920 feet long, 142 feet wide, and 37.4 feet in draft, and a proposed 250,000-cubic-meter membrane-type tanker 1,126 feet long, 177 feet wide, and 39.4 feet in draft. The LNG facilities are in the Sabine Pass Channel and Port Arthur reaches. The project design vessel for crude petroleum tankers using the Entrance Channel and going to Beaumont is 899 feet long and 164 feet wide. These dimensions correspond to a 158,000 DWT crude petroleum tanker.

Table V-28
Tanker Characteristics and Hourly Operating Cost
Double-Hull Tankers, December 2008 IWR Release

| Vessel DWT | Design Draft (feet) | Immersion Factor | Hourly Cost ($) Foreign-Flag At Sea | Foreign-Flag In Port | U.S. Flag At Sea | U.S. Flag In Port |
|---|---|---|---|---|---|---|
| 20,000 | 32.3 | 78.7 | 659 | 403 | 1,470 | 1,214 |
| 25,000 | 33.4 | 90.8 | 696 | 430 | 1,565 | 1,300 |
| 35,000 | 35.6 | 112.6 | 766 | 481 | 1,747 | 1,463 |
| 50,000 | 38.7 | 141.4 | 865 | 554 | 2,005 | 1,693 |
| 60,000 | 40.7 | 158.9 | 952 | 622 | 2,239 | 1,909 |
| 70,000 | 42.6 | 175.4 | 1,001 | 653 | 2,354 | 2,007 |
| 80,000 | 44.6 | 191.0 | 1,058 | 692 | 2,496 | 2,130 |
| 90,000 | 46.4 | 205.9 | 1,107 | 724 | 2,610 | 2,226 |
| 110,000 | 50.0 | 234.1 | 1,192 | 772 | 2,793 | 2,374 |
| 150,000 | 56.4 | 285.4 | 1,369 | 878 | 3,190 | 2,700 |
| 165,000 | 58.6 | 303.4 | 1,439 | 922 | 3,350 | 2,833 |
| 175,000 | 70.3 | 410.7 | 1,485 | 951 | 4,400 | 3,707 |
| 265,000 | 73.2 | 444.5 | 1,900 | 1,207 | 4,764 | 4,010 |
| 320,000 | 74.5 | 463.3 | 2,061 | 1,306 | 4,971 | 4,182 |

Source: USACE (2008a).

Table V-29
Dry Bulk Carrier Characteristics and Hourly Operating Cost
Foreign Flag Dry Bulk Carriers, December 2008 IWR Release

| Vessel DWT | Design Draft (feet) | Immersion Factor | Hourly Cost ($) At Sea | Hourly Cost ($) In Port |
|---|---|---|---|---|
| 60,000 | 42.1 | 153.5 | 807 | 552 |
| 70,000 | 44.1 | 168.6 | 847 | 578 |
| 80,000 | 46.0 | 183.7 | 886 | 603 |
| 90,000 | 47.7 | 197.4 | 940 | 643 |
| 100,000 | 49.4 | 211.1 | 994 | 683 |
| 120,000 | 52.3 | 236.5 | 1,092 | 754 |
| 135,000 | 54.2 | 254.2 | 1,236 | 857 |
| 150,000 | 56.1 | 271.8 | 1,236 | 857 |
| 175,000 | 58.9 | 299.2 | 1,355 | 942 |

Source: USACE (2008a).

Table V-30
Liquefied Natural Gas Carriers
Characteristics and Hourly Operating Cost (December 2008 Vessel Costs)

| Vessel DWT | Design Draft (feet) | Cubic Meters Capacity | Immersion Factor | Hourly Cost ($) | |
|---|---|---|---|---|---|
| | | | | At Sea | At Sea |
| 76,500 | 37 | 145,000 | 248.7 | 1,773 | 1,506 |
| 100,000 | 39 | 210,000 | 315.2 | 2,073 | 1,753 |
| 125,000 | 40 | 250,000 | 358.1 | 2,302 | 1,937 |
| 125,000 | 40 | 265,000 | 372.4 | 2,423 | 2,039 |

For the transportation cost calculations, an average of 1 foot of underkeel clearance was used for petroleum vessels. Based on industry input, a 4- to 6-foot underkeel clearance was used for LNG vessel. The indication from pilot discussion was that an absolute minimum of 4 feet underkeel clearance would be required; and the preference was for 6 feet. The effects of varying underkeel clearance are addressed in detail in the sensitivity section of the Economic Appendix (Appendix 2).

## Transportation Savings Benefits for Channel Deepening

Transportation savings benefits from reductions in the vessel operating costs were calculated based on the relative difference in transportation costs between the without-project and with-project conditions. Transportation costs and savings were calculated for vessels that minimize transportation costs given trade route constraints. As previously noted, long-term fleet selection would continue to reflect goals of minimizing vessel operating costs. The basic procedure used to calculate transportation costs using 110,000- and 150,000-DWT foreign flag tankers as an example is illustrated in Table V-31. Similar computations were made for appropriate distances and vessel sizes for each of the channel depth alternatives. The resulting costs-per-ton computations were calculated over the relevant range of vessels projected for each channel depth improvement, and the associated savings per ton were measured using the net differences in costs between the existing 40-foot channel and the depth alternative. Unless otherwise noted, the 2019–2069 tonnage forecasts used for the benefit calculations were summarized in tables V-10 and V-11.

### Crude Petroleum Imports Transportation Savings Benefits

The transportation costs used to calculate the benefits for crude petroleum imports are presented in Table V-32. The per-ton transportation costs correspond to the least-cost method of shipment associated with the particular trade route. Review of the depths at trading ports and significant savings per ton indicates that a large share of crude petroleum tonnage from Mexico, Venezuela, and Trinidad would be loaded to vessel drafts over 40 feet. Expectations concerning the percentage of Middle East and Africa movements are subject to greater uncertainty. Nearly all Middle East tonnage is lightered and nearly all West Africa crude is lightened. The logistics associated with these offshore transfers introduces higher degrees of uncertainty than with direct shipment and, therefore, generates large cost variances.

Table V-31
Transportation Cost Calculation (South America to SNWW)

| Channel Depth (feet) | 40 | 45 | 50 | 40 | 45 | 50 |
|---|---|---|---|---|---|---|
| Vessel Deadweight Tons | 110,000 | 110,000 | 110,000 | 150,000 | 150,000 | 150,000 |
| Design Draft (feet) | 50.0 | 50.0 | 50.0 | 56.4 | 56.4 | 56.4 |
| Cargo Capacity (%)* | 95 | 95 | 95 | 97 | 97 | 97 |
| Cargo Capacity (short tons)* | 104,500 | 104,500 | 104,500 | 145,500 | 145,500 | 145,500 |
| Immersion Factor (tons per inch) | 234.1 | 234.1 | 234.1 | 285.4 | 285.4 | 285.4 |
| Hourly Cost at Sea (from EGM) ($) | 1,192 | 1,192 | 1,192 | 1,369 | 1,369 | 1,369 |
| Underkeel Clearance (feet)** | 1 | 1 | 1 | 1 | 1 | 1 |
| Hourly Cost in Port (from EGM) ($) | 772 | 772 | 772 | 878 | 878 | 878 |
| Round Trip Mileage from South America** | 5,627 | 5,627 | 5,627 | 5,627 | 5,627 | 5,627 |
| Speed (Knots) | 15 | 15 | 15 | 15 | 15 | 15 |
| Total Voyage Cost ($) | 447,127 | 447,127 | 447,127 | 513,521 | 513,521 | 513,521 |
| Other Components (Loading and Unloading and Port Time) | | | | | | |
| Maximum Load at Channel Depth | 73,599 | 87,645 | 101,691 | 85,908 | 103,032 | 120,156 |
| Cost Per Ton for Sea Voyage ($) | 6.08 | 5.10 | 4.40 | 5.98 | 4.98 | 4.27 |
| Loading/Unloading Rate (short tons/hour) | 5,250 | 5,250 | 5,250 | 5,250 | 5,250 | 5,250 |
| Hours in Port | 30 | 30 | 30 | 30 | 30 | 30 |
| Total Loading Cost at Foreign Port ($) | 23,160 | 23,160 | 23,160 | 26,340 | 26,340 | 26,340 |
| Total Unloading Cost SNWW ($) | 23,160 | 23,160 | 23,160 | 26,340 | 26,340 | 26,340 |
| Pilot and Tug Costs ($) | 45,501 | 48,624 | 51,031 | 56,923 | 60,331 | 62,908 |
| Total Loading, Unloading, and Port Costs ($) | 91,821 | 94,944 | 97,351 | 109,603 | 113,011 | 115,588 |
| Total Cost Sum ($) | 538,948 | 542,072 | 544,478 | 623,124 | 626,532 | 629,109 |
| Total Cost Per Ton ($) | 7.32 | 6.18 | 5.35 | 7.25 | 6.08 | 5.24 |

*Estimated short tons ≅ (DWT * Maximum % Load) - (Immersion Factor * 12 inches per ton * number of feet light-loaded).

**Weighted mileage based on distance from Venezuela and Brazil. The weight factor of 0.7 was used for Venezuela, and a factor of 0.3 was used for Brazil. The weights were determined based on the expected percentage of tonnage by origin.

Additionally, and as Table V-32 illustrates, the cost savings for offshore transfer is lower than with direct shipment; however, distinct cost savings are apparent. The savings for lightering results from increases in shuttle loads due to greater channel depth in SNWW. For lightering, the effect of increasing channel depths at SNWW allows for the reduction in the number of shuttles necessary to totally lighter VLCC. The savings for lightened movements results from decreases in offshore unloading time from the mother vessel to shuttles. For lightening, the mother vessel is substituting offshore unloading time for dock-side unloading time. Additionally, the shuttle vessel reduces its overall loading and unloading time.

Table V-32
SNWW Crude Petroleum Imports Transportation Cost and Savings
Most Likely Transportation Mode Trade Route and Channel Depth (December 2008 Vessel Costs)

| Trade Route/Depth (feet) and Method of Shipment | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|
| Mexico | Direct | Direct | Direct | Direct | Direct | Direct | Direct |
| Cost/ton Beaumont | 2.76 | 2.34 | 2.28 | 2.21 | 2.15 | 2.11 | 2.07 |
| Cost/ton Port Arthur | 2.77 | 2.37 | 2.30 | 2.23 | 2.18 | 2.14 | 2.11 |
| Savings/ton Beaumont | | 0.41 | 0.48 | 0.55 | 0.60 | 0.65 | 0.69 |
| Savings/ton Port Arthur | | 0.41 | 0.47 | 0.54 | 0.59 | 0.63 | 0.67 |
| Venezuela | Direct | Direct | Direct | Direct | Direct | Direct | Direct |
| Cost/ton Beaumont | 7.22 | 6.09 | 5.91 | 5.73 | 5.58 | 5.45 | 5.34 |
| Cost/ton Port Arthur | 7.28 | 6.17 | 5.98 | 5.81 | 5.67 | 5.55 | 5.47 |
| Savings/ton Beaumont | | 1.13 | 1.31 | 1.49 | 1.64 | 1.77 | 1.88 |
| Savings/ton Port Arthur | | 1.11 | 1.30 | 1.47 | 1.62 | 1.73 | 1.81 |
| Africa/North Sea | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered |
| Cost/ton Beaumont | 8.41 | 8.18 | 8.13 | 8.12 | 8.05 | 8.01 | 8.01 |
| Cost/ton Port Arthur | 8.46 | 8.19 | 8.13 | 8.12 | 8.12 | 8.11 | 8.08 |
| Savings/ton Beaumont | | 0.23 | 0.28 | 0.30 | 0.36 | 0.40 | 0.40 |
| Cost/ton Port Arthur | | 0.27 | 0.33 | 0.34 | 0.35 | 0.35 | 0.39 |
| Middle East | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered |
| Cost/ton Beaumont | 14.43 | 14.20 | 14.15 | 14.13 | 14.06 | 14.03 | 14.03 |
| Cost/ton Port Arthur | 14.48 | 14.19 | 14.13 | 14.11 | 14.11 | 14.10 | 14.06 |
| Savings/ton Beaumont | | 0.23 | 0.28 | 0.30 | 0.36 | 0.40 | 0.40 |
| Savings/ton Port Arthur | | 0.29 | 0.35 | 0.36 | 0.37 | 0.38 | 0.42 |

Lightening generates comparatively lower savings than lightering because the latter produces the possibility of reducing the number of shuttles needed. Examination of the cost data also revealed that as channel depth increases the resulting savings may provide incentive to switch from lightening to direct shipment for movements from Africa and the North Sea. Table V-33 presents the lightening costs and Table V-34 presents the lightering costs. Historically, lightening was the most common choice for Africa and the North Sea movements; however, lightering has become more common for this route in recent years due to structural changes in oil production of the coast off West Africa. Lightering has always been

the method of choice for Middle East movements. The small percentage of North Sea using SNWW tends to be lightered, and an increasing portion of West Africa crude is lightered. Lightering was assumed to represent the without- and with-project future choice for West Africa crude due to its relative low cost and increasing popularity.

Table V-33
SNWW Crude Petroleum Imports
Lightened Cost per Ton by Channel Depth and Trade Route (December 2008 Vessel Costs)

| | Channel Depth and Vessel DWT | | | | | | |
|---|---|---|---|---|---|---|---|
| | 40 feet | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
| Mother Vessels (DWT) | | | | | | | |
| Minimum | 150,000 | 150,000 | 162,500 | 162,500 | 162,500 | 162,500 | 162,500 |
| Maximum | 175,000 | 175,000 | 175,000 | 175,000 | 175,000 | 175,000 | 175,000 |
| Shuttle Vessels (DWT) | | | | | | | |
| Minimum | 72,000 | 57,000 | 57,000 | 57,000 | 57,000 | 57,000 | 57,000 |
| Maximum | 85,000 | 68,000 | 65,000 | 65,000 | 65,000 | 65,000 | 65,000 |
| Africa and North Sea | Per Ton Transportation Cost ($) to SNWW | | | | | | |
| Minimum | 10.10 | 10.08 | 10.08 | 10.08 | 10.08 | 10.08 | 10.08 |
| Mean | 10.56 | 10.49 | 10.49 | 10.49 | 10.49 | 10.49 | 10.49 |
| Maximum | 11.02 | 10.90 | 10.90 | 10.90 | 10.90 | 10.90 | 10.90 |
| Middle East | Per Ton Transportation Cost ($) to SNWW | | | | | | |
| Minimum | 14.70 | 14.68 | 14.68 | 14.68 | 14.68 | 14.68 | 14.68 |
| Mean | 15.17 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 |
| Maximum | 15.63 | 15.51 | 15.51 | 15.51 | 15.51 | 15.51 | 15.51 |

Table V-34
SNWW Crude Petroleum Imports
Lightering Cost per Ton by Channel Depth Alternative and Trade Route (December 2008 Vessel Costs)

| Depth | 40 feet | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|---|
| Africa and North Sea per Ton Transportation Cost ($) | | | | | | | |
| Minimum | 8.31 | 8.16 | 8.04 | 8.02 | 8.00 | 7.90 | 7.89 |
| Mean | 8.41 | 8.18 | 8.13 | 8.12 | 8.05 | 8.01 | 8.01 |
| Maximum | 8.66 | 8.53 | 8.51 | 8.28 | 8.26 | 8.26 | 8.26 |
| Middle East per Ton Transportation Cost ($) | | | | | | | |
| Minimum | 14.33 | 14.17 | 14.06 | 14.04 | 14.02 | 13.92 | 13.91 |
| Mean | 14.43 | 14.20 | 14.15 | 14.13 | 14.06 | 14.03 | 14.03 |
| Maximum | 14.68 | 14.55 | 14.52 | 14.30 | 14.27 | 14.27 | 14.27 |

Tables V-35 and V-36 display Beaumont and Port Arthur's transportation cost savings based on the least-cost shipping methods displayed in Table V-32. For Port Arthur, the maximum vessel DWT used for the benefit calculations is less than 120,000 DWT. As previously noted, deepening of the channel leading to the Taylor Bayou terminal would enable the existing fleet to be more fully loaded but it would not result in transition to larger vessels. The transportation savings calculation costs shown in tables V-35 and V-36 reflect continuation of this limitation. As previously noted, the 2019–2069 tonnage forecasts used in the

benefit calculations are presented in tables V-10 and V-11. The specific tonnage volumes used for the benefit calculations are presented in the Economic Appendix.

Table V-35
Beaumont Crude Petroleum Imports
Annual Transportation Savings ($1,000s) by Trade Route and Decade (December 2008 Vessel Costs)

| Channel Depth Alternative/ Trade Route | 2002/2004 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| | | | (all costs in dollars) | | | | |
| **45-foot Channel** | | | | | | | |
| Mexico | 6,065 | 3,227 | 3,597 | 3,808 | 3,870 | 3,945 | 4,235 |
| Central/South America | 8,348 | 14,216 | 15,850 | 16,779 | 17,052 | 17,380 | 18,660 |
| Europe and Africa | 2,021 | 6,842 | 7,629 | 8,076 | 8,207 | 8,365 | 8,981 |
| Middle East | 5,879 | 6,402 | 7,138 | 7,556 | 7,679 | 7,827 | 8,403 |
| Total Savings | 22,313 | 30,686 | 34,214 | 36,219 | 36,808 | 37,516 | 40,280 |
| **46-foot Channel** | | | | | | | |
| Mexico | 7,089 | 3,771 | 4,205 | 4,451 | 4,524 | 4,611 | 4,950 |
| Central/South America | 9,724 | 16,558 | 18,461 | 19,543 | 19,861 | 20,243 | 21,735 |
| Europe and Africa | 2,431 | 8,230 | 9,176 | 9,714 | 9,872 | 10,062 | 10,803 |
| Middle East | 7,071 | 7,700 | 8,585 | 9,088 | 9,236 | 9,414 | 10,107 |
| Total Savings | 26,315 | 36,259 | 40,427 | 42,796 | 43,493 | 44,329 | 47,595 |
| **47-foot Channel** | | | | | | | |
| Mexico | 8,051 | 4,283 | 4,775 | 5,055 | 5,137 | 5,236 | 5,622 |
| Central/South America | 11,016 | 18,758 | 20,914 | 22,140 | 22,500 | 22,933 | 24,623 |
| Europe and Africa | 2,566 | 8,687 | 9,685 | 10,253 | 10,420 | 10,620 | 11,403 |
| Middle East | 7,464 | 8,128 | 9,062 | 9,593 | 9,749 | 9,937 | 10,669 |
| Total Savings | 29,097 | 39,856 | 44,437 | 47,041 | 47,807 | 48,726 | 52,316 |
| **48-foot Channel** | | | | | | | |
| Mexico | 8,867 | 4,717 | 5,259 | 5,567 | 5,658 | 5,767 | 6,192 |
| Central/South America | 12,147 | 20,684 | 23,062 | 24,413 | 24,810 | 25,288 | 27,151 |
| Europe and Africa | 3,162 | 10,705 | 11,935 | 12,635 | 12,840 | 13,087 | 14,052 |
| Middle East | 9,198 | 10,016 | 11,167 | 11,821 | 12,014 | 12,245 | 13,147 |
| Total Savings | 33,373 | 46,121 | 51,423 | 54,437 | 55,323 | 56,387 | 60,541 |
| **49-foot Channel** | | | | | | | |
| Mexico | 9,549 | 5,080 | 5,664 | 5,996 | 6,093 | 6,210 | 6,668 |
| Central/South America | 13,093 | 22,295 | 24,858 | 26,315 | 26,743 | 27,258 | 29,266 |
| Europe and Africa | 3,490 | 11,816 | 13,175 | 13,947 | 14,174 | 14,447 | 15,511 |
| Middle East | 10,153 | 11,056 | 12,327 | 13,049 | 13,261 | 13,516 | 14,512 |
| Total Savings | 36,285 | 50,247 | 56,023 | 59,307 | 60,272 | 61,431 | 65,957 |
| **50-foot Channel** | | | | | | | |
| Mexico | 10,171 | 5,411 | 6,033 | 6,386 | 6,490 | 6,615 | 7,102 |
| Central/South America | 13,900 | 23,669 | 26,390 | 27,937 | 28,391 | 28,937 | 31,069 |
| Europe and Africa | 3,490 | 11,816 | 13,175 | 13,947 | 14,174 | 14,447 | 15,511 |
| Middle East | 10,153 | 11,056 | 12,327 | 13,049 | 13,261 | 13,516 | 14,512 |
| Total Savings | 37,714 | 51,952 | 57,924 | 61,319 | 62,317 | 63,515 | 68,195 |

Table V-36
Port Arthur Crude Petroleum Imports
Annual Transportation Savings ($1,000s) by Trade Route and Decade
(December 2008 Vessel Costs)

| Channel Depth Alternative/ Trade Route | 2002/2004 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| | | | (all costs in dollars) | | | | |
| **45-foot Channel** | | | | | | | |
| Mexico | 3,355 | 484 | 539 | 573 | 584 | 596 | 611 |
| Central/South America | 399 | 2,128 | 2,370 | 2,514 | 2,560 | 2,611 | 2,745 |
| Europe and Africa | 128 | 1,214 | 1,353 | 1,437 | 1,466 | 1,496 | 1,532 |
| Middle East | 299 | 1,194 | 1,331 | 1,414 | 1,442 | 1,471 | 1,507 |
| Total Savings | 4,180 | 5,020 | 5,594 | 5,937 | 6,053 | 6,174 | 6,395 |
| **46-foot Channel** | | | | | | | |
| Mexico | 3,928 | 567 | 631 | 670 | 684 | 698 | 715 |
| Central/South America | 465 | 2,481 | 2,764 | 2,931 | 2,985 | 3,044 | 3,201 |
| Europe and Africa | 154 | 1,467 | 1,635 | 1,736 | 1,771 | 1,807 | 1,851 |
| Middle East | 365 | 1,461 | 1,628 | 1,729 | 1,764 | 1,800 | 1,844 |
| Total Savings | 4,913 | 5,976 | 6,659 | 7,067 | 7,205 | 7,349 | 7,611 |
| **47-foot Channel** | | | | | | | |
| Mexico | 4,468 | 644 | 718 | 763 | 778 | 794 | 813 |
| Central/South America | 527 | 2,813 | 3,134 | 3,324 | 3,385 | 3,452 | 3,629 |
| Europe and Africa | 160 | 1,527 | 1,702 | 1,807 | 1,843 | 1,881 | 1,927 |
| Middle East | 382 | 1,528 | 1,703 | 1,808 | 1,845 | 1,882 | 1,928 |
| Total Savings | 5,537 | 6,512 | 7,256 | 7,701 | 7,851 | 8,008 | 8,297 |
| **48-foot Channel** | | | | | | | |
| Mexico | 4,908 | 708 | 789 | 838 | 855 | 872 | 893 |
| Central/South America | 580 | 3,094 | 3,446 | 3,655 | 3,722 | 3,796 | 3,991 |
| Europe and Africa | 163 | 1,550 | 1,728 | 1,835 | 1,872 | 1,910 | 1,957 |
| Middle East | 389 | 1,554 | 1,732 | 1,840 | 1,877 | 1,915 | 1,962 |
| Total Savings | 6,039 | 6,906 | 7,695 | 8,167 | 8,325 | 8,492 | 8,802 |
| **49-foot Channel** | | | | | | | |
| Mexico | 5,242 | 756 | 843 | 895 | 913 | 931 | 954 |
| Central/South America | 620 | 3,306 | 3,683 | 3,906 | 3,978 | 4,057 | 4,265 |
| Europe and Africa | 165 | 1,567 | 1,746 | 1,854 | 1,891 | 1,930 | 1,977 |
| Middle East | 393 | 1,573 | 1,753 | 1,861 | 1,899 | 1,937 | 1,985 |
| Total Savings | 6,420 | 7,201 | 8,024 | 8,516 | 8,681 | 8,855 | 9,181 |
| **50-foot Channel** | | | | | | | |
| Mexico | 5,501 | 793 | 884 | 939 | 958 | 977 | 1,001 |
| Central/South America | 649 | 3,461 | 3,856 | 4,089 | 4,165 | 4,247 | 4,465 |
| Europe and Africa | 182 | 1,730 | 1,928 | 2,048 | 2,089 | 2,131 | 2,184 |
| Middle East | 439 | 1,756 | 1,958 | 2,079 | 2,121 | 2,164 | 2,217 |
| Total Savings | 6,771 | 7,741 | 8,626 | 9,155 | 9,332 | 9,519 | 9,866 |

### Petroleum and Chemical Product Transportation Savings Benefits

Reductions in the vessel operating costs for SNWW foreign petroleum product import and exports and coastwise shipments were calculated based on the relative difference in transportation costs between the without-project and with-project conditions. As with crude petroleum, transportation costs and savings were calculated for vessels that minimize transportation costs given trade route constraints. Again, long-term fleet selection would continue to reflect goals of minimizing vessel-operating costs. Table V-37 displays the annual transportation costs for Beaumont's petroleum and chemical product imports and exports. Table V-38 summarizes the annual transportation savings benefits for Port Arthur's petroleum and chemical product imports and exports. Table V-39 summarizes the annual transportation savings benefits for Beaumont's and Port Arthur's petroleum and chemical product imports and exports.

Table V-40 summarizes the benefit calculations for coastwise product shipments. As noted, deepening of the channel leading to the Taylor Bayou terminal would enable the existing fleet to be more fully loaded, but it would not result in transition to larger vessels. The transportation savings shown in Table V-40 reflect continuation of this limitation. The maximum sized coastwise vessels do not exceed Taylor Bayou's limitation.

### Grain Exports Transportation Savings Benefits

Beaumont wheat exports comprise 5 percent of the current U.S. total. Forecast of future exports were estimated based on analysis of USDA's February 2009 forecast. Per ton transportation costs were estimated based on exports shipped from Beaumont to Europe and the Mediterranean. The per ton transportation costs are presented in Table V-41. The transportation costs by channel depth alternative are presented in Table V-42.

Reductions in the vessel-operating costs for SNWW steel slab and iron ore imports were calculated based on the relative difference in transportation costs between the without- and with-project conditions. As with the previous presentations, transportation costs and savings were calculated for vessels that minimize transportation costs given trade route constraints. Again, long-term fleet selection would continue to reflect goals of minimizing vessel-operating costs. Port Arthur's breakbulk terminal is located outside the Taylor Bayou reach and the bulk carriers are not subject to the beam and length limitations. However, the maximum beam width for the bulk carrier fleet is 106 feet. The design drafts for these vessels are generally less than 45 feet. The DWT range of bulk carriers used for the benefit calculations is 60,000 to 99,999. Larger vessels could be used but are not anticipated over the next 20 years. The maximum size presently being used is 78,000 DWT. The transportation savings calculations were based on average costs for the anticipated 60,000 to 99,999 DWT range. As previously noted, the tonnage forecast and average annual growth rate for 2002–2004 to 2069 tonnage growth was displayed in tables V-10 and V-11.

Table V-37
Beaumont Petroleum and Chemical Product Imports and Exports
Annual Transportation Cost ($1,000) by Trade Route and Decade
(December 2008 Vessel Costs)

| | 2004/2006 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| **40-foot Channel** | | | | | | | |
| Imports | 12,810 | 14,840 | 24,440 | 27,850 | 31,205 | 34,967 | 39,187 |
| Exports | 17,347 | 28,367 | 43,489 | 54,111 | 61,328 | 69,310 | 78,463 |
| Total Cost | 30,157 | 43,207 | 67,928 | 81,962 | 92,533 | 104,278 | 117,650 |
| **45-foot Channel** | | | | | | | |
| Imports | 10,795 | 12,506 | 20,595 | 23,469 | 26,296 | 29,467 | 33,023 |
| Exports | 14,618 | 23,905 | 36,648 | 45,599 | 51,681 | 58,408 | 66,121 |
| Total Cost | 25,413 | 36,411 | 57,243 | 69,069 | 77,977 | 87,874 | 99,143 |
| **46-foot Channel** | | | | | | | |
| Imports | 10,465 | 12,123 | 19,965 | 22,752 | 25,492 | 28,565 | 32,013 |
| Exports | 14,171 | 23,174 | 35,527 | 44,205 | 50,100 | 56,621 | 64,098 |
| Total Cost | 24,636 | 35,297 | 55,492 | 66,956 | 75,592 | 85,186 | 96,111 |
| **47-foot Channel** | | | | | | | |
| Imports | 10,155 | 11,764 | 19,374 | 22,077 | 24,737 | 27,719 | 31,064 |
| Exports | 13,751 | 22,487 | 34,474 | 42,895 | 48,615 | 54,943 | 62,199 |
| Total Cost | 23,906 | 34,251 | 53,848 | 64,972 | 73,352 | 82,662 | 93,263 |
| **48-foot Channel** | | | | | | | |
| Imports | 9,885 | 11,451 | 18,859 | 21,491 | 24,080 | 26,983 | 30,239 |
| Exports | 13,386 | 21,890 | 33,558 | 41,755 | 47,324 | 53,484 | 60,547 |
| Total Cost | 23,271 | 33,341 | 52,418 | 63,246 | 71,404 | 80,467 | 90,786 |
| **49-foot Channel** | | | | | | | |
| Imports | 9,646 | 11,174 | 18,403 | 20,971 | 23,497 | 26,330 | 29,507 |
| Exports | 13,062 | 21,360 | 32,746 | 40,745 | 46,179 | 52,189 | 59,081 |
| Total Cost | 22,708 | 32,534 | 51,149 | 61,716 | 69,676 | 78,519 | 88,588 |
| **50-foot Channel** | | | | | | | |
| Imports | 9,438 | 10,933 | 18,005 | 20,518 | 22,989 | 25,761 | 28,869 |
| Exports | 12,779 | 20,899 | 32,039 | 39,864 | 45,181 | 51,062 | 57,805 |
| Total Cost | 22,217 | 31,831 | 50,044 | 60,382 | 68,170 | 76,822 | 86,674 |

Table V-38
Port Arthur Petroleum and Chemical Product Imports and Exports
Annual Transportation Cost ($1,000) by Trade Route and Decade (December 2008 Vessel Costs)

| | 2004/2006 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| **40-foot Channel** | | | | | | | |
| Imports | 5,956 | 6,887 | 11,616 | 13,244 | 14,835 | 16,619 | 18,620 |
| Exports | 17,563 | 28,722 | 44,032 | 54,788 | 62,094 | 70,176 | 79,444 |
| Total Cost | 23,519 | 35,609 | 55,648 | 68,032 | 76,930 | 86,796 | 98,064 |
| **45-foot Channel** | | | | | | | |
| Imports | 5,039 | 5,826 | 9,826 | 11,204 | 12,550 | 14,059 | 15,751 |
| Exports | 14,858 | 24,297 | 37,249 | 46,347 | 52,529 | 59,366 | 67,205 |
| Total Cost | 19,896 | 30,123 | 47,075 | 57,551 | 65,079 | 73,425 | 82,957 |
| **46-foot Channel** | | | | | | | |
| Imports | 4,887 | 5,651 | 9,531 | 10,867 | 12,173 | 13,637 | 15,278 |
| Exports | 14,411 | 23,567 | 36,130 | 44,955 | 50,950 | 57,582 | 65,186 |
| Total Cost | 19,298 | 29,218 | 45,661 | 55,822 | 63,123 | 71,219 | 80,464 |
| **47-foot Channel** | | | | | | | |
| Imports | 4,745 | 5,486 | 9,253 | 10,551 | 11,818 | 13,240 | 14,833 |
| Exports | 13,991 | 22,881 | 35,077 | 43,645 | 49,466 | 55,905 | 63,287 |
| Total Cost | 18,736 | 28,367 | 44,331 | 54,196 | 61,285 | 69,144 | 78,121 |
| **48-foot Channel** | | | | | | | |
| Imports | 4,627 | 5,351 | 9,025 | 10,290 | 11,526 | 12,912 | 14,466 |
| Exports | 13,646 | 22,315 | 34,210 | 42,567 | 48,244 | 54,523 | 61,723 |
| Total Cost | 18,273 | 27,666 | 43,235 | 52,856 | 59,770 | 67,435 | 76,189 |
| **49-foot Channel** | | | | | | | |
| Imports | 4,529 | 5,237 | 8,832 | 10,071 | 11,281 | 12,637 | 14,158 |
| Exports | 13,355 | 21,840 | 33,481 | 41,659 | 47,215 | 53,361 | 60,408 |
| Total Cost | 17,884 | 27,076 | 42,314 | 51,730 | 58,496 | 65,998 | 74,566 |
| **50-foot Channel** | | | | | | | |
| Imports | 4,453 | 5,149 | 8,684 | 9,901 | 11,091 | 12,425 | 13,920 |
| Exports | 13,130 | 21,472 | 32,918 | 40,959 | 46,422 | 52,464 | 59,392 |
| Total Cost | 17,583 | 26,621 | 41,602 | 50,861 | 57,513 | 64,888 | 73,312 |

Table V-39
SNWW Petroleum and Chemical Products Annual Savings by Channel Depth Alternative, 2019–2069
($1,000s)

| | 2004–2006 | 2019 | 2030 | 2040 | 2050 | 2060 | 2069 |
|---|---|---|---|---|---|---|---|
| SNWW Total Petroleum Product Imports | | | | | | | |
| 45-foot | 2,932.7 | 3,395.3 | 5,633.8 | 6,421.2 | 7,194.1 | 8,060.7 | 9,032.6 |
| 46-foot | 3,414.3 | 3,952.9 | 6,559.0 | 7,475.7 | 8,375.5 | 9,384.5 | 10,516.0 |
| 47-foot | 3,866.7 | 4,476.8 | 7,428.3 | 8,466.5 | 9,485.5 | 10,628.2 | 11,909.7 |
| 48-foot | 4,253.7 | 4,924.8 | 8,171.6 | 9,313.7 | 10,434.6 | 11,691.6 | 13,101.4 |
| 49-foot | 4,591.6 | 5,316.0 | 8,820.4 | 10,053.1 | 11,263.1 | 12,619.9 | 14,141.5 |
| 50-foot | 4,876.2 | 5,645.5 | 9,366.5 | 10,675.5 | 11,960.4 | 13,401.2 | 15,017.1 |
| SNWW Total Petroleum Product Exports | | | | | | | |
| 45-foot | 5,434.3 | 8,886.9 | 13,624.2 | 16,952.0 | 19,212.9 | 21,713.5 | 24,581.0 |
| 46-foot | 6,327.9 | 10,348.1 | 15,864.3 | 19,739.3 | 22,371.9 | 25,283.7 | 28,622.7 |
| 47-foot | 7,167.6 | 11,721.3 | 17,969.5 | 22,358.7 | 25,340.7 | 28,638.9 | 32,421.0 |
| 48-foot | 7,878.6 | 12,884.2 | 19,752.2 | 24,576.9 | 27,854.6 | 31,480.1 | 35,637.3 |
| 49-foot | 8,493.4 | 13,889.5 | 21,293.5 | 26,494.6 | 30,028.1 | 33,936.5 | 38,418.1 |
| 50-foot | 9,000.1 | 14,718.2 | 22,563.8 | 28,075.3 | 31,819.6 | 35,961.1 | 40,710.2 |

Table V-40
SNWW Petroleum Product Coastwise Shipments and Receipts
Vessel Data, Base Tonnage, and Transportation Savings Benefit Summary
(December 2008 Vessel Costs)

**Origin-Destination Data: U.S. East Coast to/from SNWW**

| | |
|---|---|
| Initial % of total outbound shipments: | 10 |
| Round trip mileage | 3,000 |
| Hourly Cost at Sea: | 2,425 |
| Hourly Cost in Port: | 2,007 |
| Vessel Speed (Knots) | 14 |

**Vessel Input Data and Transportation Cost**

| Channel Depth (feet) | Design Draft (feet) | Vessel DWT | No. of feet Light-Loaded | Cargo by Channel Depth | Round Trip Voyage Cost ($) | Loading, Unloading and Port Cost ($) | Total Cost ($) | Cost Per Ton ($) |
|---|---|---|---|---|---|---|---|---|
| 40 | 45 | 75,000 | 6 | 58,571 | 519,643 | 124,110 | 643,753 | 10.99 |
| 45 to 50 | 45 | 75,000 | 1 | 69,173 | 519,643 | 124,110 | 641,908 | 9.64 |
| | | | | | | | Saving/ton | 1.36 |

**SNWW Domestic Coastwise Petroleum Product Tonnage**

| Year | Total Short Tons | Short Tons Used for Benefits |
|---|---|---|
| 2004–2006 Average | 5,068,000 | 506,800 |

**SNWW Domestic Coastwise Petroleum Product Annual Transportation Benefits**

| Year | Total Tonnage | Used for Benefits | Percentage Used for Benefits | Annual Savings ($) |
|---|---|---|---|---|
| 2002–2004 | 5,067,667 | 506,767 | 10 | 687,121 |
| 2019 | 7,901,200 | 790,120 | 10 | 1,071,317 |
| 2029 | 9,878,897 | 987,890 | 10 | 1,339,472 |
| 2039 | 11,856,594 | 1,185,659 | 10 | 1,607,626 |
| 2049 | 13,834,291 | 1,383,429 | 10 | 1,875,781 |
| 2059 | 15,811,988 | 1,581,199 | 10 | 2,143,935 |
| 2069 | 17,789,685 | 1,778,968 | 10 | 2,412,089 |

Table V-41
Beaumont Wheat Exports, Shipments to Europe, Mediterranean, and Far East
Total Cost per Ton by Channel Depth (December 2008 Vessel Costs)
(All costs in dollars)

| | Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 70,000 | 20.07 | 16.83 | 16.83 | 15.80 | 15.80 | 15.80 | 15.80 |
| 80,000 | 19.58 | 16.39 | 16.39 | 15.38 | 14.92 | 14.49 | 14.49 |
| 90,000 | 17.97 | 15.24 | 14.78 | 14.35 | 13.94 | 13.56 | 13.20 |
| 100,000 | 18.01 | 15.25 | 14.79 | 14.36 | 13.95 | 13.56 | 13.20 |
| 120,000 | 17.32 | 14.73 | 14.31 | 13.92 | 13.49 | 13.13 | 12.78 |

Table V-42
Beaumont Wheat Exports, Shipments to Europe, Mediterranean, and Far East
Total Cost ($1,000s) by Channel Depth (December 2008 Vessel Costs)

| | | Transportation Cost ($1,000s) by Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DWT | % by Vessel DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 70,000 | 2.0 | 7,883 | 6,610 | 6,610 | 6,208 | 6,208 | 6,208 | 6,208 |
| 80,000 | 15.0 | 7,691 | 6,437 | 6,437 | 6,040 | 5,860 | 5,690 | 5,690 |
| 90,000 | 55.0 | 7,059 | 5,984 | 5,805 | 5,636 | 5,477 | 5,327 | 5,184 |
| 100,000 | 20.0 | 7,074 | 5,991 | 5,811 | 5,642 | 5,479 | 5,327 | 5,184 |
| 120,000 | 8.0 | 6,802 | 5,786 | 5,621 | 5,466 | 5,298 | 5,156 | 5,019 |
| Weighted Cost | | 7,153 | 6,050 | 5,902 | 5,696 | 5,535 | 5,385 | 5,267 |
| 2005/2007 Savings | | | 1,103 | 1,251 | 1,457 | 1,618 | 1,768 | 1,886 |

Annual Transportation Savings

| | Transportation Savings ($1,000s) by Channel Depth (feet) | | | | | |
|---|---|---|---|---|---|---|
| Year | 45 | 46 | 47 | 48 | 49 | 50 |
| 2005/2007 | 1,103 | 1,251 | 1,457 | 1,618 | 1,768 | 1,886 |
| 2019 | 1,793 | 2,033 | 2,369 | 2,630 | 2,874 | 3,065 |
| 2029 | 1,980 | 2,246 | 2,617 | 2,905 | 3,174 | 3,386 |
| 2039 | 2,187 | 2,480 | 2,890 | 3,209 | 3,506 | 3,740 |
| 2049 | 2,416 | 2,740 | 3,193 | 3,545 | 3,873 | 4,132 |
| 2059 | 2,669 | 3,027 | 3,527 | 3,916 | 4,278 | 4,564 |
| 2069 | 2,948 | 3,343 | 3,896 | 4,325 | 4,726 | 5,041 |

Table V-43 presents the cost-per-ton transportation cost for steel slab and iron ore. The costs shown are for Beaumont tonnage. The costs for Port Arthur would be approximately 1 percent less. Based on existing port depths and vessel utilization, an estimated 15 percent of tonnage was projected to use channel depths over 40 feet for the years prior to 2014. By 2014, the expansion of the Panama Canal is expected to result in the existing base tonnage from the deepwater port of Lazaro Cardenas on the West Coast of Mexico to load to vessel drafts over 40 feet. At that time, an estimated 50 percent of tonnage is anticipated to be loaded to vessel drafts over 40 feet. As outlined in the Economic Appendix (Table 48) 99 percent of sand and gravel 1999–2007 imports, 70 percent of limestone 1999–2007 imports, and 15 percent of 2005–2007 dry sulphur exports were shipped in vessels with design drafts of 40 feet or more. Review of the Lloyd's Register-Fairplay (2003) showed that 23 percent of bulk carriers constructed over the past decade are in the 66,000 to 78,000 DWT range. Table V-44 summarizes the annual transportation savings benefits for Beaumont's steel slab and iron ore import tonnage. Table V-45 summarizes the annual transportation savings benefits for Port Arthur's tonnage.

Table V-43
Beaumont Steel Slab and Iron Ore from South America, Mediterranean, and the Far East
(December 2008 Vessel Costs)

| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|
| Transportation Cost ($)/Ton to Port Arthur | | | | | | | |
| 60,000 | 17.63 | 14.60 | 14.13 | 13.66 | 13.66 | 13.66 | 13.66 |
| 70,000 | 15.60 | 13.08 | 12.68 | 12.29 | 12.29 | 12.29 | 12.29 |
| 80,000 | 15.22 | 12.74 | 12.35 | 11.96 | 11.60 | 11.26 | 11.26 |
| 90,000 | 14.12 | 11.95 | 11.60 | 11.25 | 10.94 | 10.63 | 10.35 |
| Transportation Cost ($)/Ton to Beaumont | | | | | | | |
| 60,000 | 18.35 | 15.22 | 14.73 | 14.23 | 14.23 | 14.23 | 14.23 |
| 70,000 | 16.23 | 13.63 | 13.22 | 12.80 | 12.80 | 12.80 | 12.80 |
| 80,000 | 15.84 | 13.29 | 12.89 | 12.49 | 12.12 | 11.77 | 11.77 |
| 90,000 | 14.70 | 12.47 | 12.12 | 11.77 | 11.44 | 11.14 | 10.84 |

The transportation cost calculations are based on a representative weighted mileage for the applicable South America, Mediterranean, and Far East routes. The weighted mileage is approximately 14,000 miles round trip. One of its greatest impacts would be felt in the breakbulk trade where expansion would enable larger vessels to transit the canal. Expansion of the canal project is expected to be completed in 2014. Completion of the Panama Canal expansion, from its present width restriction of 106 feet and approximate loaded draft limit of 39.6 feet, by the year 2014 would allow for more fully loaded vessel movements from deepwater ports in the Asia and the western coasts of Mexico and South America. The canal expansion would accommodate maximum loaded drafts of 15 meters or approximately 49 feet. Completion of the canal will coincides with port expansion projects in India and Chile. Steel is imported to SNWW from Dhamra. The Dhamra channel expansion will provide a channel depth of 18 meters, which can accommodate super cape-size vessels up to 180,000 DWT. Dhamra's master plan provides for 13 berths, capable of handling more than 83 million metric tons per annum of dry bulk, liquid bulk, breakbulk, and containerized cargo.

Table V-44
Beaumont Steel Slab and Iron Ore from South America, Mediterranean, and the Far East Tonnage and Annual Transportation Cost by Ton
($1,000) (December 2008 Vessel Costs)

| Year | Total Exports | Used for Benefit Calculations |
|---|---|---|
| 2001 | 103,000 | |
| 2002 | 204,000 | |
| 2003 | 115,000 | |
| 2004 | 420,000 | |
| 2005 | 471,000 | |
| 2006 | 364,000 | |
| 2007 | 173,000 | |
| 2019 | 428,221 | 213,254 |
| 2029 | 498,041 | 248,025 |
| 2039 | 579,247 | 288,465 |
| 2049 | 673,692 | 335,499 |
| 2059 | 783,537 | 390,201 |
| 2069 | 911,292 | 453,823 |

| Transportation Cost ($) by Vessel Size and Channel Depth Using 2005–2007 Average Tonnage* | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 60,000 | 616 | 511 | 495 | 478 | 478 | 478 | 478 |
| 70,000 | 545 | 458 | 444 | 430 | 430 | 430 | 430 |
| 80,000 | 532 | 446 | 433 | 420 | 407 | 395 | 395 |
| 90,000 | 494 | 419 | 407 | 395 | 385 | 374 | 364 |
| Average Cost | 547 | 459 | 445 | 431 | 425 | 419 | 417 |
| Average Savings | | 88 | 102 | 116 | 122 | 128 | 130 |

| Transportation Savings ($) by Year* | | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 46 | 47 | 48 | 49 | 50 |
| 2005/2007 | 88 | 102 | 116 | 122 | 128 | 130 |
| 2019 | 560 | 649 | 737 | 774 | 809 | 825 |
| 2029 | 652 | 755 | 857 | 900 | 941 | 960 |
| 2039 | 869 | 1,006 | 1,143 | 1,200 | 1,254 | 1,279 |
| 2049 | 1,175 | 1,360 | 1,546 | 1,623 | 1,697 | 1,730 |
| 2059 | 1,589 | 1,840 | 2,091 | 2,196 | 2,295 | 2,341 |
| 2069 | 2,150 | 2,489 | 2,828 | 2,970 | 3,105 | 3,166 |

*The costs are based on the 2005–2007 average tonnage volume multiplied by the cost per ton shown in Table V-43 for Beaumont.

Note: Application of data as presented may produce some differences due to rounding.

Table V-45
Port Arthur Steel Slab and Iron Ore from South America, Mediterranean, and the Far East Tonnage and Annual Transportation Cost by Ton
($1,000) (December 2008 Vessel Costs)

| Year | Total Exports | Used for Benefit Calculations |
|---|---|---|
| 2001 | 665,000 | |
| 2002 | 641,000 | |
| 2003 | 557,000 | |
| 2004 | 564,000 | |
| 2005 | 710,000 | |
| 2006 | 542,000 | |
| 2007 | 122,000 | |
| 2019 | 523,626 | 262,651 |
| 2029 | 607,630 | 304,787 |
| 2039 | 705,110 | 353,683 |
| 2049 | 818,228 | 410,423 |
| 2059 | 949,493 | 476,266 |
| 2069 | 1,101,817 | 552,671 |

| Transportation Cost ($) by Vessel Size and Channel Depth Using 2005–2007 Average Tonnage* | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 60,000 | 616 | 511 | 495 | 478 | 478 | 478 | 478 |
| 70,000 | 545 | 458 | 444 | 430 | 430 | 430 | 430 |
| 80,000 | 532 | 446 | 433 | 420 | 407 | 395 | 395 |
| 90,000 | 494 | 419 | 407 | 395 | 385 | 374 | 364 |
| Average Cost | 547 | 459 | 445 | 431 | 425 | 419 | 417 |
| Average Savings | | 88 | 102 | 116 | 122 | 128 | 130 |

| Transportation Savings ($) by Year* | | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 46 | 47 | 48 | 49 | 50 |
| 2005–2007 | 88 | 102 | 116 | 122 | 128 | 130 |
| 2019 | 560 | 649 | 737 | 774 | 809 | 825 |
| 2029 | 652 | 755 | 857 | 900 | 941 | 960 |
| 2039 | 869 | 1,006 | 1,143 | 1,200 | 1,254 | 1,279 |
| 2049 | 1,175 | 1,360 | 1,546 | 1,623 | 1,697 | 1,730 |
| 2059 | 1,589 | 1,840 | 2,091 | 2,196 | 2,295 | 2,341 |
| 2069 | 2,150 | 2,489 | 2,828 | 2,970 | 3,105 | 3,166 |

*The costs are based on the 2005–2007 average tonnage volume multiplied by the cost per ton shown in Table V-43 for Port Arthur.

Note: Application of data as presented may produce some differences due to rounding.

### Limestone and Rock Transportation Savings Benefits

As with steel slab and iron ore, the DWT range of bulk carriers used for the aggregate rock benefit calculations are in the 60,000 to 90,000 DWT range. Larger vessels could be used but are not anticipated over the next 20 years. The maximum size presently being used is 78,000 DWT. The transportation savings calculations were based on average costs for the anticipated 60,000 to 90,000 DWT range. As with the previous presentations, transportation costs and savings were calculated for vessels that minimize transportation costs given trade route constraints. The DWT range of bulk carriers used for the benefit calculations are in the 60,000 to 90,000 range.

The applicable tonnage forecast and average annual growth rate for 2002–2004 to 2069 was contained in tables V-10 and V-11. Based on existing port depths and vessel utilization, an estimated 50 percent of tonnage was projected to use channel depths over 40 feet. A representative weighted mileage for the applicable Mexico, South America, Mediterranean, and Far East routes was used. The weighted mileage is approximately 14,000 miles round trip. Table V-46 presents the cost-per-ton transportation costs. The costs shown are for Port Arthur tonnage. The costs for Beaumont would be approximately 1 percent higher. Table V-47 summarizes the annual transportation savings benefits for Beaumont's import and SNWW export tonnage. Table V-48 summarizes the annual transportation savings benefits for Port Arthur's import tonnage. Port Arthur's share of bulk material exports has historically been low in comparison to Beaumont's, with Beaumont's recent historical share representing approximately 90 percent of the SNWW total. Due to the recent historical distribution, the benefit calculations were estimated using the average mileage for Beaumont and Port Arthur. For presentation purposes, the benefit calculations for exports are presented in Table V-47.

Table V-46
SNWW Crude Material Imports and Exports via Mexico, South America, Mediterranean, and Far East Cost per Ton (December 2008 Vessel Costs)

| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|
| Transportation Cost ($)/Ton to Beaumont | | | | | | | |
| 60,000 | 17.93 | 14.85 | 14.37 | 13.89 | 13.89 | 13.89 | 13.89 |
| 70,000 | 15.86 | 13.30 | 12.90 | 12.49 | 12.49 | 12.49 | 12.49 |
| 80,000 | 15.48 | 12.96 | 12.56 | 12.16 | 11.80 | 11.46 | 11.46 |
| 90,000 | 14.36 | 12.14 | 11.80 | 11.45 | 11.12 | 10.82 | 10.52 |
| Transportation Cost ($)/Ton to Port Arthur | | | | | | | |
| 60,000 | 17.85 | 14.78 | 14.31 | 13.83 | 13.83 | 13.83 | 13.83 |
| 70,000 | 15.79 | 13.25 | 12.84 | 12.44 | 12.44 | 12.44 | 12.44 |
| 80,000 | 15.41 | 12.90 | 12.51 | 12.11 | 11.75 | 11.41 | 11.41 |
| 90,000 | 14.30 | 12.09 | 11.75 | 11.40 | 11.08 | 10.77 | 10.48 |

Table V-47
Beaumont Imports and SNWW Exports of Crude Materials
Mexico, South America, Mediterranean and the Far East Tonnage and
Annual Transportation Cost by Ton
($1,000) (December 2008 Vessel Costs)

| Year | Beaumont Imports | SNWW Exports | Total | Imports | Used for Benefit Calculations | |
|---|---|---|---|---|---|---|
| | | | | | Exports | Total |
| 2001 | 622,000 | 165,000 | 787,000 | | | |
| 2002 | 394,000 | 16,000 | 410,000 | | | |
| 2003 | 583,000 | 93,000 | 676,000 | | | |
| 2004 | 559,000 | 145,000 | 704,000 | | | |
| 2005 | 624,000 | 120,000 | 744,000 | | | |
| 2006 | 550,000 | 297,000 | 847,000 | | | |
| 2007 | 617,000 | 485,000 | 1,102,000 | | | |
| 2019 | 760,862 | 383,193 | 1,144,055 | 364,453 | 57,287 | 728,906 |
| 2029 | 884,920 | 444,711 | 1,329,631 | 423,877 | 66,484 | 847,754 |
| 2039 | 1,029,206 | 517,220 | 1,546,426 | 492,990 | 77,324 | 985,980 |
| 2049 | 1,197,017 | 601,552 | 1,798,569 | 573,371 | 89,932 | 1,146,742 |
| 2059 | 1,392,189 | 699,635 | 2,091,824 | 666,858 | 104,595 | 1,333,716 |
| 2069 | 1,619,184 | 813,710 | 2,432,894 | 775,589 | 121,650 | 1,551,178 |

Transportation Cost ($) by Vessel Size and Channel Depth Using
2005–2007 Average Tonnage*

| | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|
| 60,000 | 807 | 669 | 647 | 625 | 625 | 625 | 625 |
| 70,000 | 714 | 599 | 581 | 563 | 563 | 563 | 563 |
| 80,000 | 697 | 584 | 566 | 548 | 531 | 516 | 516 |
| 90,000 | 647 | 547 | 531 | 515 | 501 | 487 | 474 |
| Average Cost | 716 | 600 | 581 | 563 | 555 | 548 | 544 |
| Average Savings | | 117 | 135 | 154 | 161 | 169 | 172 |

Transportation Savings ($) by Year*

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| 2005/2007 | 117 | 135 | 154 | 161 | 169 | 172 |
| 2019 | 669 | 775 | 881 | 925 | 967 | 986 |
| 2029 | 777 | 899 | 1,022 | 1,073 | 1,122 | 1,144 |
| 2039 | 901 | 1,044 | 1,186 | 1,246 | 1,302 | 1,328 |
| 2049 | 1,046 | 1,211 | 1,376 | 1,446 | 1,511 | 1,541 |
| 2059 | 1,214 | 1,405 | 1,597 | 1,677 | 1,754 | 1,788 |
| 2069 | 1,408 | 1,631 | 1,853 | 1,947 | 2,035 | 2,075 |

*The costs are based on the 2005–2007 average tonnage multiplied by the cost per ton shown in Table V-46.

Note: Application of data as presented may produce some differences due to rounding.

Table V-48
Port Arthur Crude Material Imports from Mexico, South America, Mediterranean, and the Far East Tonnage and Annual Transportation Cost by Ton
($1,000) (December 2008 Vessel Costs)

| Year | Total Imports | Used for Benefit Calculations |
|---|---|---|
| 2001 | 131,000 | |
| 2002 | 919,000 | |
| 2003 | 481,000 | |
| 2004 | 531,000 | |
| 2005 | 558,000 | |
| 2006 | 566,000 | |
| 2007 | 513,000 | |
| 2019 | 712,739 | 356,370 |
| 2029 | 828,951 | 414,475 |
| 2039 | 964,110 | 482,055 |
| 2049 | 1,121,308 | 560,654 |
| 2059 | 1,304,136 | 652,068 |
| 2069 | 1,516,661 | 758,330 |

Transportation Cost ($) by Vessel Size and Channel Depth Using 2005–2007 Average Tonnage*

| | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|
| 60,000 | 1,022 | 846 | 819 | 792 | 792 | 792 | 792 |
| 70,000 | 904 | 758 | 735 | 712 | 712 | 712 | 712 |
| 80,000 | 882 | 739 | 716 | 693 | 672 | 653 | 653 |
| 90,000 | 819 | 692 | 672 | 653 | 634 | 617 | 600 |
| Average Cost | 907 | 759 | 736 | 712 | 703 | 693 | 689 |
| Average Savings | | 148 | 171 | 194 | 204 | 213 | 218 |

Transportation Savings ($) by Year*

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| 2005–2007 | 148 | 171 | 194 | 204 | 213 | 218 |
| 2019 | 999 | 1,156 | 1,313 | 1,393 | 1,469 | 1,515 |
| 2029 | 999 | 1,156 | 1,313 | 1,393 | 1,469 | 1,515 |
| 2039 | 1,162 | 1,344 | 1,527 | 1,620 | 1,708 | 1,762 |
| 2049 | 1,352 | 1,564 | 1,776 | 1,884 | 1,987 | 2,049 |
| 2059 | 1,572 | 1,819 | 2,065 | 2,191 | 2,311 | 2,383 |
| 2069 | 1,828 | 2,115 | 2,402 | 2,548 | 2,687 | 2,772 |

*The costs are based on the 2005–2007 average tonnage multiplied by the cost per ton shown in Table V-46.

Note: Application of data as presented may produce some differences due to rounding.

### Liquefied Natural Gas Transportation Savings Benefits

Table V-49 presents the trade route forecast used for the benefit calculations, Table V-50 presents the per-ton transportation cost, and Table V-51 presents the annual savings. The maximum loaded draft for LNG vessels is anticipated to be 40 to 42 feet. The majority of vessels would be loaded to 39 feet. The vessels will need from 3 to 6 feet of underkeel clearance. While the deepening benefits were believed to stop at an approximate channel depth of 43 feet, construction of LNG vessels with design drafts of 45 feet has taken place since 2007. The design drafts associated with 12 of the new vessels are identified to be in the 45-foot draft range (i.e., 13.6 meters).

Table V-49
SNWW Liquefied Natural Gas Trade Route Forecast, Short Tons

| Year | Middle East | Trinidad | Algeria | Total |
|---|---|---|---|---|
| 2019 | 1,946,522 | 1,940,695 | 1,940,695 | 5,827,913 |
| 2029 | 2,062,339 | 2,056,165 | 2,056,165 | 6,174,669 |
| 2039 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,670 |
| 2049 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,670 |
| 2059 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,670 |
| 2069 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,670 |

Table V-50
Liquefied Natural Gas Transportation Cost ($) per Ton by Channel Depth
Vessel DWT, and Shipment Origin (December 2008 Vessel Costs)

| Vessel | Middle East | | Trinidad | | Algeria | |
|---|---|---|---|---|---|---|
| DWT | 40 | 43 | 40 | 43 | 40 | 43 |
| 76,500 | 26.70 | 26.70 | 5.83 | 5.83 | 14.12 | 14.12 |
| 100,000 | 24.14 | 20.78 | 5.28 | 4.61 | 12.77 | 11.03 |
| 125,000 | 22.11 | 19.22 | 4.82 | 4.25 | 11.69 | 10.20 |

| | Savings/Ton for 43 feet for SNWW Fleet | | |
|---|---|---|---|
| DWT | Qatar | Trinidad | Algeria |
| 100,000 | 3.36 | 0.67 | 1.74 |
| 125,000 | 2.89 | 0.57 | 1.49 |
| Average | 3.12 | 0.62 | 1.62 |

Table V-51
SNWW Liquefied Natural Gas Annual Transportation Savings ($) by Trade Route*
(December 2008 Vessel Costs)

| Year | Middle East | Trinidad | Algeria | Total |
|---|---|---|---|---|
| 2019 | 6,080,341 | 1,209,365 | 3,137,311 | 10,427,016 |
| 2029 | 6,442,118 | 1,281,321 | 3,323,978 | 11,047,417 |
| 2039 | 6,442,121 | 1,281,321 | 3,323,978 | 11,047,420 |
| 2049 | 6,442,121 | 1,281,321 | 3,323,978 | 11,047,420 |
| 2059 | 6,442,121 | 1,281,321 | 3,323,978 | 11,047,420 |
| 2069 | 6,442,121 | 1,281,321 | 3,323,978 | 11,047,420 |

*Savings are multiplied by tonnage (Table V-49) and savings (Table V-50). Totals are subject to rounding.

## Summary of Channel Deepening Benefits

Table V-52 presents the transportation cost savings by major commodity group for channel deepening. The majority of benefits are associated with imports of crude petroleum, LNG, and petroleum product and exports of petroleum products. Crude petroleum and petroleum products represent 84 percent of the benefits at the 45-foot depth and 89 percent at the 50-foot depth. The LNG composes 7 percent of benefits at the 45-foot depth and 4 percent at 50 feet. The LNG benefits are for facilities in the Sabine Pass Channel and Port Arthur Canal reaches. Distributions of the Taylor Bayou, Port Arthur, and Neches River deepening benefits are presented in Tables V-53.

Table V-52
Total Average Annual Deepening Benefits ($1,000s)
(50-Year Period of Analysis at 4.375%)
by Project Depth Alternative
(December 2008 Vessel Costs)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| Crude Petroleum Imports | 41,130 | 48,650 | 53,411 | 61,081 | 66,173 | 68,759 |
| Petroleum Products Imports | 5,923 | 6,896 | 7,810 | 8,591 | 9,273 | 9,848 |
| Petroleum Products Exports | 15,309 | 17,826 | 20,191 | 22,194 | 23,926 | 25,354 |
| Coastwise | 1,481 | 1,481 | 1,481 | 1,481 | 1,481 | 1,481 |
| Grain Exports | 2,172 | 2,463 | 2,870 | 3,187 | 3,482 | 3,714 |
| Breakbulk | 4,536 | 5,247 | 5,247 | 5,247 | 5,247 | 5,247 |
| LNG | 11,140 | 11,140 | 11,140 | 11,140 | 11,140 | 11,140 |
| Deepening Benefits | 81,691 | 93,703 | 102,150 | 112,921 | 120,722 | 125,543 |

Table V-53
Total Average Annual Benefits ($1,000s)
by Channel Reach and Alternative
(50-Year Period of Analysis at 4.375%) (December 2008 Vessel Costs)

| Reach and Commodity | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| **Sabine Pass LNG** | 3,676 | 3,676 | 3,676 | 3,676 | 3,676 | 3,676 |
| **Port Arthur LNG** | 7,464 | 7,464 | 7,464 | 7,464 | 7,464 | 7,464 |
| **Taylor Bayou** | | | | | | |
| Crude Petroleum Imports | 5,790 | 6,892 | 7,510 | 7,964 | 8,305 | 8,928 |
| Petroleum Product Imports | 2,369 | 2,758 | 3,124 | 3,436 | 3,709 | 3,939 |
| Petroleum & Chemical Product Exports | 7,348 | 8,556 | 9,692 | 10,653 | 11,485 | 12,170 |
| Coastwise Petro Products | 563 | 563 | 563 | 563 | 563 | 563 |
| **Taylor Bayou Total** | 16,070 | 18,769 | 20,889 | 22,616 | 24,062 | 25,600 |
| **Sabine-Neches Canal** | | | | | | |
| Breakbulk and Aggregate | 2,065 | 2,387 | 2,387 | 2,387 | 2,387 | 2,387 |
| **Neches River Channel to Beaumont** | | | | | | |
| Crude Petroleum Imports | 35,340 | 41,759 | 45,901 | 53,117 | 57,868 | 59,832 |
| Petroleum Product Imports | 3,554 | 4,138 | 4,686 | 5,155 | 5,564 | 5,909 |
| Petroleum & Chemical Product Exports | 7,961 | 9,269 | 10,499 | 11,541 | 12,442 | 13,184 |
| Coastwise Petroleum Products | 918 | 918 | 918 | 918 | 918 | 918 |
| Grain Exports | 2,172 | 2,463 | 2,870 | 3,187 | 3,482 | 3,714 |
| Breakbulk and Aggregate | 2,471 | 2,860 | 2,860 | 2,860 | 2,860 | 2,860 |
| **Neches River Total** | 52,416 | 61,407 | 67,734 | 76,777 | 83,134 | 86,417 |

## V.E CHANNEL WIDENING BENEFITS

The SNWW is currently subject to transit rules that are needed for the pilots to safely guide large tankers through the narrow channel. The waterway's high volume of inland barge and deep-draft vessel traffic exacerbates congestion and results in increased delays and accident probabilities. To address these problems, a range of alternatives was evaluated, including channel widening and sidings. The effect of the project alternatives would be to reduce delay frequencies and durations. An additional expectation would be reductions in accident probabilities. Benefits were not quantified for reductions in accidents because, while accident probabilities are high, rates are low. Traffic increases and associated congestion recognizably increase the probability of accidents; however, "avoidance behavior," in the form of delays characterized by the existing conditions, keeps accident rates low. This behavior provides the basis for the monetary benefits associated with the proposed project alternatives as the proposed modifications would reduce the duration and frequency of delays.

Reduction in delay benefits were calculated for channel widening and for holding area alternatives. The benefit estimates are based on comparison of transit times between project alternatives. Transportation costs for existing conditions, the without-project condition, and the project alternatives were calculated using 2004 SNWW traffic base. Vessel characteristics and related details were obtained from the USACE NDC detailed records.

In terms of channel width, there are three main traffic rules presently affecting vessel traffic. The traffic rules, which affect movements in the 400- and 500-foot project reaches, are instituted by the SPA for the purpose of helping to ensure safe navigation. The general categorization of the transit rules are daylight-only sailing restrictions applied in specific reaches for vessels that exceed certain DWT, length, and breadth criteria. There is no meeting during nighttime sailing for vessels exceeding a given draft limitation. No meeting during either day or night applied to vessels by DWT, length, breadth, draft combinations. The specific rules posted by the Sabine Pilots are displayed in Table V-54. The results of these rules provide for a safe channel and a relatively low accident rate. The rules also affect a significant portion of traffic in the form of vessel delays.

The HarborSym model was used in evaluation of the entrance channel widening and the Neches River TB and anchorage features. HarborSym is a planning-level model developed by IWR to assist in economic analyses of channel widening improvements. HarborSym is an event-driven simulation model and includes data from user-specified transit rules that the model processes with each vessel call in order to calculate delays within the system. The model is presently in the model certification process. While not yet certified, the model is scheduled for review under the USACE certification system. The model is presently being used by several USACE district offices for channel widening studies, and the outputs of these studies have undergone Agency Technical Review (ATR) and USACE headquarters review.

HarborSym outputs were crucial for aggregation and understanding of base condition delays. Pilot interviews were used to identify a wide range of information, including delay times. Vessel class-specific

delay times were obtained from the model output, with these inputs having been defined using pilot logs and extensive pilot interviews. The key element in modeling the harbor system was replicating transit rules as listed in Table V-54.

Table V-54
SNWW Pilot's Rules

General: Vessels 85,000 DWT or over, or greater than 875 feet in length and 125 feet in beam width will move during daylight hours only above the Texas Island intersection with the GIWW West. In the event that meeting situations are applicable but circumstances will not permit the utilization of turning basins, the following criteria will prevail:

1. Vessels with combined beam widths that equal or exceed one-half of the channel width will not meet day or night.
2. Vessels 48,000 metric DWT or more with a draft of 30 feet or more will not meet above Buoys 29 and 30.
3. Vessels ≥85,000 DWT will not meet vessels of either ≥30,000 DWT or ≥30-foot draft above Buoys 29 and 30.
4. Vessels ≥85,000 DWT will not meet vessels of either ≥30,000 DWT or ≥25-foot draft above the Texas Island intersection.
5. Vessels with a combined draft of 70 feet or more will not meet between the Neches River intersection and Day Beacon #40 (Smith Bluff) at night. Vessels with a combined draft of 65 feet or more will not meet above Day Beacon #40 at night.

Source: SPA (2007).

Benefits from reductions in delays were calculated for widening the 500-foot entrance channel sections to a project width of 700 feet. A 700-foot project width up to the junction of the Sabine-Neches Canal with Taylor Bayou would provide a consistent series of reaches for vessels to meet. Specifically, it would allow two-way traffic for vessels that cannot presently meet in the 500-foot sections of the reaches. The 700-foot reach does not presently cause the pilots to impose vessel-meeting restrictions. The portions of the channel that are presently 500 feet do result in vessel meeting restrictions. The delays associated with the 500-foot width are a problem.

Two-way traffic is not allowed for LNG tankers under either the without- or with-project future. Construction of the Sabine Pass terminal is presently complete and the first vessels arrived in April 2008. Construction of the Golden Pass LNG terminal is scheduled for completion in September 2010. Construction of the third permitted facility, Port Arthur, is anticipated after 2012. All LNG tankers would be subject to one-way traffic rules in spite of channel widening. The LNG facilities are located in the Sabine Pass Channel and Port Arthur Canal reaches; these reaches are presently 500 feet. The ERDC modeling that was performed under the direction of the permit applicants showed that 500 feet is adequate for one-way transits of LNG vessels. The LNG traffic would be affected by USCG rules limiting the distance of other vessels traveling before and after the LNG tanker. Delays resulting from LNG traffic would occur under both the without- and with-project conditions. Channel deepening and widening would decrease the duration and frequency of delays for LNG and all vessels affected by either pilot or USCG rules. The beam widths for the smallest LNG (i.e., 76,000 DWT) are in the 142- to 158-foot range.

In addition to widening the entrance channel reaches, widening of the Neches River Channel to Beaumont was also evaluated and modeled by the ERDC. The results of the ERDC modeling showed increasing the Neches River channel width from 400 to 500 feet was not sufficient for safe negotiation of vessel meeting. Furthermore, both the 500-foot width and more optimal widths necessary for two-way traffic would necessitate extensive dock modifications and land acquisition, and this cost was anticipated to greatly exceed the reduction in delays that it would afford.

As a less costly and more practical alternative to the Neches River widening, the Sabine Pilots suggested the use of "sidings" or "channel pull-overs" to help facilitate vessel meeting. At the present time, suggested sites are commonly referred to and used as TB. The TBs are presently used as "holding" or "waiting areas"; however, the depth and width of these areas do not accommodate the full range of larger tankers common on the SNWW. Again, the "holding areas" serve the dual function of TB. In spite of their depth and width limitations, the TB are presently used to facilitate turning small vessels and are also used to "tuck small vessels away" while other vessels move along the channel.

## Vessel Traffic

Over 70 percent of SNWW's 1998–2007 crude petroleum tonnage was shipped in vessels of 90,000 DWT or larger, up by 30 percent since the early 1990s. The largest concentration of SNWW crude petroleum tonnage is in vessels between 90,000 and 119,999 DWT. Table V-55 displays SNWW's 1990–2004 crude oil import by vessel class.

Table V-56 presents 1990–2007 vessel trips by loaded draft for vessels. Analysis of the data showed that trips increased at an annual rate of 3.7 percent, with the highest rates of growth for 36 feet and greater. Total trips for drafts over 35 feet greater at an average annual rate of 7.3 percent, while trips for loaded drafts of 35 feet or less grew at 3.7 percent. For the period 1990–2007, total deep-draft tonnage grew at an average annual rate of 5.2 percent.

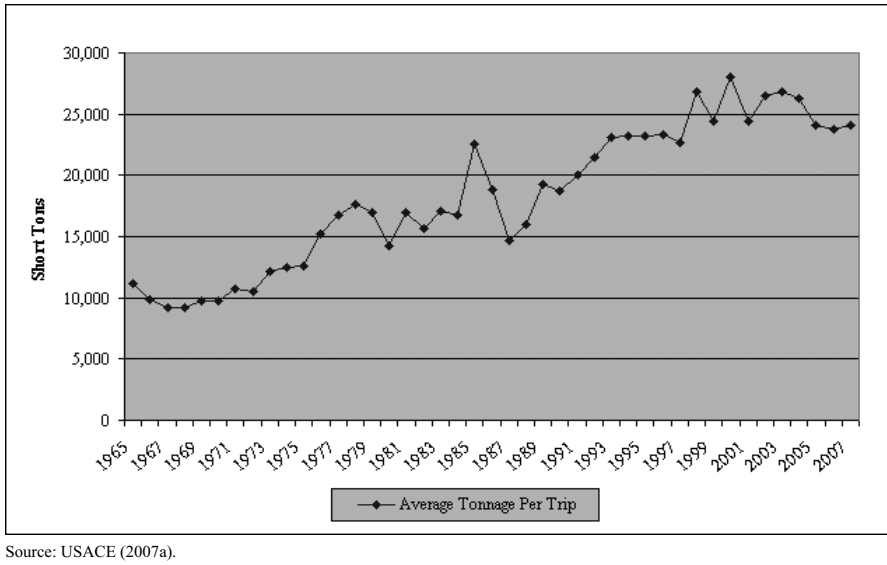
SNWW's vessel utilization patterns were also reviewed in terms of the average tonnage per trip for 1965–2007. Figure V-5 shows average tonnage per trip for oceangoing traffic. The graph shows trips increasing at a slightly decreasing rate and suggests an overall increase in average tonnage per trip. While the increases in the volume of tonnage per trip are primarily associated with crude petroleum and petrochemical products, larger vessels are being used for manufactured goods and crude materials. Since 1993, the volume of tonnage per vessel has increase as the variety of commodities using the waterway has diversified.

Table V-55
SNWW Crude Petroleum Imports,
Percentage of Imports by Vessel DWT,
and Design Draft and Year Built

| DWT 1,000s | 1993 | 1998 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|
| <50 | 0.6 | 0.1 | 0.1 | 0.4 | 0.8 | 1.6 | 0.9 | 0.8 |
| 50–74.5 | 3.8 | 1.2 | 8.5 | 3.1 | 1.7 | 1.8 | 3.4 | 3.7 |
| 75–84.9 | 18.4 | 8.1 | 8.6 | 18.1 | 20.4 | 18.0 | 25.0 | 23.0 |
| 85–89.9 | 17.3 | 10.6 | 9.9 | 4.6 | 0.5 | 0.0 | 0.3 | 0.0 |
| 90–119.9 | 56.0 | 72.1 | 65.6 | 65.8 | 67.8 | 71.8 | 63.8 | 66.3 |
| 120–149.9 | 1.9 | 2.7 | 2.8 | 2.7 | 3.3 | 3.0 | 2.0 | 1.7 |
| 150–175 | 2.0 | 5.2 | 4.5 | 5.3 | 5.5 | 3.8 | 4.6 | 4.5 |
| Total | 100.0 | 100 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, NDC unpublished data were used to compile the percentage distribution of tonnage by vessel size. The Lloyd's Register-Fairplay were used to obtain the vessel DWT and associated characteristics.

Figure V-5
Sabine-Neches Waterway
1965–2007
Average Tonnage per Trip for Ocean-Going Vessels




Source: USACE (2007a).

Table V-56
SNWW Trips by Loaded Draft (Includes Loaded and Light Vessels)

| SNWW Total Inbound and Outbound Trips by Loaded Draft (feet) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year/feet | ≥43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | ≤35 | Total |
| 1990 | – | – | 39 | 42 | 123 | 82 | 80 | 52 | 1,511 | 1,929 |
| 1993 | 2 | – | – | 115 | 77 | 214 | 209 | 155 | 1,261 | 2,033 |
| 1996 | 1 | – | – | 160 | 192 | 277 | 279 | 168 | 1,274 | 2,351 |
| 1999 | – | 1 | – | 117 | 139 | 276 | 142 | 172 | 1,987 | 2,834 |
| 2000 | – | – | – | 107 | 139 | 325 | 156 | 155 | 2,096 | 2,978 |
| 2001 | 1 | – | – | 124 | 168 | 324 | 175 | 173 | 2,090 | 3,055 |
| 2002 | – | 2 | – | 167 | 112 | 441 | 167 | 146 | 2,258 | 3,293 |
| 2003 | 1 | – | 1 | 289 | 114 | 347 | 158 | 175 | 2,364 | 3,449 |
| 2004 | 2 | – | – | 248 | 232 | 300 | 167 | 147 | 2,508 | 3,604 |
| 2005 | – | – | – | 206 | 154 | 312 | 189 | 178 | 2,410 | 3,449 |
| 2006 | 1 | – | 1 | 185 | 148 | 545 | 231 | 78 | 2,136 | 3,425 |
| 2007 | – | – | 2 | 178 | 271 | 263 | 136 | 143 | 2,380 | 3,373 |
| Inbound Trips by Loaded Draft (feet) | | | | | | | | | | |
| Year/feet | ≥43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | ≤35 | Total |
| 1990 | – | – | 14 | 38 | 102 | 69 | 55 | 33 | 610 | 921 |
| 1993 | 1 | – | – | 56 | 37 | 108 | 104 | 78 | 642 | 1026 |
| 1996 | 1 | – | – | 80 | 95 | 140 | 139 | 83 | 627 | 1,165 |
| 1999 | – | – | – | 101 | 121 | 250 | 126 | 135 | 657 | 1,390 |
| 2000 | – | – | – | 86 | 110 | 289 | 127 | 113 | 689 | 1,414 |
| 2001 | – | – | – | 101 | 147 | 301 | 147 | 114 | 646 | 1,456 |
| 2002 | – | – | – | 141 | 97 | 382 | 145 | 108 | 714 | 1,587 |
| 2003 | – | – | – | 254 | 102 | 289 | 130 | 121 | 746 | 1,642 |
| 2004 | 1 | – | – | 230 | 207 | 260 | 141 | 96 | 993 | 1,721 |
| 2005 | – | – | – | 181 | 141 | 280 | 164 | 104 | 762 | 1,632 |
| 2006 | – | – | 1 | 164 | 133 | 514 | 192 | 94 | 567 | 1,666 |
| 2007 | – | – | 2 | 148 | 252 | 209 | 107 | 73 | 869 | 1,660 |
| Outbound Trips by Loaded Draft (feet) | | | | | | | | | | |
| Year/feet | ≥43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | ≤35 | Total |
| 1990 | – | – | 25 | 4 | 21 | 13 | 25 | 19 | 901 | 1,008 |
| 1993 | 1 | – | – | 59 | 40 | 106 | 105 | 77 | 619 | 1,007 |
| 1996 | – | – | – | 80 | 97 | 137 | 140 | 85 | 647 | 1,186 |
| 1999 | – | 1 | – | 16 | 18 | 26 | 16 | 37 | 1,330 | 1,444 |
| 2000 | – | 0 | – | 21 | 29 | 36 | 29 | 42 | 1,407 | 1,564 |
| 2001 | 1 | 0 | – | 23 | 21 | 23 | 28 | 59 | 1,444 | 1,499 |
| 2002 | – | 2 | – | 26 | 15 | 59 | 22 | 38 | 1,544 | 1,706 |
| 2003 | 1 | – | 1 | 35 | 12 | 58 | 28 | 54 | 1,618 | 1,807 |
| 2004 | 1 | – | – | 18 | 25 | 40 | 26 | 51 | 1,515 | 1,883 |
| 2005 | – | – | – | 25 | 13 | 32 | 25 | 74 | 1,648 | 1,817 |
| 2006 | – | – | – | 21 | 15 | 31 | 39 | 84 | 1,569 | 1,759 |
| 2007 | – | – | – | 30 | 19 | 54 | 29 | 70 | 1,511 | 1,713 |

Source: USACE (2007a).

Examination of world trends showed that vessels are not only requiring deeper drafts but that there is an increased concentration of wider beams. Table V-57 displays SNWW 2000, 2001, and 2004 distributions of deep-draft vessels by vessel beam. The table helps illustrate the concentration of wide-beamed vessels. Vessel widths over 110 feet are generally associated with crude oil tankers. An effect of the growing concentration in wider-beam vessels using SNWW is more-difficult and subsequently more-dangerous vessel-meeting situations. The existing 500-foot channel is not wide enough for vessels with beams of 125 feet or more to meet comparable or larger-sized vessels. Project alternatives include channel widening and the construction of vessel holding areas. Widening to 700 feet would enable meetings between Panamax vessels, which have beams of 106 feet, and non-LNG tankers with beams of 144 feet or greater. The availability of several holding area improvements along the Neches River would allow loaded vessels to await berths and would save time that they originally would have spent in an inbound transit mode when the berth became clear. With the holding areas, vessels would only have to shift from the anchorage instead of waiting to sail from offshore.

Table V-57
SNWW Total Vessel Trips for Piloted Vessels

| Vessel | 2000 | | 2001 | | 2004 | |
|---|---|---|---|---|---|---|
| Beam (feet) | Vessels | Percent | Vessels | Percent | Vessels | Percent |
| <95 | 619 | 34 | 659 | 37 | 528 | 23 |
| 100 | 91 | 5 | 128 | 7 | 230 | 10 |
| 106 | 273 | 15 | 292 | 16 | 367 | 16 |
| 115–134 | 219 | 12 | 238 | 13 | 253 | 11 |
| 135–144 | 565 | 31 | 475 | 26 | 804 | 35 |
| 145–154 | 36 | 2 | 18 | 1 | 46 | 2 |
| >155 | 18 | 1 | 0 | 0 | 69 | 3 |
| Total | 1,821 | 100 | 1,810 | 100 | 2,297 | 100 |

Source: SPA (2005).

As input to the HarborSym model vessel trip estimate were prepared for the 2000–2004 period base and for 2030–2040 average trips. The vessel classes were established based on the HarborSym vessel structure. The coding sheet corresponding to the vessel class groupings is presented in Table V-58. The 2000–2004 period tonnage and the 2000–2004 fleet data used to define existing traffic patterns are presented in tables V-59 and V-60.

Tables V-61 through V-63 present the 2030–2040 period tonnage and trip data. Table V-61 presents the 2030–2040 period tonnage. Table V-62 presents 2030–2040 vessel trips based on no deepening. Table V-63 presents 2030–2040 vessel trips based on deepening. Comparison of the 2030–2040 tonnage and vessel transit data presented in tables V-62 and V-63 shows that the number of vessels for the "without-deepening scenario" is 12 percent higher than the number for the "with-deepening scenario." The effect of modifications to the Sabine Pass Channel and Port Arthur Canal reaches would be a change in the vessel pilot rules. The pilot expectations are that the effect of deepening and widening would be likely to result in vessels with loaded drafts of less than 40 feet being able to meet; however, vessels with loaded drafts

Table V-58
HarborSym Vessel Classes

| | | Class 1 | Class 2 | Class 3 | Class 4 | Class 5 | Class 6 | Total Calls |
|---|---|---|---|---|---|---|---|---|
| Bulk | Min Beam | 0 | 76.1 | 105 | | | | |
| | Max Beam | 76 | 104.9 | 107 | | | | |
| | # calls | 46 | 143 | 59 | | | | 248 |
| | Min Capacity | 0 | 25,001 | 34,000 | | | | |
| | Max Capacity | 25,000 | 53000 | 78,000 | | | | |
| Chemical Tanker | Min Beam | 0 | 76.1 | 105 | 130 | | | |
| | Max Beam | 76 | 104.9 | 107 | 138 | | | |
| | # calls | 102 | 76 | 131 | 1 | | | 310 |
| | Min Capacity | 0 | 25001 | 33000 | 85,000 | | | |
| | Max Capacity | 25,000 | 44000 | 49000 | 105,000 | | | |
| General Cargo | Min Beam | 0 | 76.1 | 104 | 120 | | | |
| | Max Beam | 76 | 103.9 | 107 | 142 | | | |
| | # calls | 125 | 58 | 16 | 3 | | | 202 |
| | Min Capacity | 0 | 25,001 | 42,000 | 75,000 | | | |
| | Max Capacity | 25,000 | 50,000 | 69,000 | 95,000 | | | |
| LPG | Min Beam | 0 | 76.1 | 115 | 140 | | | |
| | Max Beam | 76 | 107 | 120 | 150 | | | |
| | # calls | 15 | 16 | 1 | 1 | | | 33 |
| | Min Capacity | 0 | 25,001 | 60,000 | 157,000 | | | |
| | Max Capacity | 25,000 | 56,000 | 70,000 | 167,000 | | | |
| MISC. | Min Beam | 0 | 106 | | | | | |
| | Max Beam | 76 | 131 | | | | | |
| | # calls | 3 | 2 | | | | | 5 |
| | Min Capacity | 0 | 50,000 | | | | | |
| | Max Capacity | 25,000 | 70,000 | | | | | |
| Oil Tanker | Min Beam | 60 | 104.1 | 115 | 127.1 | 142 | | |
| | Max Beam | 104 | 107 | 127 | 150 | 160 | | |
| | # calls | 153 | 96 | 49 | 657 | 15 | | 970 |
| | Min Capacity | 8,000 | 45,000 | 67,000 | 80,000 | 133,000 | | |
| | Max Capacity | 56,000 | 73,000 | 97,000 | 113000 | 170,000 | | |
| Tank Barge | Min Beam | 0 | 76.1 | | | | | |
| | Max Beam | 76 | 107 | | | | | |
| | # calls | 92 | 11 | | | | | 103 |
| | Min Capacity | 0 | 25,001 | | | | | |
| | Max Capacity | 25,000 | 50,000 | | | | | |
| Tug | Min Beam | 0 | 76.1 | | | | | |
| | Max Beam | 76 | 100 | | | | | |
| | # calls | 55 | 12 | | | | | 67 |
| | Min Capacity | 0 | 25,001 | | | | | |
| | Max Capacity | 25,000 | 50,000 | | | | | |
| Total Calls | # calls | 591 | 414 | 256 | 662 | 15 | | 1,938 |
| | | 30.5% | 21.4% | 13.2% | 34.2% | 0.8% | | 100.0% |

Table V-59
SNWW 2000–2004 Base Tonnage (1,000s of Short Tons)*

| | 1,000s Tonnage by Vessel Class, 2000/2004 Base | | | | | |
|---|---|---|---|---|---|---|
| Type/Class Code | 1 | 2 | 3 | 4 | 5 | Total |
| Bulk | 544.6 | 3,964.1 | 2,596.2 | 0.0 | 0.0 | 7,105.0 |
| Chemical | 733.9 | 1,583.9 | 2,950.9 | 96.7 | | 5,365.5 |
| General Cargo | 705.3 | 418.6 | 190.6 | 24.1 | | 1,338.7 |
| LPG | 147.3 | 235.0 | 1.7 | 2.9 | | 386.9 |
| Misc. | 0.0 | 0.3 | | | | 0.4 |
| Oil Tanker | 9,595.6 | 4,344.8 | 2,915.0 | 52,542.6 | 1,170.0 | 70,568.1 |
| Tank Barge | 1,306.3 | 138.6 | | | | 1,444.9 |
| Tug | 17.6 | 153.1 | | | | 170.7 |
| LNG | | | | | 5,777.0 | 5,770.0 |
| Total | 6,370.0 | 10,838.6 | 15,335.4 | 52,666.3 | 6,947.0 | 95,150.1 |

*LNG tonnage and vessels were included in the 2000–2004 HarborSym traffic analysis.

Table V-60
SNWW 2030–2040 Tonnage (1,000s of Short Tons)

| | 1,000s Tonnage by Vessel Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Type/Class Code | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Bulk | 835 | 6,079 | 3,982 | – | – | – | 10,896 |
| Chemical | 1,231 | 2,656 | 4,949 | 162 | – | – | 8,998 |
| General Cargo | 1,155 | 685 | 312 | 40 | – | – | 2,191 |
| LPG | 235 | 376 | 3 | 5 | – | – | 618 |
| Misc. | – | – | – | – | – | – | – |
| Oil Tanker | 4,497 | 6,703 | 14,804 | 81,064 | 1,805 | – | 108,875 |
| Tank Barge | 2,284 | 270 | – | – | – | – | 2,553 |
| Tug | – | 1 | – | – | – | – | 1 |
| LNG | – | – | – | – | 5,777 | – | 5,777 |
| Total | 10,237 | 16,770 | 24,049 | 81,271 | 7,582 | – | 139,909 |

Table V-61
SNWW 2030–2040 Tonnage (1,000s of Short Tons)

| | 1,000s Tonnage by Vessel Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Type/Class Code | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Bulk | 835.2 | 6,079.4 | 3,981.6 | 0.0 | 0.0 | 0 | 10,896.2 |
| Chemical | 1,230.8 | 2,656.2 | 4,948.5 | 162.2 | 0.0 | 0 | 8,997.7 |
| General Cargo | 1,154.5 | 685.3 | 312.1 | 39.5 | 0.0 | 0 | 2,191.4 |
| LPG | 235.4 | 375.6 | 2.8 | 4.6 | 0.0 | 0 | 618.4 |
| Misc. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 |
| Oil Tanker | 14,804.4 | 6,703.3 | 4,497.4 | 81,064.4 | 1,805.2 | 0 | 108,874.7 |
| Tank Barge | 2,283.5 | 269.8 | 0.0 | 0.0 | 0.0 | 0 | 2,553.3 |
| Tug | 0.3 | 0.3 | | | | 0 | 0.6 |
| LNG | 0.0 | 0.0 | 0.0 | 0.0 | 12,073.3 | 0 | 12,073.3 |
| Total | 20,544.2 | 16,769.9 | 13,742.4 | 81,270.7 | 13,878.5 | 0 | 146,205.6 |

Table V-62
SNWW 2030–2040 Vessel Trips Without Deepening

| | Vessel Trips by Vessel Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Type/Class | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Bulk | 71 | 219 | 90 | 0 | 0 | 0 | 380 |
| Chemical | 171 | 127 | 220 | 2 | 0 | 0 | 520 |
| General Cargo | 205 | 95 | 26 | 5 | 0 | 0 | 331 |
| LPG | 24 | 26 | 2 | 2 | 0 | 0 | 53 |
| Misc. | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| Oil Tanker | 76 | 148 | 236 | 1,014 | 23 | 0 | 1,497 |
| Tank Barge | 145 | 17 | 0 | 0 | 0 | 0 | 163 |
| Tug | 87 | 19 | 0 | 0 | 0 | 0 | 105 |
| LNG | 0 | 0 | 0 | 0 | 119 | 0 | 119 |
| Total | 780 | 652 | 574 | 1,023 | 142 | 0 | 3,170 |

Table V-63
SNWW 2030–2040 Number of Vessel Trips With Deepening

| | Vessel Trips by Vessel Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Type/Class | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Bulk | 71 | 138 | 112 | 0 | 0 | 0 | 321 |
| Chemical | 171 | 80 | 210 | 6 | 0 | 0 | 467 |
| General Cargo | 205 | 60 | 41 | 7 | 0 | 0 | 312 |
| LPG | 24 | 14 | 7 | 3 | 0 | 0 | 48 |
| Misc. | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| Oil Tanker | 236 | 86 | 61 | 579 | 315 | 0 | 1,277 |
| Tank Barge | 145 | 17 | 0 | 0 | 0 | 0 | 162 |
| Tug | 87 | 19 | 0 | 0 | 0 | 0 | 105 |
| LNG | 0 | 0 | 0 | 0 | 119 | 0 | 119 |
| Total | 940 | 415 | 431 | 595 | 434 | 0 | 2,815 |

over 40 feet would be much more restricted. While the vessel pilots indicated that the effect of deepening would mean a loss of some of the gains in terms of relaxing rules 3–4 (see Table V-54), the combined effect of deepening and widening would result in a reduction in the number of trips necessary to transport a given volume of tonnage and provide added savings to remaining traffic.

### Entrance Channel Widening Benefits

The HarborSym model was run for existing conditions and each of the project alternatives. The widening alternatives included widening of the Sabine Pass Channel and Port Arthur Canal from 500 to 700 feet. Evaluation of widths less than 700 feet was also conducted. Widening of the Sabine Pass Channel and Port Arthur Canal reaches were evaluated with and without the Neches River TB and anchorage alternatives and the turning basin anchorage features were evaluated on an incremental basis. The transportation cost savings associated with widening of the Sabine Pass Channel and Port Arthur Canal reaches and Neches River TB and anchorage features were evaluated based on a 40-foot channel depth.

Examination of the output data shows that for the existing condition and pre–base year condition, which reflects the inclusion of LNG carriers, vessels are in the system for 78.2 hours. The output also shows that expansion of the Entrance Channel would reduce the time in system to 76.7 hours. In reviewing the changes in delay times, it was found that there are large variances in throughput times. The minimum time for the without-project condition was on average 11.9 hours and the minimum time for the with-project condition also averaged 11.9 hours. The larger crude oil tankers showed throughput savings for the with-project condition. For instance, Suezmax vessels took an average of 86.7 hours under the without-project condition and an average of 83.1 hours with the widened Entrance Channel. The addition of the LNG vessels would result in longer waiting times for several vessel classes. Without the LNG vessels, the average number of hours in the system was 66.4. The effect of introducing the LNG vessels increases total delay times but reduces average times because the LNG vessels represent a large increase in vessels that travel shorter distances than the existing tanker fleet going to the Neches River and, therefore would not be subject to delays.

Evaluation of widening of the Entrance Channel to 700 feet through the Sabine Pass Channel and Port Arthur Canal showed that, using 2000–2004 traffic levels, vessels would save an average of 1.5 hours per round-trip voyage, with an annual savings of $3,487,322. Evaluation of Port Arthur by itself resulted in annual savings of approximately $2,579,760.

The model was run using 2004-period traffic and 2035 projected traffic. The effect on the reduction in total vessel movements resulting from channel deepening is evaluated in the sensitivity section of the Economic Appendix. Table V-64 summarizes the average annual benefits for 2019–2069 for widening of the Sabine Pass Channel and the Port Arthur Canal. While the results show that widening the contingent reaches produces higher benefits than widening one reach without the other, widening the contingent reaches as a combined feature increases total benefits by less than the sum total. These results indicate that the added benefits decline when the second reach is added. Table V-65 displays the economic

summary data associated with the widening of Sabine Pass and the Port Arthur Canal. The results of the benefit-cost analysis indicated that widening was not an incremental justified feature.

Table V-64
Sabine Pass Channel and Port Arthur Canal
Average Annual Benefits (2008 Dollars at 4.375%)

| Year | Sabine Pass Channel | Port Arthur Canal | Sabine Pass Channel and Port Arthur Canal |
|---|---|---|---|
| 2004 | 2,269,264 | 2,579,760 | 3,487,322 |
| 2019 | 2,922,548 | 3,431,103 | 4,335,553 |
| 2029 | 3,738,979 | 4,431,691 | 5,486,406 |
| 2039 | 4,691,482 | 5,599,044 | 6,829,067 |
| 2049 | 5,262,983 | 6,299,456 | 7,634,664 |
| 2059 | 6,215,486 | 7,466,809 | 8,977,326 |
| 2069 | 7,548,990 | 9,101,103 | 10,857,052 |
| | | Average Annual Benefits (4.375%) | 6,379,579 |

Table V-65
Sabine Pass Channel and Port Arthur Canal
Widening Only
Economic Summary Data (2008 Dollars at 4.375%)

| Item | Sabine Pass Channel and Port Arthur Canal |
|---|---|
| First Cost | 78,448,000 |
| Mitigation Cost | 48,484,500 |
| Interest During Construction | 36,282,311 |
| Total First Cost | 163,241,841 |
| Average Annual Construction Cost | 8,091,727 |
| Incremental Average Annual O&M Cost | 9,587,005 |
| Total Average Annual Cost | 17,678,732 |
| Average Annual Benefits | 6,379,579 |
| BCR | 0.4 |

### Neches River Holding Areas

Evaluation of the Neches River AB was conducted using the HarborSym Model. These proposed features would be used to facilitate vessel passing. The locations of the TBs are contained in Table V-66. As the titles indicate, some of the individual features would include a TB and an anchorage (No. 1, 2, and 4) and some just a TB (No. 3, 5, and 6) or an anchorage (No. 7 and 8). The Sabine Pilots noted that the Turning Basin Anchorages (TBA), such as 1, 2, 4, 7, and 8 would be designed to enable a 48-foot loaded Suezmax tanker to use the inner portion of the feature as an anchorage and also allow a 48-foot loaded Suezmax tanker to turn in the TB section. While some of the features described in Table V-66 would be developed from existing basins (1, 4, and 6) or are new basins (2, 3, 5, 7, and 8), the anchorage components of the

Table V-66
Neches River Turning Basin and Anchorage Features

| | | | | | CURRENT USE Maximum Vessel Size and Federal Authority (Y/N) | | | | PROPOSED USE Maximum Vessel Size and Federal Authority (Y/N) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TURNING Maximum Vessel Size | | ANCHORAGE Maximum Vessel Size | | TURNING Maximum Vessel Size | | ANCHORAGE Maximum Vessel Size | |
| Title | Location | Description | Station Number | Estimated Miles from Sea Buoy | FEDERAL (Y/N) | | | | FEDERAL (Y/N) | | | |
| TBA 1 | Lower Fina | Turning Basin Anchorage 1 | 210+00 | 43.4 | Suezmax | Y | None* | N | Suezmax | Y | Suezmax | Y |
| TBA 2 | Upper Fina | Turning Basin Anchorage 2 | 275+00 | 44.6 | Suezmax* | N | None* | N | Suezmax | Y | Suezmax | Y |
| TB 3 | Pt Neches | Turning Basin 3 | 370+00 | 46.4 | None | N | None | N | Suezmax | Y | None | N |
| TBA 4 | Lower Sun | Turning Basin Anchorage 4 | 510+00 | 49.1 | Suezmax | Y | None* | N | Suezmax | Y | Suezmax | Y |
| TB 5 | Upper Sun | Turning Basin 5 | 570+00 | 50.2 | Shallow-Draft Barges** | N | Shallow-Draft Barges** | N | Suezmax | Y | None | N |
| TB 6 | Oil Tanking | Turning Basin 6 | 700+00 | 52.7 | Suezmax | Y | None | N | Suezmax | Y | None | N |
| AB 7 | PA 25 | Anchorage Basin 7 | 750+00 | 53.6 | None | N | None | N | None | N | Suezmax*** | Y |
| AB 8 | Below Exxon | Anchorage Basin 8 | 850+00 | 56.5 | None | N | None | N | None | N | Suezmax*** | Y |
| None | Beaumont | Beaumont Maneuvering Area | 975+00 | 58.8 | Suezmax | Y | None | N | Suezmax | Y | None | N |

*Light vessels under emergency conditions.

**Under existing conditions, TB 5 is private and used by shallow-draft barges. A new turning basin is proposed immediately north of existing TB 5. This basin would be designed for loaded Suezmax tankers.

***For the "with-project future," anchorage basins 7 and 8 are designed for anchorage; however, the pilots intend to use anchorage basins 7 and 8 for both the anchorage and turning of Suezmax vessels.

features are essentially new, and the proposed dimensions represent new dredging. All but TB 6 are proposed to be dredged over the existing 40-foot project depth. HarborSym was not used to evaluate deepening of the existing TBs. Benefits would be based on related delays in waiting and traveling to another TB.

As an example of how the TBs would be used, an inbound convoy would arrive on the Neches River Channel with the vessels going to docks on the upper end of the Neches leading the convoy. Each vessel would proceed to their respective dock and head into the berth (for the SNWW vessels turn after finishing at the dock). The availability of several holding area improvements was emphasized as it allow loaded vessels to await berths and would save time that they originally would have spent in an inbound transit mode when the berth became clear. With the holding areas, vessels would only have to shift from the anchorage instead of awaiting the ship to sail and to start in according to the traffic rules. The pilots noted that the number of hours saved depends on the dock facility and that the benefits would be primarily for the crude oil tankers and some product carriers; however, all traffic would realize some savings. The availability of anchorages is expected to allow the inclusion of additional ships as part of inbound convoys. Under present conditions, the size of an inbound convoy is limited to berth space. When the berths are available, the vessels would switch from the holding area to a berth. It was noted that it is quicker to put a vessel in an anchorage (approximately 20 minutes) than to dock (approximately 1 hour). Similarly, it is quicker to depart from anchorage than to undock and turn. The net result is that the convoys would move faster and include additional vessels.

The with-project condition would provide for concurrent use of TBA1, TBA2, and TBA4 for both turning and anchorage of individual vessels. An additional item revealed at the meetings was that the maximum vessel size using the TBs was the same for the without- and with-project conditions. Additionally the model assumptions were based on “no change in Neches River transit rules” for the with-project condition. At the meeting, the pilots said that they would, in fact, trade vessels out between the Neches River “holding areas” and “docks” despite night rules and beam and depth restrictions. The vessel arrivals and departures from the Neches River Channel are planned and/or orchestrated rather than random. Under present conditions, a new Neches River inbound fleet cannot come in until the outbound Neches River fleet has traveled down the Neches River Channel and has cleared the Jetty Channel and is in the Outer Bar Channel. Under the without-project condition, the vessels wait offshore. Under the with-project condition, they would also wait offshore; however, the sidings would allow a vessel to move to the dock and start unloading when, under the without-project condition, it would be waiting for an outbound convoy to clear the Jetty Channel. The convoy behavior would not change between the without- and with-project conditions. It is recognized that it would take extra time to maneuver in and out of the sidings, and the effect of this behavior is accounted for in the benefit estimates.

Initial input concerning the number of TBs, TBA combinations, and ABs was made based on pilot interviews. The TBs and TBA combinations are used for both turning and for vessels to wait while others pass. In regard to incremental justification of review concerns, the pilots expressed considerable reluctance to agree to anything less than the six TBs; however, they conceded that if priorities had to be

placed on TBA construction, the priorities would be 1, 4, and 7. Next noted grouping was 1, 4, 5, and 7. It was emphasized that the priority was for all TB improvements.

The benefits of the TB features were evaluated based on pilot input and examination of the HarborSym output data associated with waiting times and other related variables. The initial focus of the discussions with the pilots was to understand present use of the TBs and obtain clarification on the DWT, loaded drafts, beam, length, and number of vessels associated with each of the TBs. Presently, the TBs are used for vessel turning and holding of light vessels (i.e., loaded drafts less than 29 feet). Some TBs are also used for holding light Aframax tankers, again with drafts loaded to less than 29 feet. It was noted that Aframax tankers can be pushed into a TB; however, lack of maintenance dredging makes this practice less frequent and more difficult but it would occur if a vessel, communication, or other breakdown situation requires. The vessel arrivals and departures from the Neches River Channel are planned and/or orchestrated rather than random. Under present conditions, a new Neches River inbound fleet cannot come in until the outbound Neches River fleet has traveled down the Neches, has cleared the Jetty Channel, and is in the Outer Bar Channel. Under the without-project condition, the vessels wait offshore. Under the with-project condition, they would also wait offshore; however, the sidings would allow a vessel to move to the dock and start unloading when, under the without-project condition, it would be waiting for an outbound convoy to clear the Jetty Channel. By building the Neches River sidings, an inbound convoy can save a significant portion of the inbound transit time by being in the sidings and ready to move to the docks as the outbound convoy leaves. The convoy behavior would not change between the without- and with-project conditions. Table V-67 presents the HarborSym output associated with the Neches River anchorages. Discussion with the pilots indicated uncertainty concerning shifting charges; therefore, the effect of their inclusion was evaluated. The benefits were calculated based on shifting costs being levied 50 percent of the time. Tables V-68 and V-69 summarize the average annual savings in comparison to the average construction cost. Table V-68 is similar to Table V-69 and presents the same combinations but differs in that the annual benefits reflect inclusion of “pilot shifting costs” for 100 percent of the time. The annual benefits presented in tables V-67 and V-68 do not reflect future growth and are based on 2004-period traffic levels. Analysis of the data presented in the tables shows that the combination of basins that include alternatives 1, 4, and 8 produce the highest net excess benefits among the alternatives evaluated.

Table V-70 summarizes the project cost and benefits associated with the combination of 1, 4, and 8. The annual benefits presented in Table V-70 are average annual numbers and reflect future growth based on 2019–2069 traffic levels.

Table V-67
Neches River Anchorage Basins (2004-Period Savings)
(All costs in dollars)

| Feature | No Shifting Cost | With Shifting Cost | Shifting Cost 50% of the Time |
|---|---|---|---|
| Alt 1 | 1,011,421 | 212,798 | 612,110 |
| Alt 2 | 1,085,993 | 287,370 | 686,682 |
| Alt 3 | 5,045 | 1,335 | 3,190 |
| Alt 4 | 711,087 | 0 | 355,544 |
| Alt 5 | 3,304 | 0 | 1,652 |
| Alt 7 | 367,215 | 0 | 183,608 |
| Alt 8 | 278,304 | 0 | 139,152 |
| Alt 1, 2 | 1,590,026 | 791,403 | 1,190,715 |
| Alt 1, 3 | 1,012,551 | 213,928 | 613,240 |
| Alt 1, 4 | 1,598,751 | 800,128 | 1,199,440 |
| Alt 1, 5 | 1,012,551 | 213,928 | 613,240 |
| Alt 1, 7 | 1,328,837 | 530,215 | 929,526 |
| Alt 1, 8 | 1,263,380 | 464,758 | 864,069 |
| Alt 2, 4 | 1,598,187 | 799,565 | 1,198,876 |
| Alt 2, 7 | 1,413,856 | 615,233 | 1,014,545 |
| Alt 2, 8 | 1,344,211 | 0 | 672,106 |
| Alt 4, 7 | 1,178,793 | 380,170 | 779,482 |
| Alt 4, 8 | 1,103,461 | 304,838 | 704,150 |
| Alt 1, 2, 3 | 1,592,519 | 793,896 | 1,193,208 |
| Alt 1, 2, 4 | 1,897,906 | 1,099,283 | 1,498,595 |
| Alt 1, 2, 5 | 1,208,613 | 297,153 | 752,883 |
| Alt 1, 2, 7 | 1,824,395 | 1,025,773 | 1,425,084 |
| Alt 1, 2, 8 | 1,750,352 | 951,730 | 1,351,041 |
| Alt 1, 3, 4 | 1,601,048 | 802,425 | 1,201,737 |
| Alt 1, 3, 5 | 1,012,551 | 213,928 | 613,240 |
| Alt 1, 3, 7 | 1,334,789 | 536,166 | 935,478 |
| Alt 1, 3, 8 | 1,334,789 | 536,166 | 935,478 |
| Alt 1, 4, 5 | 1,601,048 | 802,425 | 1,201,737 |
| Alt 1, 4, 7 | 1,697,713 | 898,950 | 1,298,332 |
| Alt 1, 4, 8 | 1,761,501 | 962,878 | 1,362,190 |
| Alt 2, 4, 7 | 1,796,902 | 0 | 898,451 |
| Alt 2, 4, 8 | 1,750,548 | 0 | 875,274 |
| Alt 2, 7, 8 | 1,370,980 | 998,280 | 1,184,630 |
| Alt 4, 7, 8 | 1,259,138 | 460,516 | 859,827 |
| Alt 1, 2, 3, 4 | 1,902,467 | 1,103,845 | 1,503,156 |
| Alt 1, 2, 4, 7 | 2,100,114 | 1,301,491 | 1,700,803 |
| Alt 1, 2, 4, 8 | 2,062,240 | 1,263,618 | 1,662,929 |
| Alt 1, 2, 7, 8 | 1,879,960 | 1,081,337 | 1,480,649 |
| Alt 1, 4, 7, 8 | 1,850,392 | 1,051,629 | 1,451,011 |
| Alt 2, 3, 4, 5 | 1,797,233 | 998,610 | 1,397,922 |
| Alt 2, 4, 7, 8 | 1,707,628 | 909,005 | 1,308,317 |
| Alt 1, 2, 4, 7, 8 | 1,982,703 | 1,184,081 | 1,583,392 |
| Alt 2, 3, 4, 5, 7 | 1,797,233 | 998,610 | 1,397,922 |
| Alt 2, 4, 5, 7, 8 | 1,838,302 | 1,039,679 | 1,438,991 |
| Alt 3, 4, 5, 7, 8 | 1,261,556 | 462,934 | 862,245 |

Table V-68
Average Annual Cost, Transportation Savings Benefits, Net Excess Benefits (4.375%) and BCRs (No Shifting Charges)

| Feature | Average Annual Cost | Benefits Based on 2004-Period Traffic | Net Excess Benefits | BCR |
|---|---|---|---|---|
| | | (All costs in dollars) | | |
| Alt 1 | 317,880 | 1,011,421 | 693,541 | 3.2 |
| Alt 2 | 393,568 | 1,085,993 | 692,424 | 2.8 |
| Alt 3 | 120,157 | 5,045 | –115,112 | 0.0 |
| Alt 4 | 192,390 | 711,087 | 518,697 | 3.7 |
| Alt 5 | 351,101 | 3,304 | –347,797 | 0.0 |
| Alt 7 | 144,821 | 367,215 | 222,393 | 2.5 |
| Alt 8 | 132,768 | 278,304 | 145,536 | 2.1 |
| Alt 1, 2 | 711,448 | 1,590,026 | 878,578 | 2.2 |
| Alt 1, 3 | 438,037 | 1,012,551 | 574,514 | 2.3 |
| Alt 1, 4 | 510,270 | 1,598,751 | 1,088,481 | 3.1 |
| Alt 1, 5 | 462,701 | 1,012,551 | 549,849 | 2.2 |
| Alt 1, 7 | 450,648 | 1,328,837 | 878,189 | 2.9 |
| Alt 1, 8 | 317,880 | 1,263,380 | 945,501 | 4.0 |
| Alt 2, 4 | 585,958 | 1,598,187 | 1,012,229 | 2.7 |
| Alt 2, 7 | 538,390 | 1,413,856 | 875,466 | 2.6 |
| Alt 2, 8 | 526,337 | 1,344,211 | 817,874 | 2.6 |
| Alt 4, 7 | 337,211 | 1,178,793 | 841,582 | 3.5 |
| Alt 4, 8 | 325,158 | 1,103,461 | 778,303 | 3.4 |
| Alt 1, 2, 3 | 831,605 | 1,592,519 | 760,914 | 1.9 |
| Alt 1, 2, 4 | 903,838 | 1,897,906 | 994,068 | 2.1 |
| Alt 1, 2, 5 | 1,062,549 | 1,208,613 | 146,064 | 1.1 |
| Alt 1, 2, 7 | 856,269 | 1,824,395 | 968,126 | 2.1 |
| Alt 1, 2, 8 | 844,216 | 1,750,352 | 906,136 | 2.1 |
| Alt 1, 3, 4 | 630,427 | 1,601,048 | 970,621 | 2.5 |
| Alt 1, 3, 5 | 789,138 | 1,012,551 | 223,413 | 1.3 |
| Alt 1, 3, 7 | 582,858 | 1,334,789 | 751,930 | 2.3 |
| Alt 1, 3, 8 | 570,805 | 1,334,789 | 763,983 | 2.3 |
| Alt 1, 4, 5 | 861,371 | 1,601,048 | 739,677 | 1.9 |
| Alt 1, 4, 7 | 655,091 | 1,697,713 | 1,042,622 | 2.6 |
| Alt 1, 4, 8 | 643,038 | 1,761,501 | 1,118,463 | 2.7 |
| Alt 2, 4, 7 | 730,780 | 1,796,902 | 1,066,123 | 2.5 |
| Alt 2, 4, 8 | 889,491 | 1,750,548 | 861,057 | 2.0 |
| Alt 2, 7, 8 | 683,211 | 1,370,980 | 687,769 | 2.0 |
| Alt 4, 7, 8 | 469,980 | 1,259,138 | 789,159 | 2.7 |
| Alt 1, 2, 3, 4 | 1,023,995 | 1,902,467 | 878,472 | 1.9 |
| Alt 1, 2, 4, 7 | 1,048,659 | 2,100,114 | 1,051,455 | 2.0 |
| Alt 1, 2, 4, 8 | 1,036,606 | 2,062,240 | 1,025,634 | 2.0 |
| Alt 1, 2, 7, 8 | 989,038 | 1,879,960 | 890,922 | 1.9 |
| Alt 1, 4, 7, 8 | 787,859 | 1,850,392 | 1,062,533 | 2.3 |
| Alt 2, 3, 4, 5 | 1,057,216 | 1,797,233 | 740,017 | 1.7 |
| Alt 2, 4, 7, 8 | 863,548 | 1,707,628 | 844,080 | 2.0 |
| Alt 1, 2, 4, 7, 8 | 1,181,428 | 1,982,703 | 801,276 | 1.7 |
| Alt 2, 3, 4, 5, 7 | 1,202,038 | 1,797,233 | 595,195 | 1.5 |
| Alt 2, 4, 5, 7, 8 | 1,189,985 | 1,838,302 | 648,317 | 1.5 |
| Alt 3, 4, 5, 7, 8 | 941,238 | 1,261,556 | 320,318 | 1.3 |

Table V-69
Average Annual Cost, Transportation Savings Benefits, Net Excess Benefits (4.375%) and BCRs (Shifting Charges 100% of the Time)

| Feature | Average Annual Cost | Benefits Based on 2004-Period Traffic | Net Excess Benefits | BCR |
|---|---|---|---|---|
| | (All costs in dollars) | | | |
| Alt 1 | 317,880 | 212,798 | –105,082 | 0.7 |
| Alt 2 | 393,568 | 287,370 | –106,198 | 0.7 |
| Alt 4 | 192,390 | 0 | –192,390 | 0.0 |
| Alt 7 | 144,821 | 0 | –144,821 | 0.0 |
| Alt 8 | 132,768 | 0 | –132,768 | 0.0 |
| Alt 1, 2 | 711,448 | 791,403 | 79,955 | 1.1 |
| Alt 1, 3 | 438,037 | 213,928 | –224,109 | 0.5 |
| Alt 1, 4 | 510,270 | 800,128 | 289,859 | 1.6 |
| Alt 1, 5 | 462,701 | 213,928 | –248,773 | 0.5 |
| Alt 1, 7 | 450,648 | 530,215 | 79,567 | 1.2 |
| Alt 1, 8 | 317,880 | 464,758 | 146,878 | 1.5 |
| Alt 2, 4 | 585,958 | 799,565 | 213,607 | 1.4 |
| Alt 2, 7 | 538,390 | 615,233 | 76,843 | 1.1 |
| Alt 2, 8 | 526,337 | 0 | –526,337 | 0.0 |
| Alt 4, 7 | 337,211 | 380,170 | 42,959 | 1.1 |
| Alt 4, 8 | 325,158 | 304,838 | –20,320 | 0.9 |
| Alt 1, 2, 3 | 831,605 | 793,896 | –37,709 | 1.0 |
| Alt 1, 2, 4 | 903,838 | 1,099,283 | 195,446 | 1.2 |
| Alt 1, 2, 5 | 1,062,549 | 297,153 | –765,396 | 0.3 |
| Alt 1, 2, 7 | 856,269 | 1,025,773 | 169,503 | 1.2 |
| Alt 1, 2, 8 | 844,216 | 951,730 | 107,513 | 1.1 |
| Alt 1, 3, 4 | 630,427 | 802,425 | 171,998 | 1.3 |
| Alt 1, 3, 5 | 789,138 | 213,928 | –575,210 | 0.3 |
| Alt 1, 3, 7 | 582,858 | 536,166 | –46,692 | 0.9 |
| Alt 1, 3, 8 | 570,805 | 536,166 | –34,639 | 0.9 |
| Alt 1, 4, 5 | 861,371 | 802,425 | –58,946 | 0.9 |
| Alt 1, 4, 7 | 655,091 | 898,950 | 243,859 | 1.4 |
| Alt 1, 4, 8 | 643,038 | 962,878 | 319,840 | 1.5 |
| Alt 2, 4, 7 | 730,780 | 0 | –730,780 | 0.0 |
| Alt 2, 4, 8 | 889,491 | 0 | –889,491 | 0.0 |
| Alt 2, 7, 8 | 683,211 | 998,280 | 315,068 | 1.5 |
| Alt 4, 7, 8 | 469,980 | 460,516 | –9,464 | 1.0 |
| Alt 1, 2, 3, 4 | 1,023,995 | 1,103,845 | 79,850 | 1.1 |
| Alt 1, 2, 4, 7 | 1,048,659 | 1,301,491 | 252,832 | 1.2 |
| Alt 1, 2, 4, 8 | 1,036,606 | 1,263,618 | 227,012 | 1.2 |
| Alt 1, 2, 7, 8 | 989,038 | 1,081,337 | 92,299 | 1.1 |
| Alt 1, 4, 7, 8 | 787,859 | 1,051,629 | 263,770 | 1.3 |
| Alt 2, 3, 4, 5 | 1,057,216 | 998,610 | –58,606 | 0.9 |
| Alt 2, 4, 7, 8 | 863,548 | 909,005 | 45,457 | 1.1 |
| Alt 1, 2, 4, 7, 8 | 1,181,428 | 1,184,081 | 2,653 | 1.0 |
| Alt 2, 3, 4, 5, 7 | 1,202,038 | 998,610 | –203,427 | 0.8 |
| Alt 2, 4, 5, 7, 8 | 1,189,985 | 1,039,679 | –150,306 | 0.9 |
| Alt 3, 4, 5, 7, 8 | 941,238 | 462,934 | –478,304 | 0.5 |

Table V-70
SNWW Neches River Anchorage Analysis
Basins 1, 4, and 8
Economic Summary Data
October 2008 Dollars
(All costs in dollars)

| | |
|---|---|
| First Cost of Construction | 9,452,214 |
| Interest During Construction | 190,786 |
| Total Investment | 9,643,000 |
| Average Annual Construction Cost | 478,073 |
| Average Annual O&M | 190,106 |
| Total Annual Cost | 668,179 |

Average Annual Benefits at 4.375%
Incorporates Traffic Growth (2019–2069)
Based on Pilot Shifting Cost Scenarios

| Benefit Component | Based on No Pilot Shifting Cost | Based on Pilot Shifting Cost 100% of the Time | Based on Pilot Shifting Cost 50% of the Time |
|---|---|---|---|
| Average Annual Benefits | 2,784,668 | 1,522,166 | 2,153,417 |
| Net Excess Benefits | 2,116,489 | 853,987 | 1,485,238 |
| BCRs | 4.2 | 2.3 | 3.2 |

## Summary of Widening Benefits

Table V-71 displays a summary of the widening benefits. The benefits are for widening the Sabine Pass Channel and Port Arthur Canal to 700 feet and constructing the Neches River anchorage features. Table V-72 presents the economic summary data associated with the channel widening alternatives. The results of the widening analysis show that widening of the Sabine Pass Channel and Port Arthur Canal is not an incrementally justified feature. Widening was not carried forward as a project feature. The ABs are incrementally justified and were included as part of the recommended plan.

The benefit calculations shown in tables V-71 and V-72 are based on 2004-period historical and 2030–2040 projected traffic. The 2030–2040 traffic levels do not account for the effect of trip reductions due to channel deepening. The effect on the reduction in total vessel movements resulting from channel deepening is evaluated in the sensitivity section of the Economic Appendix. For the sensitivity, HarborSym widening model was run based on the reduction in vessel trips as a result of channel deepening. The purpose of the sensitivity was to determine changes in the annual delays in relationship to the widening alternative in combination with channel deepening. The change in vessel trips due to channel deepening was estimated based on the decrease in the number of trips necessary to transport future tonnage. The model results suggest that the reduction in the number of vessel trips, resulting from channel deepening, has a significant effect on the net difference in the duration of vessel delays between the without- and with-project conditions. Further analyses based on various ranges of fleet forecasts

indicate that the increase in benefits from scenarios that included either "deepening and widening" or "deepening and the TB" are primarily attributable to the reduction in trips due to channel deepening. These savings result from the reduction in trips based on vessels carrying additional cargo from the redistribution of vessel sizes based on the availability of a deeper channel and do not vary significantly from the "widening only" benefits shown in Table V-71. The effect of adding these savings to the project benefits is outlined in the sensitivity section of the Economic Appendix.

Table V-71
Sabine Pass Channel and Port Arthur Canal
Average Annual Benefits (2008 Dollars at 4.375%)

| Year | Sabine Pass Channel | Port Arthur Canal | Sabine Pass Channel and Port Arthur Canal | Neches River Anchorage Basins |
|---|---|---|---|---|
| 2004 | 2,269,264 | 2,579,760 | 3,487,322 | |
| 2019 | 2,922,548 | 3,431,103 | 4,335,553 | 1,712,658 |
| 2029 | 3,738,979 | 4,431,691 | 5,486,406 | 1,946,282 |
| 2039 | 4,691,482 | 5,599,044 | 6,829,067 | 2,179,907 |
| 2049 | 5,262,983 | 6,299,456 | 7,634,664 | 2,441,575 |
| 2059 | 6,215,486 | 7,466,809 | 8,977,326 | 2,734,652 |
| 2069 | 7,548,990 | 9,101,103 | 10,857,052 | 3,062,910 |
| Average Annual Benefits (4.375%) | | | 6,379,579 | 2,153,417 |

Table V-72
Widening Only
Sabine Pass Channel and Port Arthur Canal
Economic Summary Data (2008 Dollars at 4.375%)
(All costs in dollars)

| Item | Sabine Pass Channel and Port Arthur Canal | Neches River Anchorage Basins |
|---|---|---|
| First Cost | 78,448,000 | 9,452,214 |
| Mitigation Cost | 48,484,500 | – |
| Interest During Construction | 36,282,311 | 190,786 |
| Total First Cost | 163,241,841 | 9,643,000 |
| Average Annual Construction Cost | 8,091,727 | 478,073 |
| Incremental Average Annual O&M Cost | 9,587,005 | 190,106 |
| Total Average Annual Cost | 17,678,732 | 668,179 |
| Average Annual Benefits | 6,379,579 | 2,153,417 |
| Net Excess Benefits | –11,299,154 | 1,485,238 |
| BCRs | 0.4 | 3.2 |

## V.F NED BENEFIT SUMMARY

Table V-73 presents the transportation cost savings by major commodity group and channel reach. The majority of benefits are associated with imports of crude petroleum, LNG and petroleum products, and exports of petroleum products. Crude petroleum and petroleum products represent 84 percent of the benefits at the 45-foot depth and 89 percent at the 50-foot depth. LNG comprises 7 percent of benefits at the 45-foot depth and 4 percent at 50 feet. The LNG benefits are for facilities in the Sabine Pass Channel and Port Arthur Canal reaches.

Table V-74 summarizes the benefit cost analysis, including the first cost of construction, net excess benefits, and the BCR for the project alternatives. The results of the analysis indicate that the 49-foot channel depth represents the plan that most reasonably maximizes net excess benefits.

### Incremental Analysis

The project benefits start in the Sabine Pass Channel reach where the Sabine Pass LNG terminal is located (see Figure II-3). The Port Arthur Canal reach follows the Sabine Pass Channel reach. The Golden Pass LNG terminal, which is nearing completion, is located in the Sabine Pass Channel reach. An additional LNG terminal, Port Arthur, is permitted for construction in the Port Arthur Canal reach; however, due to uncertainty, the LNG transportation savings benefits (see Table V-52) do not include the Port Arthur terminal. The Port Arthur Canal reach also provides access to the Taylor Bayou side channel and basin. The Port of Port Arthur facilities are located along the main portion of the Sabine-Neches Canal. The incremental analyses for channel improvements through Port Arthur excluding the Taylor Bayou side channel are shown in Table V-75.

Separable analysis of the Taylor Bayou is shown in Table V-76. The analysis presented in Table V-76 shows that the BCRs for the Taylor Bayou increment are well above unity. Table V-77 presents the Sabine-Neches and Taylor Bayou increments as a separable unit. Table V-77 indicates that the BCRs for the segment through the Sabine-Neches Canal and including Taylor Bayou are below unity due to the inclusion of the entrance channel costs and exclusion of the Neches River benefits. Incremental analysis of the Neches River reach in Table V-78 shows that the BCRs are well above unity. Table V-79 displays the Neches River analysis excluding Taylor Bayou. Table V-80 reflects exclusion of benefits from Taylor Bayou, LNG, and breakbulk. Table V-81 presents calculation of the benefits and costs without inclusion of LNG.

The results of the analyses presented in Tables V-75 through V-81 show that the downstream benefits are not needed to justify the upstream costs. The analysis shows that each of the major reaches provides significant incremental benefits.

Table V-73
Total Average Annual Benefits ($1,000s)
by Channel Reach and Alternative
(50-Year Period of Analysis at 4.375%) (December 2008 Vessel Costs)
(All costs in dollars)

| Reach and Commodity | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| **Sabine Pass LNG** | 3,676 | 3,676 | 3,676 | 3,676 | 3,676 | 3,676 |
| **Port Arthur LNG** | 7,464 | 7,464 | 7,464 | 7,464 | 7,464 | 7,464 |
| **Taylor Bayou** | | | | | | |
| Crude Petroleum Imports | 5,790 | 6,892 | 7,510 | 7,964 | 8,305 | 8,928 |
| Petroleum & Chemical Product Imports | 2,369 | 2,758 | 3,124 | 3,436 | 3,709 | 3,939 |
| Petroleum & Chemical Product Exports | 7,348 | 8,556 | 9,692 | 10,653 | 11,485 | 12,170 |
| Coastwise Petroleum Products | 563 | 563 | 563 | 563 | 563 | 563 |
| **Taylor Bayou Total** | 16,070 | 18,769 | 20,889 | 22,616 | 24,062 | 25,600 |
| **Sabine-Neches Canal** | | | | | | |
| Breakbulk and Aggregate | 2,065 | 2,387 | 2,387 | 2,387 | 2,387 | 2,387 |
| **Neches River Channel to Beaumont** | | | | | | |
| Crude Petroleum Imports | 35,340 | 41,759 | 45,901 | 53,117 | 57,868 | 59,832 |
| Petroleum & Chemical Product Imports | 3,554 | 4,138 | 4,686 | 5,155 | 5,564 | 5,909 |
| Petroleum & Chemical Product Exports | 7,961 | 9,269 | 10,499 | 11,541 | 12,442 | 13,184 |
| Coastwise Petroleum Products | 918 | 918 | 918 | 918 | 918 | 918 |
| Grain Exports | 2,172 | 2,463 | 2,870 | 3,187 | 3,482 | 3,714 |
| Breakbulk and Aggregate | 2,471 | 2,860 | 2,860 | 2,860 | 2,860 | 2,860 |
| Neches River Turning Basins | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |
| **Neches River Total** | 54,569 | 63,560 | 69,887 | 78,931 | 85,287 | 88,570 |
| **Grand Total*** | 83,844 | 95,856 | 104,303 | 115,074 | 122,875 | 127,696 |

*Some totals may not add due to rounding.

Table V-74
SNWW Economic Summary Data
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 88,981 | 99,115 | 109,248 | 119,382 | 128,315 | 137,247 |
| Total Investment | 887,901 | 989,021 | 1,090,139 | 1,191,259 | 1,280,394 | 1,369,527 |
| Average Annual Cost | 44,020 | 49,033 | 54,046 | 59,059 | 63,478 | 67,897 |
| Deferred Construction (F&W*) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Average Annual Benefits | 83,844 | 95,856 | 104,303 | 115,074 | 122,875 | 127,696 |
| Net Excess Benefits | 13,627 | 18,598 | 20,004 | 23,733 | 26,249 | 25,785 |
| BCRs | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 |

F&W = Fish and Wildlife

Table V-75
Sabine Pass, Port Arthur Canal, and Sabine-Neches Canal Incremental Analysis
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 510,640 | 564,696 | 618,751 | 672,807 | 725,314 | 777,822 |
| Interest During Construction | 48,541 | 54,539 | 60,538 | 66,536 | 71,713 | 76,889 |
| Total Investment | 559,181 | 619,235 | 679,289 | 739,343 | 797,027 | 854,711 |
| Average Annual Cost | 27,723 | 30,700 | 33,677 | 36,655 | 39,514 | 42,374 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 21,870 | 23,477 | 25,089 | 26,705 | 27,332 | 27,965 |
| Total Annual Cost | 49,767 | 54,365 | 58,967 | 63,575 | 67,067 | 70,566 |
| Average Annual Benefits | 13,205 | 13,527 | 13,527 | 13,527 | 13,527 | 13,527 |
| Net Excess Benefits | –36,562 | –40,838 | –45,440 | –50,048 | –53,540 | –57,039 |
| BCRs | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |

Table V-76
Taylor Bayou Incremental Analysis
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 43,755 | 51,811 | 59,865 | 67,919 | 76,527 | 85,136 |
| Interest During Construction | 2,106 | 2,494 | 2,882 | 3,270 | 3,683 | 4,099 |
| Total Investment | 45,861 | 54,305 | 62,747 | 71,189 | 80,210 | 89,235 |
| Average Annual Cost | 2,274 | 2,692 | 3,111 | 3,529 | 3,977 | 4,424 |
| Average Annual O&M | 1,267 | 1,451 | 1,631 | 1,807 | 1,945 | 2,075 |
| Total Annual Cost | 3,541 | 4,143 | 4,742 | 5,336 | 5,922 | 6,499 |
| Average Annual Benefits | 16,070 | 18,769 | 20,889 | 22,617 | 24,062 | 25,599 |
| Net Excess Benefits | 12,529 | 14,626 | 16,147 | 17,281 | 18,140 | 19,100 |
| BCRs | 4.5 | 4.5 | 4.4 | 4.2 | 4.1 | 3.9 |

Table V-77
Project Improvements through Port Arthur (including Taylor Bayou)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 554,395 | 616,507 | 678,616 | 740,725 | 801,842 | 862,958 |
| Interest During Construction | 50,647 | 57,033 | 63,420 | 69,806 | 75,396 | 80,988 |
| Total Investment | 605,042 | 673,540 | 742,036 | 810,531 | 877,238 | 943,946 |
| Average Annual Cost | 30,171 | 33,580 | 36,989 | 40,399 | 43,712 | 47,025 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 23,137 | 24,929 | 26,720 | 28,512 | 29,276 | 30,041 |
| Total Annual Cost | 53,482 | 58,697 | 63,910 | 69,126 | 73,209 | 77,293 |
| Average Annual Benefits | 29,275 | 32,296 | 34,416 | 36,144 | 37,589 | 39,126 |
| Net Excess Benefits | –24,207 | –26,401 | –29,494 | –32,982 | –35,620 | –38,167 |
| BCRs | 0.5 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 |

Table V-78
Neches River Incremental Economic Analysis
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 244,525 | 273,399 | 302,275 | 331,152 | 350,237 | 369,322 |
| Interest During Construction | 38,334 | 42,081 | 45,829 | 49,576 | 52,918 | 56,259 |
| Total Investment | 282,859 | 315,480 | 348,104 | 380,728 | 403,156 | 425,581 |
| Average Annual Cost | 14,023 | 15,641 | 17,258 | 18,875 | 19,987 | 21,099 |
| Average Annual O&M | 2,885 | 3,109 | 3,332 | 3,555 | 3,651 | 3,746 |
| Total Annual Cost | 16,908 | 18,750 | 20,590 | 22,430 | 23,638 | 24,845 |
| Average Annual Benefits | 54,570 | 63,560 | 69,888 | 78,931 | 85,287 | 88,570 |
| Net Excess Benefits | 37,661 | 44,811 | 49,298 | 56,500 | 61,649 | 63,725 |
| BCRs | 3.2 | 3.4 | 3.4 | 3.5 | 3.6 | 3.6 |

Table V-79
SNWW Improvements (excludes Taylor Bayou)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 755,165 | 838,095 | 921,027 | 1,003,958 | 1,075,551 | 1,147,144 |
| Interest During Construction | 86,875 | 96,621 | 106,366 | 116,112 | 124,631 | 133,148 |
| Total Investment | 842,040 | 934,716 | 1,027,392 | 1,120,070 | 1,200,183 | 1,280,292 |
| Average Annual Cost | 41,746 | 46,341 | 50,935 | 55,530 | 59,502 | 63,473 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 24,755 | 26,586 | 28,422 | 30,260 | 30,982 | 31,712 |
| Total Annual Cost | 66,676 | 73,115 | 79,558 | 86,005 | 90,705 | 95,411 |
| Average Annual Benefits | 54,540 | 63,418 | 69,746 | 78,789 | 85,145 | 88,428 |
| Net Excess Benefits | –12,135 | –9,696 | –9,812 | –7,217 | –5,559 | –6,983 |
| BCRs | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |

Table V-80
Neches River Project Improvements (excludes Transportation Benefits for All Other Reaches)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 755,165 | 838,095 | 921,027 | 1,003,958 | 1,075,551 | 1,147,144 |
| Interest During Construction | 86,875 | 96,621 | 106,366 | 116,112 | 124,631 | 133,148 |
| Total Investment | 842,040 | 934,716 | 1,027,392 | 1,120,070 | 1,200,183 | 1,280,292 |
| Average Annual Cost | 41,746 | 46,341 | 50,935 | 55,530 | 59,502 | 63,473 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 24,755 | 26,586 | 28,422 | 30,260 | 30,982 | 31,712 |
| Total Annual Cost | 66,676 | 73,115 | 79,558 | 86,005 | 90,705 | 95,411 |
| Average Annual Benefits | 38,470 | 44,649 | 48,857 | 56,172 | 61,084 | 62,829 |
| Net Excess Benefits | –28,206 | –28,465 | –30,701 | –29,834 | –29,621 | –32,582 |
| BCRs | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 |

Table V-81
SNWW Improvements (excludes LNG)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 755,165 | 838,095 | 921,027 | 1,003,958 | 1,075,551 | 1,147,144 |
| Interest During Construction | 86,875 | 96,621 | 106,366 | 116,112 | 124,631 | 133,148 |
| Total Investment | 842,040 | 934,716 | 1,027,392 | 1,120,070 | 1,200,183 | 1,280,292 |
| Average Annual Cost | 41,746 | 46,341 | 50,935 | 55,530 | 59,502 | 63,473 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 24,755 | 26,586 | 28,422 | 30,260 | 30,982 | 31,712 |
| Total Annual Cost | 66,676 | 73,115 | 79,558 | 86,005 | 90,705 | 95,411 |
| Average Annual Benefits | 72,702 | 84,716 | 93,164 | 103,935 | 111,736 | 116,556 |
| Net Excess Benefits | 6,026 | 11,601 | 13,606 | 17,930 | 21,031 | 21,144 |
| BCRs | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |

## Benefit-Cost Ratio at 7 Percent

Calculation of benefits and costs at 7 percent interest is required by EC 11-2-194, commonly referred to as the budget Engineering Circular (paragraph 11). The 7 percent calculations are used for budget ranking purposes. Table V-82 outlines the economic calculations at 7 percent.

Table V-82
SNWW Economic Summary Data at 7 Percent
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis
(December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 150,031 | 167,118 | 184,204 | 201,291 | 216,352 | 231,413 |
| Total Investment | 948,951 | 1,057,024 | 1,165,095 | 1,273,168 | 1,368,431 | 1,463,693 |
| Average Annual Cost | 68,761 | 76,592 | 84,423 | 92,254 | 99,156 | 106,059 |
| Deferred Construction (F&W) | 178 | 192 | 206 | 220 | 226 | 232 |
| Average Annual O&M | 25,942 | 27,971 | 29,999 | 32,027 | 32,885 | 33,742 |
| Total Annual Cost | 94,881 | 104,755 | 114,628 | 124,501 | 132,267 | 140,033 |
| Average Annual Benefits | 81,644 | 93,305 | 101,498 | 112,028 | 119,631 | 124,300 |
| Net Excess Benefits | –13,237 | –11,450 | –13,130 | –12,473 | –12,636 | –15,733 |
| BCRs | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |

## Sensitivity Analysis for Additional Advanced Maintenance

During the development of the alternatives, several reaches of the channel were identified as requiring additional advanced maintenance beyond the standard practices of the Galveston District. These reaches included the Sabine Pass Outer Bar Channel, one section of the Sabine Pass Channel, the Port Arthur Junction, and portions of the Neches River Channel.

In these fast-shoaling areas, it was assumed that additional advance maintenance would be required to avoid frequent redredging and to ensure the reliability and least overall cost for operating and maintaining the project's authorized dimensions. This increase in advance maintenance (ranging from 1 to 5 feet) was proposed for some portions of some channel reaches to allow the proposed dredging frequency to remain the same as the existing O&M dredging frequency.

A sensitivity analysis was performed on the O&M costs to determine the impact to the BCR if the additional advance maintenance was not performed on these specific channel reaches. Table V-83 presents the summary of the economic data without this additional advanced maintenance in those limited channel reaches. In a comparison to Table V-74 which summarizes the costs and benefits for the study, the average annual O&M costs increases over the 50-year period of analysis without the additional

advance maintenance because, although less material would be dredged per dredging cycle, the frequency of O&M dredging would increase to maintain the project's authorized depth. This increase in average annual O&M costs results in a decrease in the net excess benefits and a decrease in the BCRs for each of the channel depths. The NED plan of 49-foot depth has a decrease in the BCR from 1.3 to 1.2.

Table V-83
SNWW Economic Summary Data Without Additional Advanced O&M Cost and Benefits ($1,000s) by Channel Alternative (50-Year Period of Analysis at 4.375%) (December 2008 Vessel Costs)
(All costs in dollars)

| | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 88,981 | 99,115 | 109,248 | 119,382 | 128,315 | 137,247 |
| Total Investment | 887,901 | 989,021 | 1,090,139 | 1,191,259 | 1,280,394 | 1,369,527 |
| Average Annual Cost | 44,020 | 49,033 | 54,046 | 59,059 | 63,478 | 67,897 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 28,901 | 31,139 | 33,377 | 35,615 | 36,570 | 37,525 |
| Total Annual Cost | 73,095 | 80,360 | 87,624 | 94,889 | 100,269 | 105,649 |
| Average Annual Benefits | 83,841 | 95,856 | 104,303 | 115,074 | 122,875 | 127,696 |
| Net Excess Benefits | 10,746 | 15,496 | 16,679 | 20,185 | 22,606 | 22,047 |
| BCRs | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |

## V.G REGIONAL BENEFITS

The SNWW is America's largest military port and the second largest importer of crude oil based on tonnage. An estimated 20 to 30 percent of all military jet fuel is produced on the SNWW and an estimated 118 million tons of cargo are moved through the marine terminals. The waterway delivers 12 to 16 percent of the crude oil and refined products supplied east of the Rocky Mountains.

SNWW port activity contributes significantly to the local and regional economy by generating business revenue to local and national firms providing vessel and cargo-handling services at the marine terminals. These firms, in turn, provide employment and income to individuals. The SNWW marine terminals and refinery complexes generate revenue throughout the local, state, and national economies.

Terminals along the SNWW include the public marine terminals owned by the Port of Beaumont and Port of Port Arthur, as well as the petroleum refineries, chemical plants, and bulk/breakbulk terminals. These terminals use vessel and barge transportation to move crude oil, petroleum products, liquid and dry chemicals, steel, and dry bulk cargo.

Revenue generated by the waterway is generated by firms providing services to the commodity and vessel activity at the terminals, revenue from trucking firms, railroads, pipeline operations, terminal operators and associated refineries and chemical plants (from loading and discharging vessels), chandlers, agents, pilots, towing companies, shipyards, and maritime support firms. This revenue is used to purchase

employment (direct jobs) to provide the services, to pay stockholders and for retained earnings, and to purchase goods and services from local firms, as well as national and international firms (creating indirect jobs with these firms). Businesses also pay taxes from the business revenue.

For the communities within the study area, the SNWW is responsible for benefits to the local and regional economy. The Sponsor recently contracted for a study on the *Economic Impact of the Sabine-Neches Waterway* (Martin Associates, 2006). Regional benefits of the SNWW to the communities within the study area include (based on 2004 statistics):

- 83,692 jobs in Texas and Louisiana (private and public marine terminals along SNWW);
- 14,987 jobs directly related to activities along the waterway;
- 13,628 induced jobs from local purchases from SNWW workers;
- 55,077 indirect jobs;
- $877.7 million of direct wages and salaries;
- $2.2 billion in business revenue (excluding the cargo);
- $426.5 million of State and local taxes (generated by activity at the marine terminals); and
- $853 million of Federal taxes (generated by activity at the marine terminals).

The number of jobs that the waterway supports is impressive especially since the Southeast Texas labor force totaled 176,500 people in June 2006, with personal income and consumption attributable to the waterway at $4.7 billion (*Beaumont Enterprise*, 2006).

With the value of the current 40-foot-deep SNWW channel to the region, it is expected that the proposed deepening and widening of the channel for navigational efficiency and safety would increase the benefits to the region or at a minimum maintain the existing benefits.

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# VI. DESCRIPTION OF RECOMMENDED PLAN

## VI.A OVERVIEW

In the previous chapter, the economic analysis identified the process and rationale used to identify the NED Plan, which is the 49-foot plan. However, the Recommended Plan identified in Chapter IV is the 48-foot deepening, which is also considered the LPP by the Sponsor. The Sponsor agrees that this plan best addresses the navigational efficiency and safety issues along the existing SNWW channel. This chapter describes the Recommended Plan in more detail. The Engineering Appendix, which includes design information, is available upon request.

## VI.B DESCRIPTION OF RECOMMENDED PLAN

The Recommended Plan involves the following modifications to the existing channel:

- Deepening the SNWW to Beaumont to 48 feet, extending the Entrance Channel 13.2 miles,
- Deepening and selective widening of Taylor Bayou channels and TB,
- Decreasing the width of the Sabine Bank Channel to 700 feet with tapering from 800 feet (Station 23+300) to 700 feet wide (Station 25+800 through the end of Sabine Bank Channel),
- Adding or enlarging turning and AB along the Neches River Channel, and
- Bending easing on the Sabine-Neches Canal and Neches River Channel.

With the Recommended Plan, the existing channel depth would be increased by 8 feet, increasing the inland portion from 40 feet to 48 feet and increasing the existing offshore portions from 42 to 50 feet (plus overdepth or advance maintenance as needed). The channel deepening would result in the Entrance Channel being extended 13.2 miles farther south into the Gulf of Mexico. The Sabine Pass Jetty Channel, Sabine Pass Channel, Port Arthur and Sabine-Neches canals, and the Neches River Channel would be deepened from 40 to 48 feet. The existing offshore entrance channels (Sabine Pass Outer Bar Channel and Sabine Bank Channel) would be deepened from 42 to 50 feet, and the Sabine Bank Extension Channel would be dredged to 50 feet. This would increase the SNWW from 64 miles to approximately 77 miles in length. No modifications to the existing Sabine Pass jetties would be required as part of the CIP.

The Taylor Bayou TB and channels would also be widened at its entrance and the upstream bottleneck curve and deepened to 48 feet. Neither the Sabine-Neches Canal nor the Neches River Channel would be widened, but navigation efficiency would be improved with bend easings in both reaches, and the addition or enlargement of turning and ABs on the Neches River Channel.

The Recommended Plan would result in an estimated 98 mcy of new work and 650 mcy of maintenance material over the 50-period of analysis (Table VI-1). The annual maintenance dredging quantities in the SNWW would increase from an average of 8.1 mcy for the current 40-foot project to 13.0 mcy for the proposed 48-foot project. Dredged depths would actually be deeper than the authorized depth when allowances for overdepth and advance maintenance are included. Overdepth dredging and advance

maintenance would be 2 feet each; however, in critical and fast-shoaling areas, additional advance maintenance is required to avoid frequent redredging and to ensure the reliability and least overall cost for operating and maintaining the project's authorized dimensions. An increase in advance maintenance (ranging from 1 to 5 feet) was proposed for some portions of some channel reaches to allow the proposed dredging frequency to remain the same as the existing O&M dredging frequency. These channel depths were included in the mesh for the HS modeling.

Table VI-1
New Work and 50-Year Maintenance Quantities for the Recommended Plan

| | Channel Reach | New Work Quantities | 50-Year Maintenance Quantities |
|---|---|---|---|
| Offshore | Sabine Bank Extension | 18,737,000 | 36,216,000 |
| | Sabine Bank Channel | 15,358,000 | 96,371,000 |
| | Sabine Pass Outer Bar Channel | 5,923,000 | 223,650,000 |
| | Sabine Pass Jetty Channel | 2,978,000 | 13,527,000 |
| Inshore | Sabine Pass Channel | 6,723,200 | 34,780,800 |
| | Port Arthur Canal | 11,697,200 | 82,857,600 |
| | Sabine-Neches Canal | 11,944,000 | 73,245,000 |
| | Neches River Channel | 25,014,000 | 89,724,800 |
| | Total Quantities | 98 mcy | 650 mcy |

The SNWW Recommended Plan is made up of eight channel reaches: three offshore and five inland. Each channel reach is divided into different sections for dredging contracts. These sections are shown on the Engineering Plates in Appendix 1 of this FFR. The specifics for each channel reach are discussed later in this section. Whenever economically and environmentally feasible, new work and maintenance material are used beneficially either for marsh restoration or shoreline nourishment. Sixteen existing and two new PAs would be used for upland placement.

## General Navigation Features of the Recommended Plan

Proposed structural channel improvements are described individually for each reach below (figures VI-1 through VI-7). General navigation features (GNF) of the Recommended Plan consist of:

1) Deepening of navigation channels and basins;
2) 50-year DMMP for both new work and O&M (ODMDSs, upland PAs, and the Neches River and Gulf Shore BU features);
3) Marsh mitigation in Louisiana; and
4) Bridge reinforcements.

Non-General Navigation Features project elements (aids to navigation, Land, Easements, and Rights of Way [LER], and relocations [including utility relocations]) are described at the end of this chapter. The Sabine Bank Extension is discussed separately below, but it is actually part of the Sabine Bank Channel reach.

### Sabine Bank Extension Channel

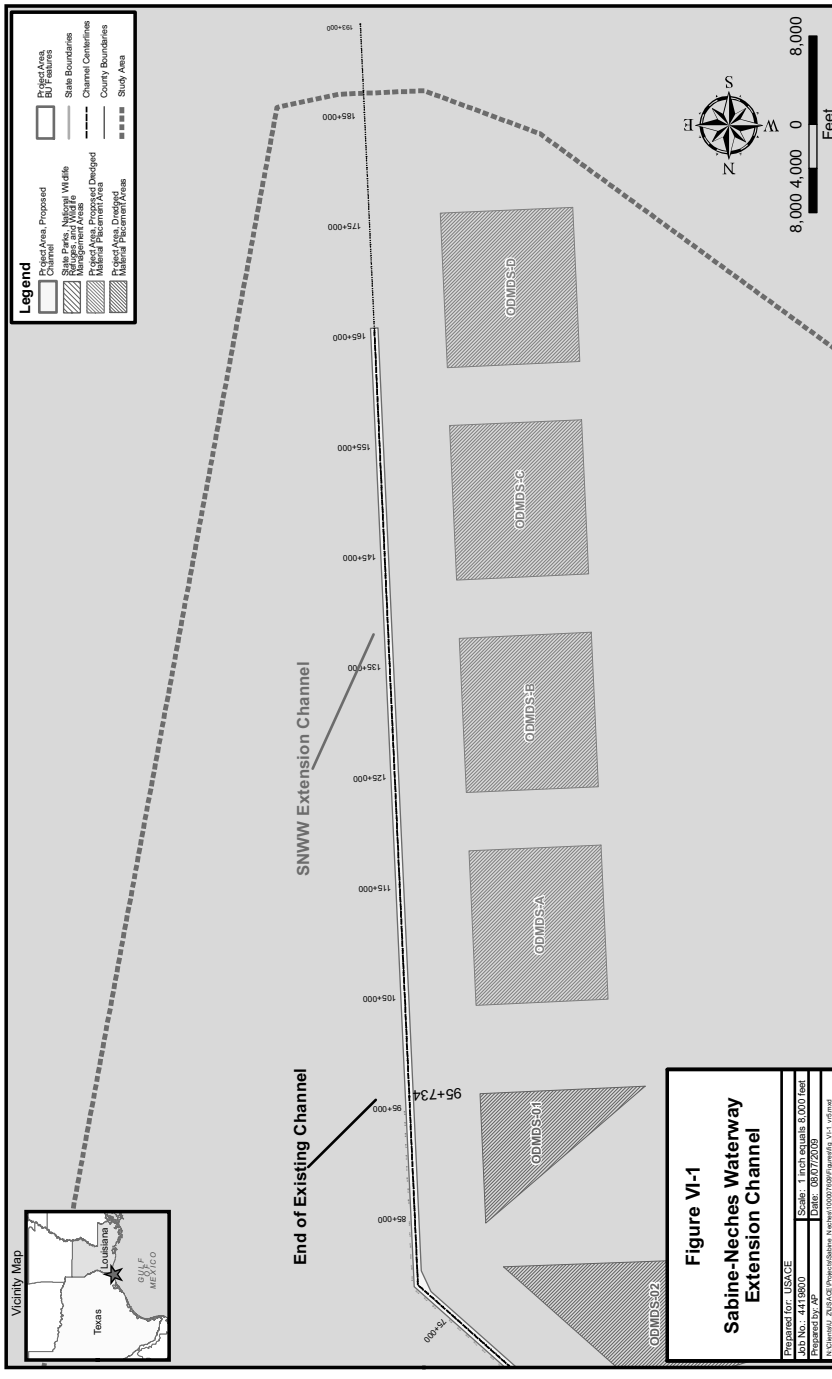
This channel lengthens the existing offshore Entrance Channel approximately 13.2 miles at a bottom width of 700 feet (Figure VI-1). The additional length is required to reach a water depth in the Gulf of Mexico equal to the proposed channel depth. The proposed offshore depth is 50 feet, but advance maintenance and allowable overdepth would add a total of 4 more feet, bringing the total dredged depth of the Extension Channel to 54 feet. It would be constructed by hopper dredge beginning at the end of the Sabine Bank Channel, and it would extend into the Gulf of Mexico at the same bearing as the Sabine Bank Channel. An overview of the project details for the Sabine Bank Extension is listed in Table VI-2.

Table VI-2
Project Details of Sabine Bank Extension

| | |
|---|---|
| Length of Reach | 13.2 miles (new) |
| Project Depth | 50 feet |
| Bottom Width | 700 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| New Work Material | 18,737,000 cubic yards |
| Placement Areas | ODMDSs A, B, C, and D |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 36,216,000 cubic yards |
| Increase in Maintenance Material | 36,216,000 cubic yards |
| Placement Areas | ODMDSs A, B, C, and D |
| Beneficial Use of Dredged Material | None |

### Sabine Bank Channel

This 14.7-mile-long channel would be deepened from 42 to 50 feet using a hopper dredge (Figure VI-2). When advance maintenance and allowable overdepth are added to the proposed 50-foot depth, the Sabine Bank Channel would be dredged to 54 feet. The bottom width of the Sabine Bank Channel is currently 800 feet; it would remain 800 feet wide for the first mile past the end of the Outer Bar Channel, and then it would taper from 800 to 700 feet over the next one-half mile. The Sabine Bank Channel would continue the 700-foot bottom width for approximately 13.2 miles to its connection with the Extension Channel. Since the existing channel is 800 feet wide, new channel markers would be required to mark the tapered transition and the remainder of the narrowed Sabine Bank Channel. An overview of the project details for the Sabine Bank Channel reach is listed in Table VI-3.


Legend
Project Area, Proposed Channel
Project Area, BUF Features
State Parks, National Wildlife Refuges, and Wildlife Management Areas
State Boundaries
Channel Centerlines
County Boundaries
Study Area
Project Area, Proposed Dredged Material Placement Area
Project Area, Dredged Material Placement Areas
Vicinity Map
Texas
Louisiana
GULF OF MEXICO
End of Existing Channel
SNWW Extension Channel
95+734
ODMDS-01
ODMDS-02
ODMDS-A
ODMDS-B
ODMDS-C
ODMDS-D
75+000
85+000
95+000
105+000
115+000
125+000
135+000
145+000
155+000
165+000
175+000
185+000
193+000
N
S
E
W
8,000 4,000 0 8,000
Feet
Figure VI-1
Sabine-Neches Waterway
Extension Channel
Prepared for: USACE
Job No.: 4419800
Scale: 1 inch equals 8,000 feet
Prepared by: AP
Date: 08/07/2008
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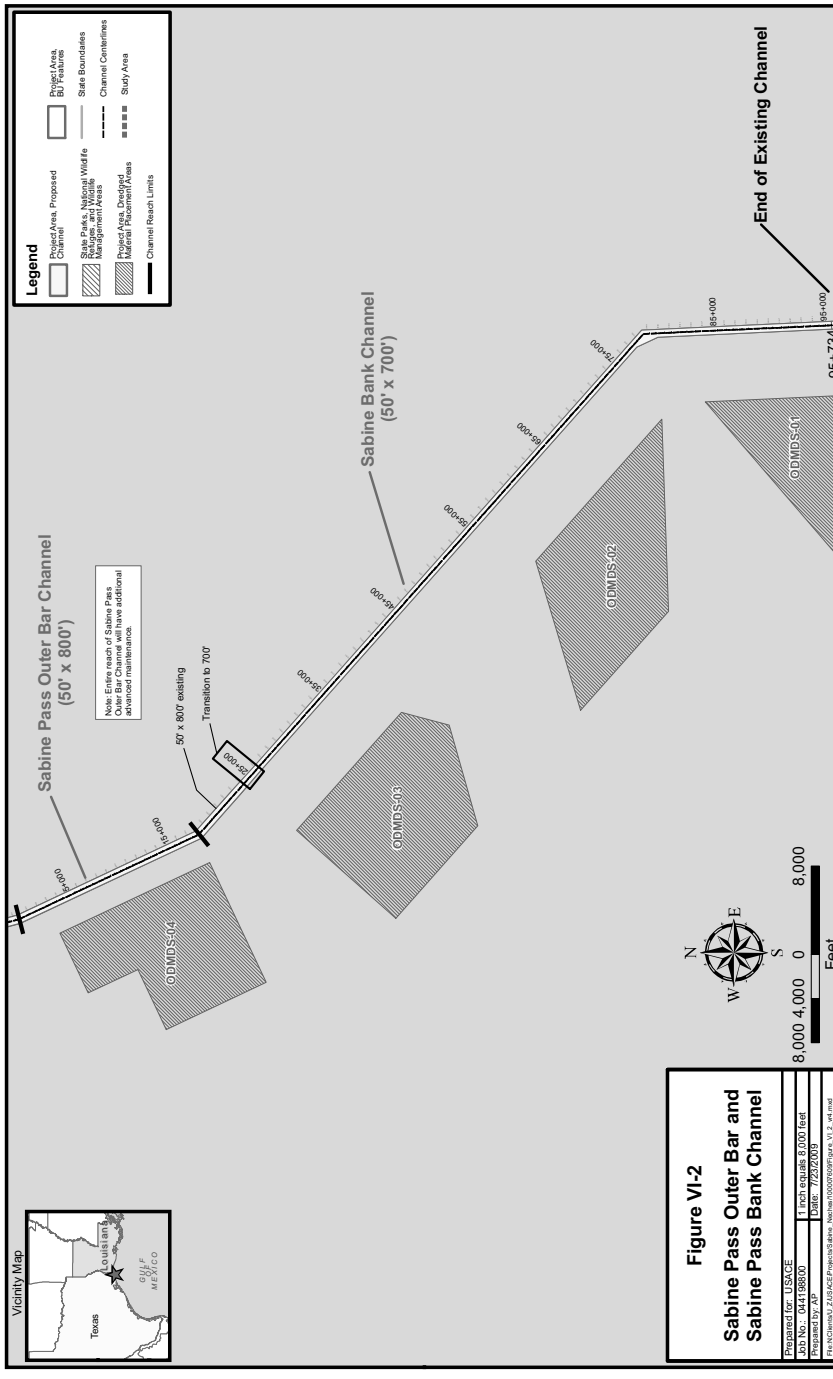
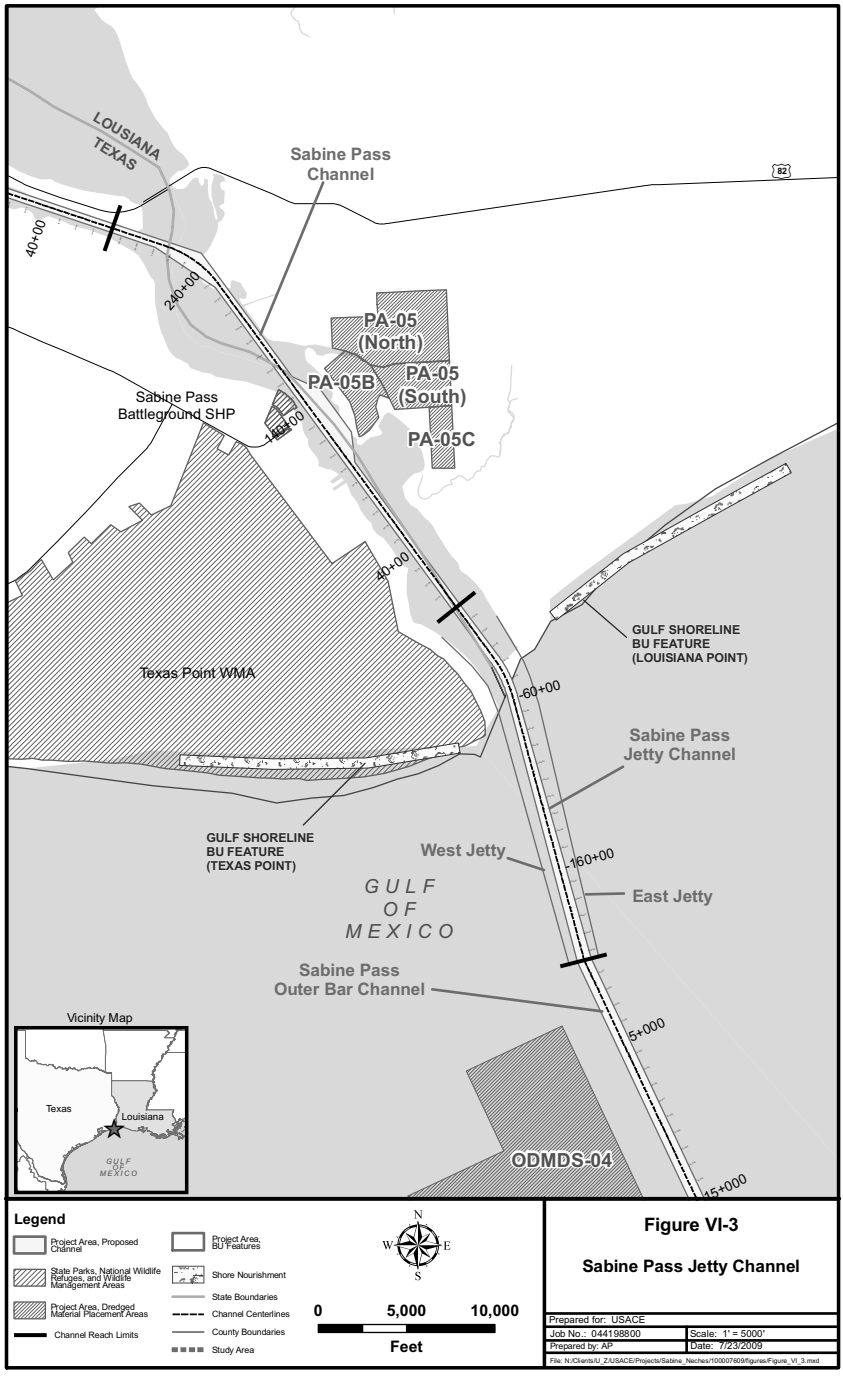
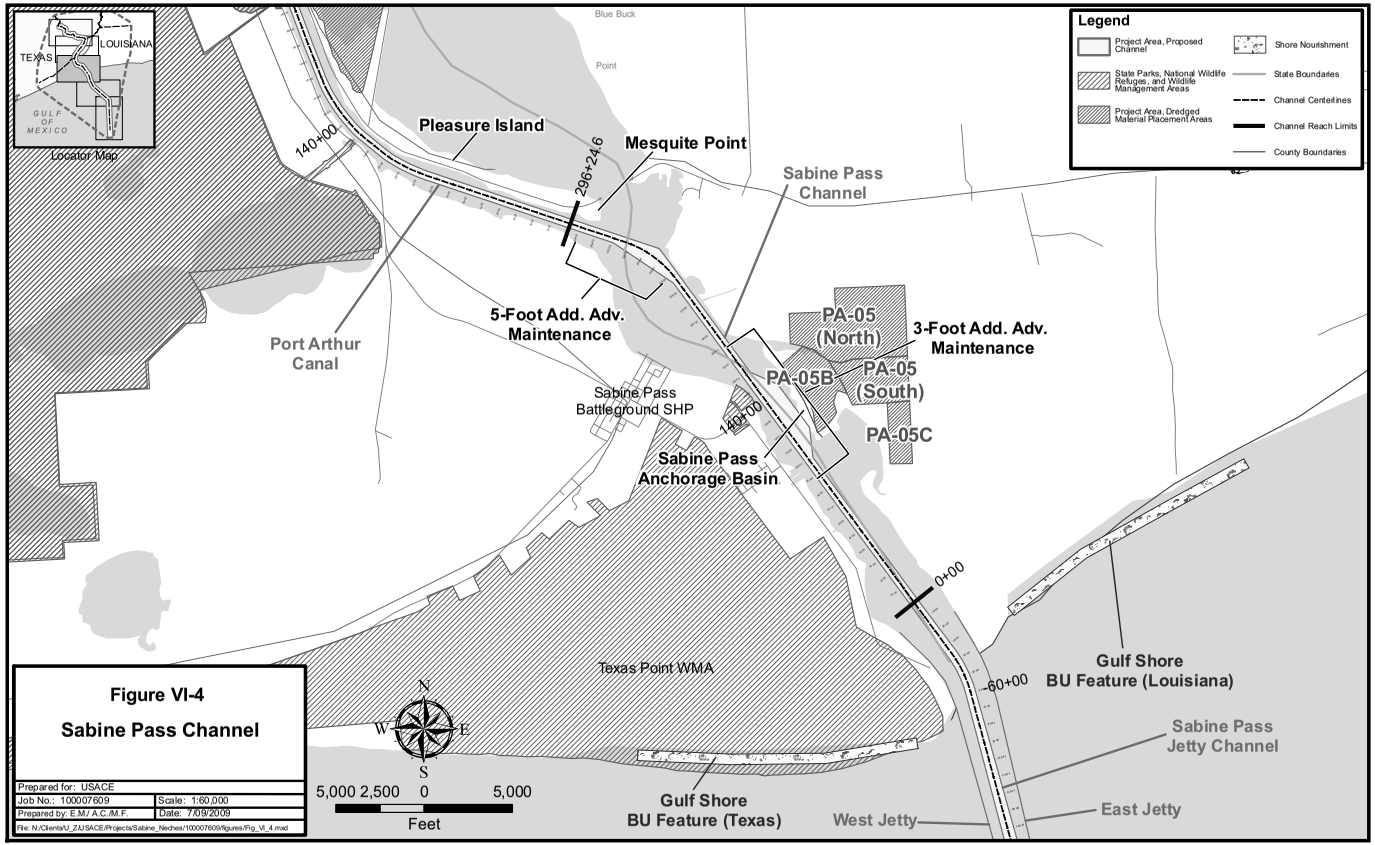
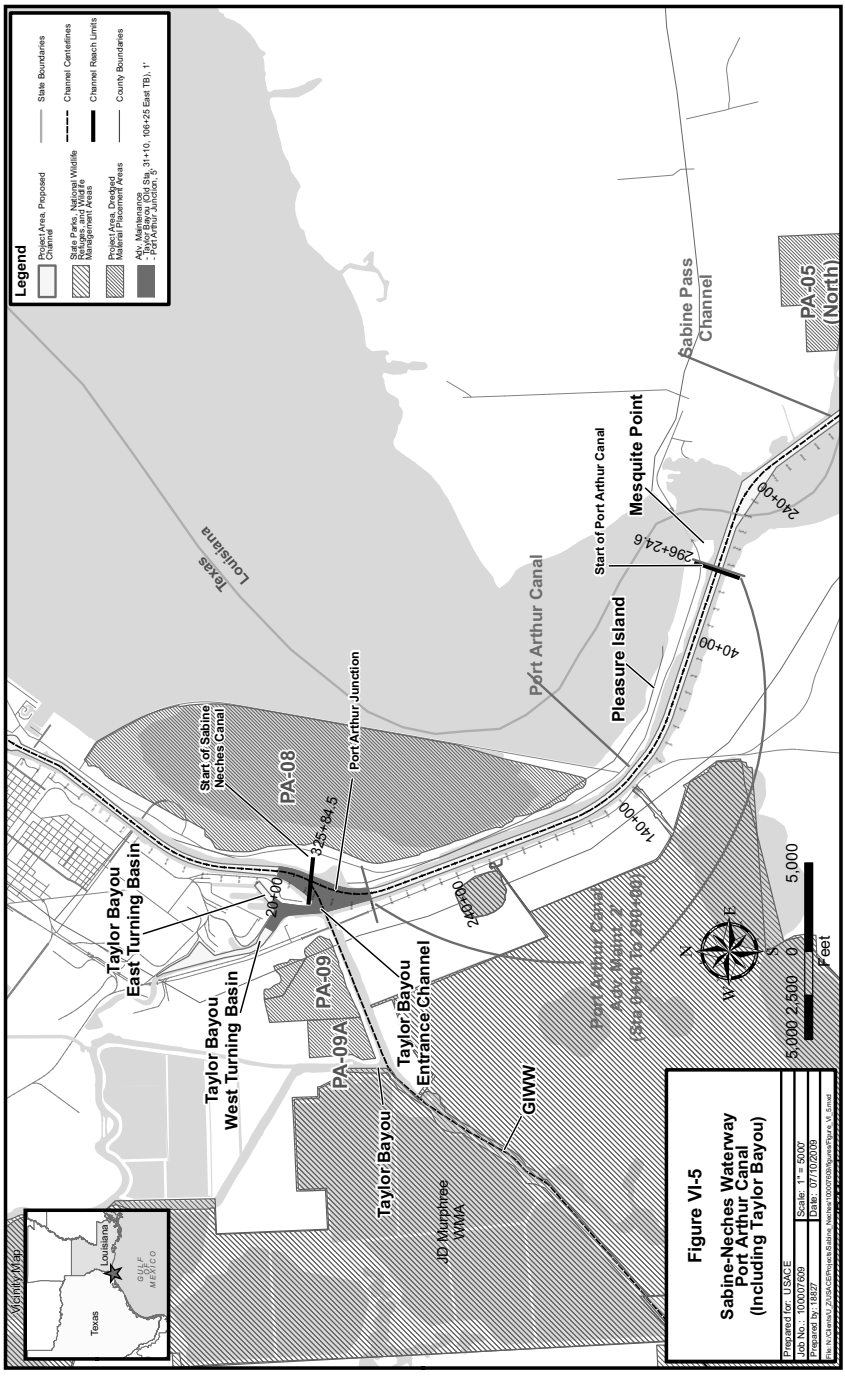
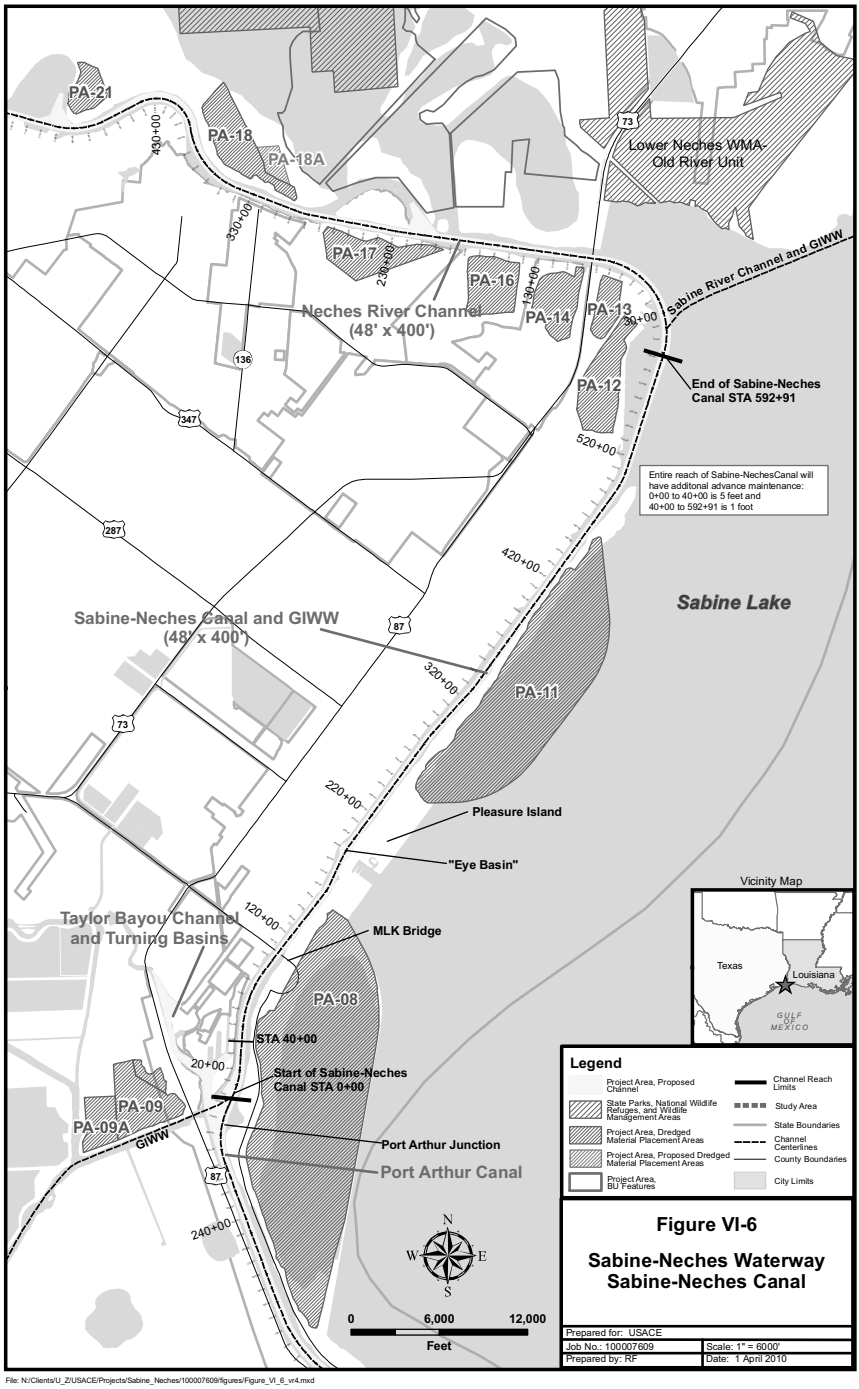

Legend
Project Area, Proposed Channel
State Parks, National Wildlife Refuges, and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
Channel Reach Limits
Project Area, BU Features
State Boundaries
Channel Centerlines
Study Area
Sabine Pass Outer Bar Channel
(50' x 800')
Note: Entire reach of Sabine Pass Outer Bar Channel will have additional advanced maintenance.
50' x 80'0' existing
Transition to 700'
Sabine Bank Channel
(50' x 700')
End of Existing Channel
95+734
ODMDS-01
ODMDS-02
ODMDS-03
ODMDS-04
Vicinity Map
Texas
Louisiana
GULF OF MEXICO
N
W
E
S
8,000 4,000 0 8,000
Feet
Figure VI-2
Sabine Pass Outer Bar and
Sabine Pass Bank Channel
Prepared for: USACE
Job No.: 04419880
Prepared by: AIP
1 inch equals 8,000 feet
Date: 7/23/2019
File Name: J:\ASA\CE Projects\Sabine_Neches\mxd\Mainfigure_VI-2_v4.mxd


LOUISIANA
TEXAS
Sabine Pass
Channel
82
40+00
240+00
PA-05
(North)
PA-05B
PA-05
(South)
PA-05C
Sabine Pass
Battleground SHP
160+00
40+00
Texas Point WMA
GULF SHORELINE
BU FEATURE
(LOUISIANA POINT)
-60+00
Sabine Pass
Jetty Channel
GULF SHORELINE
BU FEATURE
(TEXAS POINT)
West Jetty
-160+00
East Jetty
G U L F
O F
M E X I C O
Sabine Pass
Outer Bar Channel
5+000
Vicinity Map
Texas
Louisiana
GULF
OF
MEXICO
ODMDS-04
15+000
Legend
Project Area, Proposed Channel
State Parks, National Wildlife Refuges, and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
Channel Reach Limits
Project Area, BU Features
Shore Nourishment
State Boundaries
Channel Centerlines
County Boundaries
Study Area
N
W
E
S
0
5,000
10,000
Feet
Figure VI-3
Sabine Pass Jetty Channel
Prepared for: USACE
Job No.: 044198800
Scale: 1" = 5000'
Prepared by: AP
Date: 7/23/2009
File: N:\Clients\U_Z\USACE\Projects\Sabine_Neches\100007609\figures\Figure_VI_3.mxd


Legend
Project Area, Proposed Channel
State Parks, National Wildlife Refuges, and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
Shore Nourishment
State Boundaries
Channel Centerlines
Channel Reach Limits
County Boundaries
Locator Map
TEXAS
LOUISIANA
GULF OF MEXICO
Blue Buck
Point
Pleasure Island
Mesquite Point
140+00
296+24.6
Sabine Pass Channel
5-Foot Add. Adv. Maintenance
Port Arthur Canal
PA-05 (North)
3-Foot Add. Adv. Maintenance
PA-05B
PA-05 (South)
PA-05C
Sabine Pass Battleground SHP
140+00
Sabine Pass Anchorage Basin
0+00
Texas Point WMA
-60+00
Gulf Shore BU Feature (Louisiana)
Sabine Pass Jetty Channel
East Jetty
West Jetty
Gulf Shore BU Feature (Texas)
N
W
E
S
5,000 2,500 0 5,000
Feet
Figure VI-4
Sabine Pass Channel
Prepared for: USACE
Job No.: 100007609
Scale: 1:60,000
Prepared by: E.M./ A.C./M.F.
Date: 7/09/2009
File: N:\Clients\U_Z\USACE\Projects\Sabine_Neches\100007609\figures\Fig_VI_4.mxd


Legend
Project Area, Proposed Channel
State Parks, National Wildlife Refuges, and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
Adv. Maintenance
- Taylor Bayou (Old Sta. 31+10, 106+25 East TB), 1'
- Port Arthur Junction, 3'
State Boundaries
Channel Centerlines
Channel Reach Limits
County Boundaries
Louisiana
Texas
GULF OF MEXICO
Taylor Bayou East Turning Basin
Taylor Bayou West Turning Basin
20+00
Start of Sabine Neches Canal
PA-08
325+34.5
Port Arthur Junction
PA-09
PA-09A
Taylor Bayou Entrance Channel
Taylor Bayou
JD Murphree WMA
GIWW
240+30
Port Arthur Canal Adv. Maint. 2' (Sta 1+00 to 290+00)
140+00
Port Arthur Canal
Pleasure Island
40+00
Start of Port Arthur Canal
296+24.6
Mesquite Point
240+00
Sabine Pass Channel
PA-05 (North)
Louisiana
Texas
5,000 2,500 0 5,000
Feet
Figure VI-5
Sabine-Neches Waterway
Port Arthur Canal
(Including Taylor Bayou)
Prepared for: USACE
Job No.: 100/07/609
Prepared by: TRC
Scale: 1" = 5000'
Date: 07/10/2009

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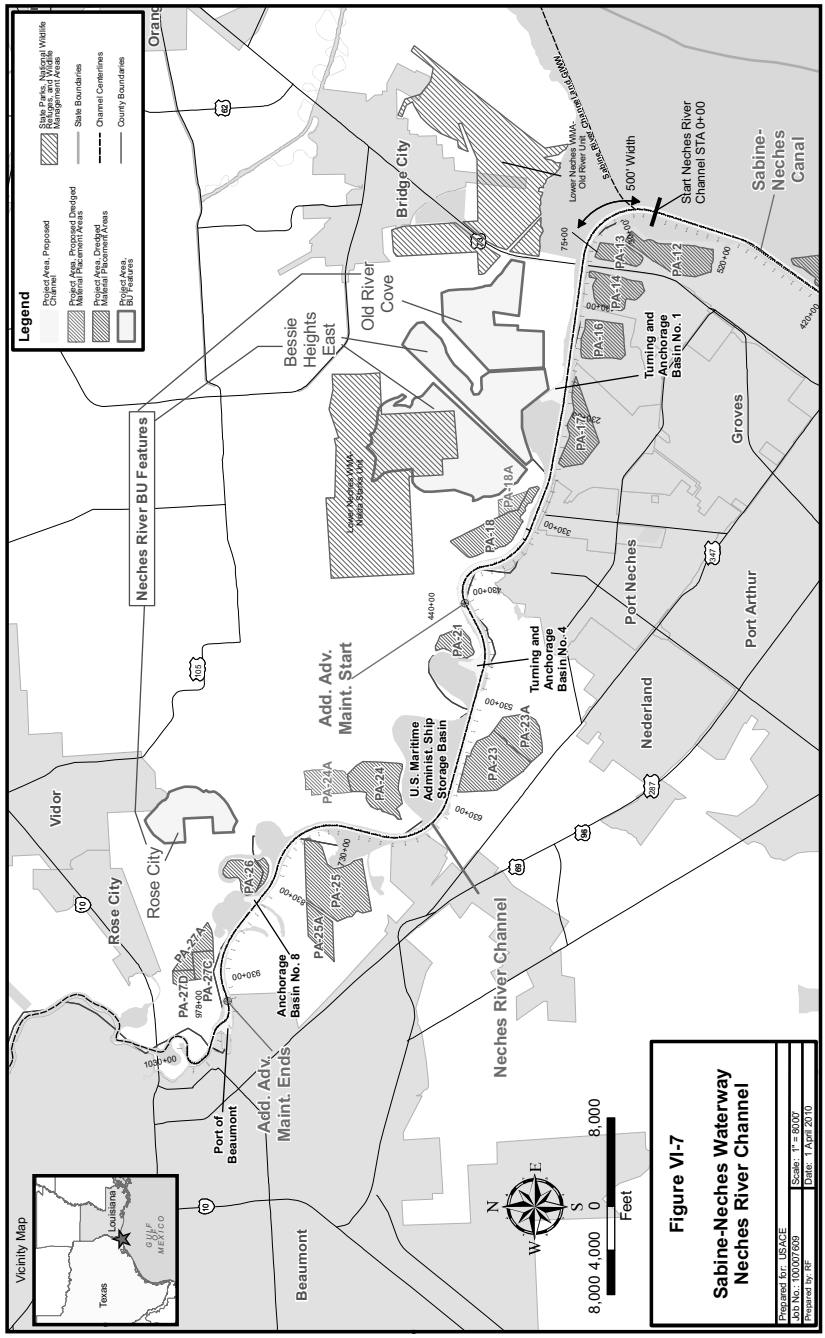
Legend
Project Area, Proposed Channel
Project Area, Proposed Dredged Material Placement Areas
Project Area, Dredged Material Placement Areas
Project Area, BU Features
State Parks, National Wildlife Refuges, and Wildlife Management Areas
State Boundaries
Channel Centerlines
County Boundaries
Neches River BU Features
Vicinity Map
Texas
Louisiana
GULF OF MEXICO
Vidor
Rose City
Beaumont
Port of Beaumont
Add. Adv. Maint. Ends
Anchorage Basin No. 8
Add. Adv. Maint. Start
U.S. Maritime Administ. Ship Storage Basin
Bessie Heights East
Old River Cove
Bridge City
Lower Neches WMA-Nelda Stokes Unit
Lower Neches WMA-Old River Unit
Sabine-Neches Waterway (Federal alignment)
500' Width
Start Neches River Channel STA 0+00
Sabine-Neches Canal
Turning and Anchorage Basin No. 1
Turning and Anchorage Basin No. 4
Groves
Port Neches
Port Arthur
Nederland
Neches River Channel
PA-27D
PA-27A
PA-27C
PA-26
PA-25A
PA-25
PA-24A
PA-24
PA-23
PA-23A
PA-21
PA-18
PA-18A
PA-17
PA-16
PA-14
PA-13
PA-12
1030+00
930+00
830+00
730+00
630+00
530+00
430+00
330+00
440+00
75+00
420+00
520+00
N
S
E
W
8,000 4,000 0 8,000
Feet
Figure VI-7
Sabine-Neches Waterway
Neches River Channel
Prepared for: USACE
Job No.: 100007609
Prepared by: RF
Scale: 1" = 8000'
Date: 1 April 2010
File: N:\Clients\U_Z\USACE\Projects\Sabine_Neches\100007609\Figure_VI_7_v4.mxd

Table VI-3
Project Details for Sabine Bank Channel Reach

| | |
|---|---|
| Length of Reach (Sections 1, 2) | 14.7 miles (no change) |
| Project Depth | 50 feet |
| Bottom Width | 800 feet then narrow to 700 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| New Work Material | 15,358,000 cubic yards |
| Placement Areas | ODMDS 1 and 2 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 96,371,000 cubic yards |
| Increase in Maintenance Material | 45,549,000 cubic yards |
| Placement Areas | ODMDS 1 and 2 |
| Beneficial Use of Dredged Material | None |

### Sabine Pass Outer Bar Channel

This 3.4-mile-long channel would be deepened from 42 to 50 feet using a hopper dredge (Figure VI-2). This portion of the channel has higher velocity eddies moving around the end of the east jetty, which causes sediment to settle out as the currents cross the navigation channel, creating a higher shoaling rate. Due to the high shoaling rate, advance maintenance amounts are increased to maintain current maintenance dredging cycles. When advance maintenance and allowable overdepth are added, the Outer Bar Channel could be dredged to 58 feet. The Outer Bar Channel would remain at its current 800-foot bottom width due to strong crosscurrents just beyond the end of the jetties. An overview of the project details for the Sabine Pass Outer Bar Channel reach is listed in Table VI-4.

Table VI-4
Project Details for Sabine Pass Outer Bar Channel Reach

| | |
|---|---|
| Length of Reach (Section 3) | 3.4 miles (no change) |
| Project Depth | 50 feet |
| Bottom Width | 800 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | 4 feet |
| New Work Material | 5,923,000 cubic yards |
| Placement Areas | ODMDS 3 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 223,650,000 cubic yards |
| Increase in Maintenance Material | 123,965,000 cubic yards |
| Placement Areas | ODMDS 3 |
| Beneficial Use of Dredged Material | None |

### Sabine Pass Jetty Channel

This 4.1-mile-long channel would be deepened to 48 feet using a hopper dredge (Figure VI-3). When advance maintenance and allowable overdepth are added, the Sabine Pass Jetty Channel could be dredged to 52 feet. The width of the channel would remain the same with the channel gradually tapering from the existing 800-foot width at the jetties mouth to 500 feet wide at the jetties head (Station 0+00). No impacts to the jetties have been identified that are associated with the proposed improvements. An overview of the project details for the Sabine Pass Jetty Channel reach is listed in Table VI-5.

Table VI-5
Project Details for Sabine Pass Jetty Channel Reach

| | |
|---|---|
| Length of Reach (Section 4) | 4.1 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | 800 to 500 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| New Work Material | 2,978,000 cubic yards |
| Placement Areas | ODMDS 4 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 13,527,000 cubic yards |
| Increase in Maintenance Material | 2,142,000 cubic yards |
| Placement Areas | ODMDS 4 |
| Beneficial Use of Dredged Material | None |

### Sabine Pass Channel

This 5.6-mile-long channel begins just north of the jetties and extends upstream to Mesquite Point on Pleasure Island (Figure VI-4). It would be deepened to 48 feet and constructed with a hydraulic pipeline dredge. Advance maintenance varies in different sections of the Sabine Pass Channel to account for differences in shoaling rates. The maximum dredging depth for two reaches of this channel (Station 0+00 to Station 100+00, and Station 180+00 to Station 230+00) would be 52 feet. Due to additional advance maintenance required to maintain existing O&M dredging cycles, the reaches from Station 100+00 to Station 180+00 and Station 230+00 to the end of the Sabine Pass Channel at 295+61 would be dredged to a depth of 55 feet. The bottom width of the Sabine Pass Channel would remain at 500 feet with a new centerline closely following the existing centerline. The Sabine Pass Anchorage is located in this reach and its footprint would be reduced in size because it has never been fully utilized. The width would be decreased from 1,500 to 855 feet, but the length would remain at 8,200 feet. The angle of approach would remain the same. An overview of the project details for the Sabine Pass Channel reach is listed in Table VI-6.

Table VI-6
Project Details for Sabine Pass Channel Reach

| | |
|---|---|
| Length of Reach (Sections 5, 6) | 5.6 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | 500 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | Station 100+00 to Station 180+00 is 3 feet<br>Station 230+00 to Station 295+61 is 3 feet |
| New Work Material | 6,723,000 cubic yards |
| Placement Areas | PA 5 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 34,781,000 cubic yards |
| Increase in Maintenance Material | 4,191,000 cubic yards |
| Placement Areas | PA 5 |
| Beneficial Use of Dredged Material | Gulf Shore Beneficial Use Feature |

### Port Arthur Canal (including Taylor Bayou Channels and Turning Basins)

This 6.2-mile-long canal begins near Mesquite Point and ends at the Port Arthur Junction Area with the Taylor Bayou channels (Figure VI-5). The Junction Area serves as a TB and has an irregular shape where the Taylor Bayou channels and the GIWW merge with it. The Port Arthur Canal would be deepened to the proposed depth of 48 feet with a hydraulic pipeline dredge. Advance maintenance would vary in different sections of the Port Arthur Canal to account for differences in shoaling rates. The reach from Station 00+00 to Station 290+00 would be dredged to a maximum depth of 53 feet. The remaining part (Port Arthur Junction) between Stations 290+00 and 326+37 would be dredged to a maximum depth of 57 feet. The bottom width of the Port Arthur Canal would remain 500 feet. An overview of the project details for the Port Arthur Canal reach (including Taylor Bayou) is listed in Table VI-7.

Located at the confluence of the Port Arthur Junction Area, the GIWW, and the mouth of the original Taylor Bayou, the Taylor Bayou Channels and TB consist of several subreaches: Entrance Channel, East TB, West TB, Connecting Channel, and the Taylor Bayou TB. Several significant changes are proposed for this area. When advance maintenance and allowable overdepth are added to the proposed 48-foot depth, all of the Taylor Bayou channels and TB could be dredged to 53 feet. The Taylor Bayou portion of the Junction Area, between Taylor Bayou stations 0+00 and 31+10, would be dredged to 57 feet. The Taylor Bayou Entrance Channel and the West TB bottleneck curve would be widened, and a structural wall would protect local railroad tracks. Changes for each subreach are detailed below.

- Taylor Bayou Entrance Channel. The new bottom width widens on the west side of the channel. The channel would be widened to 444 feet at new Station 10+00. The new bottom width would taper back to the existing width by the end of the first curve at Station 28+38.

Table VI-7
Project Details for Port Arthur Canal Reach (including Taylor Bayou)

| | |
|---|---|
| Length of Reach (Sections 7, 8) | 6.2 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | Varies (widest is 500 feet) |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | (PA Canal) Station 0+00 to 290+00 is 1 foot<br>(PA Canal) Station 290+00 to 326+37 is 5 feet<br>(Taylor Bayou) Station 0+00 to 31+10 is 5 feet<br>(Taylor Bayou) Station 31+10 to 106+25 is 1 foot |
| New Work Material | 11,697,000 cubic yards |
| Placement Areas | PAs 8 and 9 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 82,858,000 cubic yards |
| Decrease in Maintenance Material | 5,391,000 cubic yards |
| Placement Areas | PA 8 and 9 |
| Beneficial Use of Dredged Material | None |

- East TB. The right side width would decrease 16 feet as the new depth extends down the existing side slope.
- West TB. The width of the existing bottleneck has been increased up to 120 feet on the west side, between new stations 33+00 and 55+00. The west bank of the basin would be protected by a structural wall, preventing impacts to the local railroad tracks present in this area.
- Connecting Channel. The West TB widening tapers back to the existing width in the Connecting Channel, between stations 55+00 and 67+00.
- Taylor Bayou TB. No changes would be made to the existing dimensions, but the basin would be deepened to the proposed 48-foot depth. Existing shore protection belonging to a local facility near Station 90+00 would be affected by penetration by the top-of-cut for the new depth.

### Sabine-Neches Canal

The 11.2-mile-long canal begins at the Port Arthur Junction Area and ends just south of the mouth of the Neches River (Figure VI-6). The GIWW shares this canal with the deep-draft channel. It would be deepened to the proposed depth of 48 feet with a hydraulic pipeline dredge. When advance maintenance and allowable overdepth are added for the shoaling rate in the canal, stations 0+00 to 40+00 could be dredged to 57 feet, and remainder of the canal through Station 592+91 could be dredged to 53 feet.

The bottom width of this canal would be selectively widened in three separate sections. The bottom width of the most-downstream curve (stations 0+00 to 20+00) would be widened to 500 feet on the east side of the channel, and then promptly tapered to the existing 400-foot width prior to the MLK Bridge (SH 82). The canal would be widened to 450 feet adjacent to the Port of Port Arthur, with gradual tapering

upstream and downstream between stations 120+00 and 170+00. The third widening section begins to taper at Station 565+00, gradually widening to 500 feet and remaining that width to the end at Station 592+91.

Bend easing is planned for three areas in the Sabine-Neches Canal to improve ship maneuverability: stations 265+00 to 305+00, stations 350+00 to 395+00, and stations 500+00 to 520+00. The bend easing between Stations 350+00 to 395+00 eliminates a wiggle in the alignment, and shifts the footprint of the canal 10 feet east of the existing alignment up to Station 520+00.

Changes are also recommended for the canal bottom adjacent to the Port Arthur Dock and the "Eye Basin." The canal toes adjacent to the Port of Port Arthur would be moved approximately 10 feet to the east while keeping the same bottom width of 450 feet. The diameter of the turning point ("Eye Basin") at Station 190+00 would be decreased by 16 feet. An overview of the project details for the Sabine-Neches Canal reach is listed in Table VI-8.

Table VI-8
Project Details for Sabine-Neches Canal Reach

| | |
|---|---|
| Length of Reach (Sections 9, 10) | 11.2 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | varies 400 to 500 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | Station 0+00 to 40+00 is 5 feet<br>Station 40+00 to 592+91 is 1 foot |
| New Work Material | 11,944,000 cubic yards |
| Placement Areas | PAs 8 and 11 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 73,245,000 cubic yards |
| Increase in Maintenance Material | 13,122,000 cubic yards |
| Placement Areas | PAs 8 and 11 |
| Beneficial Use of Dredged Material | None |

### Neches River Channel

This 18.5-mile-long channel begins just south of the mouth of the Neches River (Figure VI-7). It would be deepened to the proposed depth of 48 feet to Station 980+00 with a hydraulic pipeline dredge. Advance maintenance would vary in different sections of the Neches River Channel to account for differences in shoaling rates. Between stations 0+00 and 440+00, the maximum dredged depth would be 52 feet; between stations 440+00 and 978+00, it would be 54 feet. While the overall bottom width of 400 feet does not change for the majority of the channel length, the first curve at the mouth of the Neches River (between stations 0+00 and 75+00) would be widened to 500 feet, and then tapered back to 400 feet prior to the SH 87 twin bridges. An overview of the project details for the Neches River Channel reach is listed in Table VI-9.

Table VI-9
Project Details for the Neches River Channel Reach

| | |
|---|---|
| Length of Reach (Sections 11–18) | 18.5 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | 400 feet (majority of channel) |
| | 500 feet Station 0+00 to 75+00 |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | Station 440+00 to 978+00 is 2 feet |
| New Work Material | 25,014,000 cubic yards |
| Placement Areas | PAs 12, 13, 14, 16, 18, 21, 23, 24, 25, 26, 27 |
| Beneficial Use of Dredged Material | Neches River BU Feature |
| Maintenance Material (50-year quantity) | 89,725,000 cubic yards |
| Increase in Maintenance Material | 23,277,000 cubic yards |
| Placement Areas | PAs 12, 13, 14, 16, 17, 18, 21, 23, 24, 25, 26, 27 |
| Beneficial Use of Dredged Material | Neches River BU Feature (Bessie Heights East, Rose City East) |
| Turning Basins/Anchorage Areas | 1 new; 2 enlarged; 5 no change |

Three basins would be added or enlarged on the Neches River Channel. All three would be dredged to the proposed depth of 48 feet, plus the advance maintenance and allowable overdepth associated with the specific channel reach in which they are located. One TB, Turning Basin No. 6, is an existing basin and would continue to be maintained at the existing 40-foot depth and existing advance maintenance and allowable overdepth.

- Turning and AB No. 1 is located in an old river oxbow at the east end of Texaco Island near Station 210+00. The TB enlarges the existing basin from 1,000 to 1,350 feet in diameter. A new AB, 250 by 1,100 feet in size, would be added.
- Turning and AB No. 4 enlarges an existing turning point at Station 510+00 from 1,000 to 1,350 feet in diameter. A new AB in the old river oxbow at Station 500+00 would be 250 by 1,100 feet in size.
- AB No. 8 is new and would be located at Station 850+00. The 250- by 1,100-foot basin is located in an old river oxbow.

## Management of Dredged Material

Federal dredged material from construction and maintenance of the Recommended Plan would be managed in accordance with the DMMP as described in Section VIII of this document and Appendix D of the FEIS. The DMMP GNF includes an extensive BU plan that uses new work and maintenance material from the proposed 48-foot project to restore large marsh complexes on the Neches River, and nourish the Gulf shoreline in Texas and Louisiana.

Construction of the Recommended Plan would generate 98 mcy of new work material and 650 mcy of maintenance material for the 50-year period of analysis. Forty-four percent of the new work material would be placed in offshore disposal sites. Forty-seven percent of the new work material would be used to construct and rehabilitate PA containment levees; 8 percent would be used in DMMP marsh restoration; and 1 percent would be surplus and pumped to upland PAs. The material type expected to be dredged with construction of the Recommended Plan is predominantly clay (USACE, 1982), and is suitable material for the construction and rehabilitation of PA containment levees. However, one short stretch of the Neches River Channel near the upstream end of the project contains sandier sediments (clayey sands, sandy clays, silty sands, and poorly graded sands). Since specific dredging practices may influence the degree to which the material would stack, regular monitoring of the dredging activities would be necessary.

Shoaling is projected to increase with the Recommended Plan for several reasons (Parchure et al., 2005). The Entrance Channel is being extended an additional 13.2 miles into the Gulf of Mexico, and this would result in higher offshore maintenance dredging quantities. The larger channel cross section would lower velocities near the bottom of the navigation channel creating conditions favorable for sediment deposition; the deeper channel would have a greater surface area, making it function as a larger sediment trap; and higher salinities would increase flocculation and increase the deposition of suspended sediment.

Maintenance dredging material quantities for the proposed 48-foot project would therefore increase from 407 mcy to 650 mcy. Expressed as average annual equivalents, estimated dredging quantities increase from 8.1 mcy to 13.0 mcy per year over the 50-year period of analysis (Table VI-10). Fifty-seven percent of the maintenance quantities would originate from the offshore channels, and 43 percent from the inshore channels.

Table VI-10
Existing and Proposed Maintenance Dredging Quantities

| Channel Reach | Existing 50-Year Maintenance Quantities | Proposed 50-Year Maintenance Quantities |
|---|---|---|
| Neches River Channel | 66,447,680 | 89,724,800 |
| Sabine-Neches Canal | 60,122,600 | 73,245,000 |
| Port Arthur Canal | 88,248,750 | 82,857,600 |
| Sabine Pass Channel | 30,590,400 | 34,780,800 |
| Sabine Pass Jetty Channel | 11,385,000 | 13,527,000 |
| Sabine Pass Outer Bar Channel | 99,685,000 | 223,650,000 |
| Sabine Bank Channel | 50,822,400 | 96,371,000 |
| Sabine Bank Extension | | 36,216,000 |
| Total Quantities | 407 mcy | 650 mcy |

### Beneficial Use Features of the DMMP

Dredged material will be used beneficially to restore large degraded marsh areas on the Neches River (Rose City East, Bessie Heights East, and Old River Cove), and nourish the Gulf shoreline at Texas and

Louisiana Points. Shoreline nourishment at Texas Point is located within the boundaries of the Texas Point NWR. Detailed descriptions of these efforts can be found in Section VIII of this report and in Appendix C of the FEIS.

The DMMP BU features (Neches River and Gulf Shore BU features) are least-cost, environmentally acceptable placement alternatives and, as such, are considered GNF of the Recommended Plan. They will contribute significantly to a sustainable environment while providing placement capacity for the proposed project. The Neches River BU Feature would take advantage of new work material provided by the channel-deepening project to build hydraulic containment levees within degraded, former marsh areas at Rose City East, Bessie Heights East, and Old River Cove. Each of these areas is referred to as a component of the overall Neches River BU Feature. Marsh would be created in each component using only new work, or a combination of new work and maintenance material. At the Rose City East component, new work material would be used to construct containment levees and ridges, then the marsh would be completed with the placement of maintenance material during the first maintenance cycle following construction. In the Bessie Heights East component, maintenance material would be placed incrementally in seven maintenance cycles over 28 years. The Old River Cove component would be filled during initial construction with new work material, alone. The Gulf Shore BU Feature nourishes shorelines at Texas and Louisiana Points with the placement of maintenance material every 3 years over the 50-year period of analysis, with placement episodes alternating between each side of Sabine Pass.

BU features of the DMMP (Neches River and Gulf Shore features) will offset all project impacts in Texas by restoring 2,853 acres of emergent marsh, improving 871 acres of shallow-water habitat, and nourishing 1,234 acres of existing marsh. Benefits of the Neches River BU Feature also more than offset the direct impact of conversion of 86 acres of fresh marsh to a confined PA (PA 24A) and the indirect impact of the increase in salinity over 39,000 wetland acres in Texas. The Gulf Shore BU Feature offsets minor erosion impacts by periodically nourishing 6 miles of Texas and Louisiana Gulf shorelines. Benefits of the DMMP offset all impacts of the Recommend Plan in Texas and, therefore, no compensatory mitigation is proposed for Recommend Plan effects in Texas.

The Keith Lake Section 1135 CAP study was begun in 2003, well before impacts of the SNWW CIP had been determined or potential mitigation measures defined. Since at that time it seemed likely that the CAP study and project construction would be completed before the SNWW CIP could be authorized and constructed, the Keith Lake Section 1135 study was considered separable from the SNWW CIP. It was assumed that a water control structure at the Fish Pass would be part of the FWOP condition for the SNWW CIP.

Incremental impacts of the SNWW CIP will be calculated for the Salt Bayou unit of the SNWW study area when WVA modeling is completed for the Keith Lake Section 1135 study. It is possible that the excess DMMP benefits (316 AAHUs) of the SNWW CIP will cover all incremental project impacts. However, if it is determined that additional mitigation is needed, then the USACE and the non-Federal sponsor of the SNWW CIP will initiate consultation with resource agencies, identify and incrementally justify additional compensatory mitigation for the Salt Bayou unit, and prepare a supplement EIS.

### Upland Placement Areas

Sixteen existing PAs and two expansion cells are proposed for use with the Recommend Plan. A list and description of proposed upland PAs can be found in Chapter VII of this report. For the inland channel reaches, existing upland PAs will be used to the greatest extent possible; however, expansion of some existing PAs will also be required. Forty-seven percent of the new work material will be used to construct and rehabilitate PA containment levees; 8 percent will be used in DMMP marsh restoration; and the remainder would be pumped to upland PAs. Upland PAs on the Port Arthur and Sabine-Neches canals and the Neches River Channel would also provide capacity for non-Federal dredging of private facilities. A capped landfill has been found in PA 17 that is unrelated to dredged material or dredging activities. Issues related to possibly hazardous materials in the landfill must be resolved by the Sponsor before the PA could be used. Alternate PAs are available should this issue not be resolved in time for use.

### Ocean Dredged Material Disposal Sites

For the offshore channel reaches, the Recommended Plan provides for the use of four existing ODMDSs (1–4) and four proposed ODMDSs (A–D). These sites are in the Sabine Bank Channel and the Sabine Bank Extension (see figures VI-1 and VI-2). Site selection criteria for the four proposed Extension Channel ODMDSs are discussed in the FEIS for ODMDS designation (FEIS Appendix B) and in Chapter VII of this report. This document provides required NEPA review and public coordination to support Environmental Protection Agency (EPA) designation, per 40 CFR 228, of new ODMDSs that provide environmentally acceptable, and economically and physically feasible, areas for the placement of the construction material and future maintenance material from the Extension Channel. All of the new sites, as well as the existing sites, are located west of the navigation channel to minimize channel-shoaling effects of the prevailing east to west littoral drift in this portion of the Gulf of Mexico.

Maintenance dredging volumes for the offshore channel would increase more than the inshore reaches (increase of 128 percent and 14 percent, respectively). Additional capacity for the offshore reaches would be obtained by designating new ODMDSs. Material from four of the offshore channel reaches (Extension Channel, Sabine Bank Channel, Sabine Pass Outer Bar Channel, and Sabine Pass Jetty Channel) would be placed in the ODMDSs as described in Appendix B of the FEIS. The types of material expected to be dredged with construction of the Recommended Plan were established with soil borings through the maximum dredging depth along the centerline of the existing channel and proposed channel extension (USACE, 1982). The cores are composed overwhelmingly of inorganic clays, with the exception of the channel segment adjacent to proposed ODMDS C where sediments are approximately 70 percent silty or clayey sands and 30 percent clay.

## Compensatory Mitigation

The USACE has developed a compensatory mitigation plan for project impacts that would remain after application of DMMP BU Feature benefits. Project impacts are fully described in the FEIS; DMMP BU benefits and compensatory mitigation are summarized in chapters VII and VIII of this document. No

mitigation would be necessary in Texas because benefits of the DMMP offset all impacts in Texas; therefore, all mitigation areas would be located in Louisiana.

The recommended Mitigation Plan would consist of restoring five degraded marsh areas east of Sabine Lake in Louisiana. Each of the mitigation measures is described in detail in Section 5.0 of the FEIS. The Mitigation Plan would compensate for the Recommended Plan's salinity increase and associated losses in biological function and productivity by marsh creation activities in the Willow and Black Bayou watersheds. A hydraulic pipeline dredge would pump a sediment slurry into a total influence area of 8,095 acres. The sediment would restore 2,783 acres of emergent marsh in existing open-water areas within the influence area; improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh; and stabilize and nourish 4,355 acres of existing marsh located in the influence area. The amount of recommended mitigation was determined by the WVA Model and is the amount of marsh that would need to be restored to compensate for the mitigation target of the 1,159 AAHUs. In total, these measures produce 1,181 AAHUs and provide full compensation for all impacts of the CIP. This plan is described more fully in Chapter VIII.

## Aids to Navigation – USCG Channel Markers

Most of the existing USCG channel markers along the waterway would require removal and replacement. However, markers along the Neches River Channel upstream from the Beaumont Maneuvering Basin and in the vicinity of SH 87 would not require changes in the navigation aids. The Port Arthur Junction area would require relocation of the aids to navigation, and new aids would be required along the Extension Channel. The USCG would be responsible for replacing the structures when the channel modifications are constructed.

## Bridge Reinforcements and Fenders

Deepening improvements to the SNWW navigation channels would affect existing fender systems of the Rainbow Bridge and Veteran's Memorial Bridge over the Neches River Channel on SH 87 and the MLK Bridge over the Sabine-Neches Canal on SH 82. Bridge fender systems on both sides of the channel would require removal and replacement. Additional stabilization of the bridge foundation would be needed at the MLK Bridge. None of the bridges would cause an unreasonable obstruction to navigation, and thus would not require modification or replacement pursuant to the Truman-Hobbs Act. Bridge piers with a hardened structure would be necessary to maintain the proposed 400-foot channel width.

## Lands, Easements and Rights-of-Way

The project Sponsor is required to furnish the LER for the proposed cost-shared project. The real estate requirements must support construction as well as operation and maintenance of the project after completion. A summary of the real estate requirements for each channel reach is provided in Table VI-11. Specific details of the real estate requirements can be found in the Real Estate Plan, Appendix 4 of this document.

Table VI-11
Real Estate Requirements for Placement Areas

| | Real Estate Requirement |
|---|---|
| **Channel Reach** | |
| Sabine Bank Extension | Navigational servitude |
| Sabine Bank Channel | Navigational servitude |
| Sabine Pass Outer Bar Channel | Navigational servitude |
| Sabine Pass Jetty Channel | Navigational servitude |
| Sabine Pass Channel | Acquire in Fee (PA 5) |
| Port Arthur Canal | Navigational servitude (PA 8)<br>Acquire in Fee (PA 9) |
| Sabine-Neches Canal | Navigational servitude (PAs 8, 11) |
| Neches River Channel | Owned by Sponsor (no action)<br>(PAs 12, 13, 14, 16, 18, 18A, 21, 23, 23A, 24, 24A, 25, 25A)<br>Acquire in Fee (PAs 17, 26, 27A, 27C, 27D)<br>Turning Basins – two would require the acquisition of land in perpetual channel improvement easement. |
| **Louisiana Mitigation Areas** | |
| Willow/Black Bayou Areas | Navigational Servitude |

## Relocations

The following assumptions were made to identify pipelines that could be affected by the Recommended Plan and to develop associated costs. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. Feasibility engineering guidelines indicate that pipelines with a minimum of 8 feet of cover for trenched lines or 5 feet of cover for directionally drilled lines would not be adjusted. Pipelines that do not meet the minimum cover requirement would be required to be adjusted. The adjusted pipelines must be located 20 feet below the authorized 48-foot depth. The 20 feet includes any advance maintenance and allowable overdepth. The relocation of active pipelines is assumed to be installed with directional drilling, and bundled where possible.

A total of 104 pipelines have been identified crossing the SNWW navigation channels. Of the 104 pipelines, 46 require adjustment to meet the minimum required vertical and horizontal clearances for the CIP.

Pursuant to Section 101(a) of the Water Resources Development Act (WRDA) of 1986, as amended, the Sponsor is responsible for performing, or assuring performance, of all relocations, including utility relocations, which are necessary for the CIP. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government.

The Galveston District has concluded preliminarily that 41 of the 46 lines located within the channel must be relocated and are classified as utility relocations for which the Sponsor must perform or assure performance. In accordance with Section 101(a)(4) of WRDA 86, one-half of the cost of each such relocation will be borne by the owner of the facility being relocated and one-half of the cost of each such

relocation will be borne by the Sponsor. Such relocation costs will not include any cost for upgrading or improving such facilities, which is to be borne by the facility owner.

For more specific information regarding the utility relocations, and preliminary conclusions regarding the remaining five lines that must be removed but not replaced, see the Real Estate Plan, Appendix 4, of this document.

DMMP marsh restoration at Bessie Heights and mitigation marsh restoration measures east of Sabine Lake were assumed to require no relocations. However, since oil production is active in some of these areas, additional pipeline searches and coordination with pipeline owners would be required prior to construction to avoid impacts.

No relocations would be required for overhead power utilities, highway bridges, the Port Arthur HFP Levee, or its associated pump stations and closure structures.

### Impact Analysis and Mitigation Needs Summary for the Recommended Plan

A summary of impacts before DMMP benefits and compensatory mitigation is provided in tables VI-12 and VI-13 for Louisiana and Texas, respectively. A full summary of the impact analysis and compensatory mitigation needs for the Recommended Plan is presented in Table VI-14 for each state. The calculation of impacts and benefits of the DMMP BU features and mitigation measures are described in Section 2.5 and throughout Section 4.0 of the FEIS.

### Critical Assumptions

Critical planning and environmental assumptions were made in the evaluation of the benefits and impacts of the Recommended Plan. Table VI-15 provides a brief summary of the major assumptions, the scientific basis or rationale behind each assumption, and an indication of the consequences if the assumptions turns out not to be valid.

## VI.C RECOMMENDED PLAN AND RECENT USACE INITIATIVES

As stated in Chapter III of this report, the USACE has implemented the EOP and the Actions for Change over the past few years. These initiatives were developed to ensure the USACE success in the future by improving the current practices and decision-making processes of the USACE organization. The application of those principles as they relate to the Recommended Plan for the SNWW CIP is described below:

### USACE Environmental Operating Principles

- **Strive for environmental sustainability** – Construction of BU, restoration, and mitigation sites were developed for a 50-year period of analysis. Development and design of these areas were made to address potential changes over time (e.g., sea-level rise, shoreline erosion, etc.).

Table VI-12
SNWW WVA Impacts Summary-Before DMMP Benefits and Mitigation
Louisiana Impacts (Sorted by AAHUs)

| HU # | Hydrologic Unit | Habitat Type | FWOP Net Change Acres | FWP Net Change Total Acres | FWP Net Change % Acres | FWOP Net Change AAHUs | FWP Net Change AAHUs | FWOP Salinity (ppt) | FWP Salinity (ppt) | FWP Net Salinity Change (ppt) |
|---|---|---|---|---|---|---|---|---|---|---|
| LA 3 | Black Bayou | Intermediate Marsh | –1,713 | –130 | –0.3 | 14,734 | –509 | 4.00 | 5.10 | 1.1 |
| LA 2 | Willow Bayou | Intermediate (Brackish lumped) | –2,116 | –102 | 0.3 | 11,249 | –328 | 6.30 | 7.20 | 0.9 |
| LA 4 | West Johnson's Bayou | Intermediate Marsh | –1,703 | –142 | –0.8 | 5,729 | –269 | 6.30 | 7.50 | 1.2 |
| LA 5 | Sabine Lake Ridges | Intermediate Marsh | –1,103 | –93 | –0.7 | 4,868 | –218 | 6.30 | 7.50 | 1.2 |
| LA 9 | East Johnson's Bayou | Intermediate Marsh | –895 | –46 | –0.2 | 13,820 | –190 | 4.20 | 5.20 | 1.0 |
| LA 1 | Perry Ridge | Fresh Marsh | –921 | –50 | –0.2 | 8,947 | –65 | 0.90 | 1.24 | 0.3 |
| LA 1 | Perry Ridge | Intermediate Marsh | –191 | –12 | –0.1 | 1,873 | –53 | 0.90 | 1.24 | 0.3 |
| LA 5 | Sabine Lake Ridges | Saline Marsh | –398 | –10 | –0.5 | 2,184 | –35 | 17.00 | 18.40 | 1.4 |
| LA 8 | Southwest Gum Cove | Fresh Marsh | –152 | –8 | –0.3 | 2,170 | –2 | 1.20 | 2.10 | 0.9 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh | –2,567 | –43 | –0.1 | 9,113 | –14 | 8.00 | 8.60 | 0.6 |
| LA 7 | Southeast Sabine | Fresh Marsh | –40 | 0 | 0.0 | 1,231 | –11 | 1.80 | 2.30 | 0.5 |
| LA 6 | Johnson's Bayou Ridge | Brackish Marsh | –707 | –22 | –0.3 | 1,285 | –6 | 6.00 | 6.70 | 0.7 |
| LA 8 | Southwest Gum Cove | Intermediate (Brackish lumped) | –233 | –15 | –0.2 | 3,253 | –4 | 2.40 | 3.30 | 0.9 |
| LA 6 | Johnson's Bayou Ridge | Saline Marsh | –93 | –5 | –1.0 | 195 | –2 | 12.00 | 13.80 | 1.8 |
| LA 3 | Black Bayou | Brackish Marsh | –803 | –4 | 0.0 | 1,643 | –1 | 3.00 | 3.80 | 0.8 |
| LA 4 | West Johnson's Bayou | Brackish Marsh | –1,189 | –6 | –0.2 | 768 | –1 | 6.00 | 6.70 | 0.7 |
| LA 2 | Willow Bayou | Brackish Marsh | –695 | –2 | | 498 | –1 | | | 1.4 |
| LA/TX 1 | Sabine Island | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 4,499 | 0 | 0.69 | 1.10 | 0.4 |
| LA/TX 2 | Blue Elbow | Cypress/Tupelo Swamp (BH lumped) | 0 | 0 | 0.0 | 300 | 0 | 1.00 | 1.60 | 0.6 |
| LA 7 | Southeast Sabine | Intermediate (Brackish lumped) | –96 | –1 | 0.0 | 3,204 | 0 | 1.80 | 2.00 | 0.2 |
| LA 1 | Perry Ridge | Bottomland Hardwood | 0 | 0 | 0.0 | 2,080 | 0 | 0.90 | 1.24 | 0.3 |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0 | 0 | 0.0 | 999 | 0 | 0.69 | 1.10 | 0.4 |
| Total | | | –15,615 | –691 | | 94,642 | –1,709 | | | |

Table VI-13
SNWW WVA Impacts Summary-Before DMMP Benefits and Mitigation
Texas Impacts (Sorted by AAHUs)

| HU # | Hydrologic Unit | Habitat Type | FWOP Net Change Acres | FWP Net Change Total Acres | FWP Net Change % Acres | FWOP Net Change AAHUs | FWP Net Change AAHUs | FWOP Salinity (ppt) | FWP Salinity (ppt) | FWP Net Salinity Change (ppt) |
|---|---|---|---|---|---|---|---|---|---|---|
| TX 7 | GIWW North | Fresh (Intermediate lumped) | –539 | –63 | –0.4 | 2,602 | –140 | 0.70 | 1.20 | 1.6 |
| TX 6 | Old River Cove | Brackish Marsh | –1,518 | –46 | –0.3 | 3,061 | –116 | 10.00 | 11.00 | 1.8 |
| TX 3 | Rose City PA24A | Fresh Marsh | –3 | –86 | –63.3 | 53 | –32 | | | 0.3 |
| TX 8 | Texas Point | Intermediate (Fresh lumped) | –245 | –6 | –1.3 | 940 | –19 | 5.50 | 8.00 | 0.8 |
| TX 12 | Blue Elbow South | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 418 | –18 | 1.67 | 2.60 | 0.6 |
| TX 10 | Cow Bayou | Fresh Marsh | –75 | –6 | –0.1 | 824 | –18 | 2.00 | 2.20 | 1.0 |
| TX 11 | Adams Bayou | Fresh Marsh | –28 | –3 | –0.7 | 305 | –15 | 2.10 | 4.10 | 1.5 |
| TX 5 | Bessie Heights | Intermediate (Brackish lumped) | 31 | –1 | 0.0 | 1,273 | –14 | 4.20 | 4.70 | 0.3 |
| TX 10 | Cow Bayou | Intermediate Marsh | –59 | –3 | 0.0 | 741 | –12 | 2.00 | 2.20 | 1.0 |
| TX 7 | GIWW North | Brackish Marsh | –62 | –2 | –0.1 | 380 | –8 | 9.00 | 9.60 | 1.6 |
| TX 8 | Texas Point | Brackish Marsh | –252 | –5 | –0.4 | 1,464 | –7 | 8.50 | 11.00 | 0.8 |
| TX 8 | Texas Point | Saline Marsh | –2,446 | –17 | –0.9 | 2,480 | –5 | 12.50 | 15.00 | 0.8 |
| TX 11 | Adams Bayou | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 44 | –4 | 2.10 | 4.10 | 0.8 |
| TX 13 | Groves | Intermediate Marsh | –68 | –3 | –0.7 | 220 | –3 | | | 1.0 |
| TX 3 | Rose City | Fresh Marsh | –93 | –3 | –0.1 | 1,365 | –1 | 0.25 | 0.55 | 0.3 |
| TX 2 | Neches-Lake Bayou | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 1,977 | 0 | 2.00 | 2.90 | 0.0 |
| TX 1 | North Neches River | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 2,399 | 0 | 0.90 | 1.70 | 0.0 |
| LA/TX 2 | Blue Elbow | Cypress/Tupelo Swamp (BH lumped) | 0 | 0 | 0.0 | 1,261 | 0 | | | 0.3 |
| TX 2 | Neches-Lake Bayou | Fresh Marsh | –24 | 0 | –0.1 | 808 | 0 | 2.00 | 2.90 | 0.1 |
| LA/TX 1 | Sabine Island | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 896 | 0 | | | 0.0 |
| TX 5 | Bessie Heights | Fresh Marsh | –40 | –2 | –0.1 | 1,313 | 0 | 1.00 | 1.50 | 0.5 |
| TX 1 | North Neches River | Fresh Marsh | –8 | 0 | 0.0 | 249 | 0 | 0.90 | 1.70 | 0.0 |
| TX 10 | Cow Bayou | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 55 | 0 | 2.00 | 2.20 | 1.0 |
| TX 4 | West of Rose City | Fresh Marsh | –24 | –1 | –0.1 | 238 | 0 | 0.10 | 0.40 | 0.4 |
| TX 5 | Bessie Heights | Bottomland Hardwood | 0 | 0 | 0.0 | 225 | 0 | 1.00 | 1.50 | 0.5 |
| TX 3 | Rose City | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 217 | 0 | 0.25 | 0.55 | 0.3 |

Table VI-13 (Cont'd)

| HU # | Hydrologic Unit | Habitat Type | FWOP Net Change Acres | FWP Net Change Total Acres | FWP Net Change % Acres | FWOP Net Change AAHUs | FWP Net Change AAHUs | FWOP Salinity (ppt) | FWP Salinity (ppt) | FWP Net Salinity Change (ppt) |
|---|---|---|---|---|---|---|---|---|---|---|
| TX 1 | North Neches River | Bottomland Hardwood | 0 | 0 | 0.0 | 277 | 0 | 0.90 | 1.70 | 0.0 |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0 | 0 | 0.0 | 503 | 0 | | | 0.0 |
| TX 3 | Rose City | Bottomland Hardwood | 0 | 0 | 0.0 | 698 | 0 | 0.25 | 0.55 | 0.3 |
| TX 6 | Old River Cove | Bottomland Hardwood | 0 | 0 | 0.0 | 149 | 0 | 1.00 | 1.50 | 0.5 |
| TX 10 | Cow Bayou | Bottomland Hardwood | 0 | 0 | 0.0 | 286 | 0 | 2.00 | 2.20 | 1.0 |
| TX 11 | Adams Bayou | Bottomland Hardwood | 0 | 0 | 0.0 | 402 | 0 | 2.10 | 4.10 | 0.8 |
| TX 2 | Neches-Lake Bayou | Bottomland Hardwood | 0 | 0 | 0.0 | 1,164 | 0 | 2.00 | 2.90 | 0.0 |
| | Totals | | –5,453 | –247 | | 28,124 | –412 | | | |

Table VI-14
Impact Analysis and Mitigation Need

| | Texas | Louisiana | Project as Whole |
|---|---|---|---|
| **Impact analysis (AAHUs)** | | | |
| Negative Impacts (–) before DMMP BU | –412 | –1,709 | –2,121 |
| Positive Impacts Resulting from DMMP BU | 1,068 | 210 | 1,278 |
| Net Gain or Loss (–) after DMMP BU | 656 | –1,499 | –843 |
| Offset of Impacts to Louisiana Federal Lands from Excess Texas BU Benefits | –340 | 340 | NA |
| Net Gain or Loss (–) after BU Benefits | 316 | –1,159 | –843 |
| **Compensatory Mitigation (AAHUs)** | | | |
| Total Compensation | 0 | 1,181 | 1,181 |
| **Net Gain after BU Benefits and Mitigation** | **316** | **22** | **338** |
| **Impact Analysis (acres)** | | | |
| Size of Potential Impact | 58,649 | 197,530 | 256,179 |
| Area with No Impacts | 19,421 | 15,247 | 34,668 |
| Area of Direct Impacts | 86 | 0 | 86 |
| Area of Indirect Impacts | 39,228 | 182,283 | 221,511 |
| Net Acres of Land Loss (–) before DMMP BU | –243 | –691 | –934 |
| Total Miles of Shoreline Influenced by DMMP BU | 3 | 3 | 6 |
| Total Acres Affected by DMMP BU | 4,958 | 0 | 4,958 |
| Created Emergent Marsh | 2,853 | 0 | 2,853 |
| Improved Shallow Water | 871 | 0 | 871 |
| Nourished Existing Marsh | 1,234 | 0 | 1,234 |
| **Compensatory Mitigation (acres)** | | | |
| Total Acres Affected by Mitigation | 0 | 8,095 | 8,095 |
| Created Emergent Marsh | 0 | 2,783 | 2,783 |
| Improved Shallow Water | 0 | 957 | 957 |
| Nourished Existing Marsh | 0 | 4,355 | 4,355 |
| **Total Acres Affected by DMMP BU and Mitigation** | **4,958** | **8,095** | **13,053** |
| Created Emergent Marsh | 2,853 | 2,783 | 5,636 |
| Improved Shallow Water | 871 | 957 | 1,828 |
| Nourished Existing Marsh | 1,234 | 4,355 | 5,589 |

Table VI-15
Critical Assumptions

| Assumption | Rationale for the Assumption | Consequences if Assumption Becomes Invalid |
|---|---|---|
| **Future without-project (FWOP) Condition** | | |
| Louisiana Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Projects in operation at Willow Bayou, Black Bayou, and Perry Ridge for remainder of project life. | Ecological effects of CWPPRA projects (reductions in land loss rates and/or salinity) based upon changes projected in environmental assessments. | If ecological benefit of CWPPRA project is less than expected, then FWOP salinity and land loss impacts would be slightly higher than expected; conversely, if ecological benefits are higher, FWOP impacts would be slightly lower than expected. |
| Most likely rate of RSLR estimated to be 1.1 feet in the study area by year 2069. Full potential range of RSLR estimated to be from 0.3 to 2.8 feet over period of analysis. | Eustatic sea-level rise based upon mid- to high mid-range projected by NRC and IPCC, respectively. Local subsidence component based upon long-term trends obtained from basal peat analysis. Full potential range calculated as required by Circular No. 1165-2-211. | Little consequence if RSLR is lower than expected. High rate of RSLR could result in small increase in maintenance dredging and PA levee heights for existing project; increase in hurricane tidal surge elevation; an increase in land loss due to submergence of intertidal marshes and salinity increase. Functioning of navigation channel would not be affected; improvements at some dock facilities might be needed. |
| Future freshwater inflows assumed for HS modeling are slightly higher on Neches River than existing inflows; about the same as existing inflows on the Sabine River. | Future freshwater inflows were based upon demand projections and supply strategies approved by the 2007 Texas State Water Plan. | Little consequence if inflows are higher than projected. If inflows are lower than expected, FWOP ecological impacts would be higher than expected and more areas would be experiencing suboptimal salinities. |
| Changes in land loss rates are driven by the interaction of salinity and submergence, resulting in a reduction in plant productivity, leading to a decrease in plant growth, plant death, followed by peat collapse and wetland loss. Assumed linear relationship between change in salinity due to RSLR and change in FWOP land loss rate. | The salinity-vegetation productivity relationship is based upon algorithms developed for dominant wetland vegetation species in the study area. The algorithms were developed for the Louisiana Coastal Areas Ecosystem Restoration Study, using data from a large number of professional studies. | If the relationship between salinity and land loss is different from that projected, FWOP land loss would be higher or lower than current estimates. |

Table VI-15 (Cont'd)

| Assumption | Rationale for the Assumption | Consequences if Assumption Becomes Invalid |
|---|---|---|
| **Future with-project (FWP) Condition (Recommended Plan)** | | |
| RSLR – same as FWOP because deepening project causes only negligible increase in water surface elevation. | FWP water surface elevation change determined by the ERDC HS modeling. | Little consequence if RSLR is lower than expected. No FWP effect on maintenance dredging, PA levee heights, or tidal surge penetration. At high rate, all areas suitable for marsh mitigation could be susceptible to submergence. DMMP BUs protected by containment structures. |
| Additional land loss would result primarily from the interaction of higher FWP salinities with FWOP RSLR. Assume direct linear relationship between salinity and land loss changes. | Associating land loss with salinity increases is based upon well-documented biological responses of inundated vegetation to salinity change. No data are currently available that relate specific salinity changes to specific land loss rate changes. | If the relationship between salinity and land loss is different from that projected, FWP impacts would be higher or lower than current estimates. |
| **Cost Estimates** | | |
| Cost estimate of the Recommended Plan utilized appropriate probabilities of risk. | Cost risk analysis was performed using required forecasting and analysis tools. Cost contingencies developed by this analysis have been included in the total project cost estimate. | An increase in total project cost, exclusive of price level changes, of more than 20 percent of the total project cost stated in the authorizing legislation would require Congressional authorization. |
| It was assumed that up to 5 pipeline dredges would be available for use at one time for inshore channel dredging, and mitigation and BU marsh creation. Offshore dredging assumes use of only one hopper dredge at a time. | Assume offshore hopper dredge production averaging 7.9 mcy/yr; inshore pipeline dredge production of 7.2 mcy/yr; and no more than 550 acres/year of mitigation or BU marsh creation by any one dredge. | If the assumed production rate is too high, or if the assumed number of dredges is not available, then construction would take longer and the total cost of construction would increase. |
| **Funding** | | |
| Sufficient funding streams would be available to construct the Recommended Plan over the assumed construction periods and to provide long-term operation and maintenance. | USACE planning policy states that plans should be developed without funding constraints. Federal funding priorities are difficult to predict. | Total project cost could be higher because of longer construction schedule. Inadequate O&M funding could cause an increase in navigation costs or adversely affect monitoring of mitigation and BU features. |

mcy/yr = million cubic yards per year.

- **Consider environmental consequences** – The direct and indirect effects of the project on the environment were quantified using ecological modeling. Compensatory mitigation is provided in the Recommended Plan for all project impacts.
- **Seek balance and synergy** – Opportunities to beneficially use the large quantities of dredged material that would be generated by this project were thoroughly explored. The needs of the project to find environmentally acceptable placement areas were satisfied with the development of BU features that would contribute to the long-term sustainability of interior wetlands and the coastal zone.
- **Accept responsibility** – All environmental impacts of the proposed project have been addressed and either offset by beneficially using dredged material or mitigating for impacts.
- **Mitigate impacts** – Project impacts were identified and the type and location of the compensation to be performed. No mitigation is required in Texas since the long-term management plan more than offsets the impacts to occur in that state. Mitigation has been identified to offset project impacts in Louisiana. The recommended mitigation plan results in an excess of overall environmental benefits vs. impacts.
- **Understand the environment** – Some of the most knowledgeable and experienced environmental professionals in Texas and Louisiana participated on an ICT. Their expertise ensured that the broad spectrum of environmental habitats of the study area were adequately understood, impacts accurately identified, and the appropriate amount and type of mitigation was developed.
- **Respect other views** – Collaboration among the USACE, Sponsor, and ICT members occurred throughout the study process. The interactions were professional and respectful, and always entertaining the opinions and expertise of others.

## USACE Actions for Change as Reflected in the Campaign Plan

**Engineering Sustainable Water Resource** (integrated solutions, collaborative approaches, streamlined processes)

- SNWW study analyzed potential effects over a 2,000-square-mile area, incorporating the entire Sabine-Neches watershed.
- Dredged material placement plans were developed to beneficially use the material to the benefit of the entire system (inshore and offshore) to the greatest extent possible.
- Close collaboration with local sponsor throughout study.

**Delivering Effective, Resilient, Sustainable Solutions** (sustainable infrastructure, resilience, risk-formed strategy, innovative approaches)

- Developed plans over long-term, 50-year period of analysis.
- Utilized latest development in engineering, economic, and environmental modeling.
- Risk analyses conducted throughout the study are summarized in Chapter IX.
- Review and inspection of work will be conducted during design and construction.

- Project risks are communicated at public meetings and during the public review of the study findings. The public is allowed to comment and/or express concerns throughout the study process.
- Unlike flood risk management and hurricane protection projects, navigation projects involve minimal risk to the public.
- Independent review of the project documents and analyses was performed internally to the USACE and externally by professionals from academia and expert consultants. Comments from those reviews have been incorporated into the study documents, as appropriate.
- The expertise of State and Federal resource agency professionals familiar with the highly complex coastal ecosystems of Texas and Louisiana were integrally involved in the evaluation and development of plans to offset environmental impacts of the project.

# VII. DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

## VII.A OVERVIEW

This chapter presents the process and analyses used to evaluate dredged material placement issues and opportunities for the proposed 48-foot project (the Recommended Plan). It begins with an introduction to Regional Sediment Management (RSM), an approach that uses understanding of the SNWW sediment system to provide a context for managing the dredged material that would result from construction and management of the project. The following section describes the sediment system, summarizes a sediment budget for the Sabine Pass littoral zone, and characterizes material types and shoaling for the existing project. The next section describes problems and opportunities related to sediment management that were identified for the SNWW study area, and presents the results of a preliminary screening that was designed to identify BU features to be carried forward into the detailed phase of analysis. These BU features are then combined with upland placement features to form two alternative DMMPs, and the costs of these plans are then compared to identify the DMMP for the Recommended Plan. The BU Alternative was identified as the most-cost-effective, environmentally acceptable placement plan for both the new work and maintenance material, and it becomes the 50-year DMMP for the Recommended Plan. The DMMP is then summarized, followed by a description of the ecological benefits of the DMMP. The Base Plan for without-project disposal practices for the existing SNWW 40-foot project is then compared to proposed O&M placement activities for the Recommended Plan in order to determine the incremental O&M cost of the Recommended Plan.

## VII.B REGIONAL SEDIMENT MANAGEMENT OBJECTIVES AND SCOPE

The principles of RSM were applied in evaluating alternatives and developing the DMMP for the placement of dredged material from the proposed SNWW CIP. The RSM is an approach for managing projects involving sand and other sediments derived from dredging and other activities in riverine, estuarine, and coastal systems (USACE, 2006a). Its major objective is the retention of these sediments within natural aquatic systems, thereby supporting a more sustainable process and potentially reducing project costs (Martin, 2002). The RSM incorporates many of the principles of watershed planning, but applies them in the context of dredging and other activities that influence sediment resources. It broadens the problem-solving perspective from a project-specific scale to a larger spatial and longer-term perspective. This requires the integration of a broad range of disciplines and collaborative partnerships among stakeholders. The USACE authorities and policies that support implementation of the RSM are discussed in Technical Note No. 8 for the RSM Demonstration Program (USACE, 2003).

The geographic focus of an RSM analysis is a sediment system on a scale that is relevant to issues (e.g., dredged material management or processes like erosion or shoaling) that have been identified by stakeholders in the region. The RSM study area essentially coincides with the SNWW study area and contains riverine, estuarine, and coastal environments. It is large enough to facilitate understanding of sediment processes and behavior, and the inherent interconnectedness of all parts of a sediment system.

The RSM study area includes the existing 65-mile-long SNWW navigation channel that extends from 22 miles offshore in the Gulf of Mexico, through a jettied entrance at Sabine Pass, up artificial canals on the west side of Sabine Lake, and finally up the Neches River Channel to the City of Beaumont. The SNWW area of analysis incorporates all of the existing and proposed navigation and placement features, and significant inflows and structures that affect the system. The littoral portion of the study area extends from Holly Beach, Louisiana, to Sea Rim State Park in Texas, roughly a distance of 40 miles. It extends into the Gulf of Mexico along the existing Entrance Channel, proposed channel extension, and ODMDSs for a distance of roughly 40 miles; and it extends inland from the coastline approximately 40 miles to incorporate the tidally influenced reaches of the Sabine and Neches rivers watersheds and Sabine Lake.

The Texas Coastwide Erosion Response Plan has identified several parts of the study area as "critical erosion areas" because of impacts to habitats and traffic safety from ongoing erosion, and has called for an increase in the BU of dredged material from the SNWW project to help address these issues. The plan was developed as part of the CEPRA (GLO, 2004, 2005). The program has identified the Gulf shoreline between Texas Point and Sea Rim State Park as a critical erosion area. It attributes the erosion, in part, to a lack of sediment coming down the Sabine and Neches rivers, and the interruption of longshore sediment transport by the SNWW jetties.

The CEPRA Plan recommends that long-term RSM be utilized, along with highway realignment and beach dune restoration, to protect the important coastal evacuation route of SH 87 in Jefferson County. As described below, the Gulf Shore BU Feature would provide a long-term, RSM approach to restoring some sediment to the littoral zone in this area of high erosion. In Orange County, the CEPRA Plan calls for restoration of 9,400 acres of marsh in the Lower Neches River using dredged material to raise soil elevations in the former marsh areas that have become open water. These are the same marsh areas (i.e., Rose City, Bessie Heights, and Old River Cove) that have been combined into the Neches River BU Feature. The evaluation of these BU features is described more fully later in this chapter.

## VII.C EXISTING SHOALING AND SEDIMENT TRANSPORT CONDITIONS

A detailed description of the existing SNWW sediment system is provided in Section 2.5 of the FEIS. The reader is referred to that document for descriptions of geomorphology, winds, tides, circulation, and longshore sediment transport patterns.

### Shoreline Descriptions

Jefferson County and Cameron Parish coastlines in the study area are mainland beaches fronting the Chenier Plain (King, 2007; USACE, 2000a). The upland area adjacent to the coast is a relatively flat, gently sloping terrain with marsh elevations of 1 to 2 feet msl and ridge elevations of 5 to 6 feet msl. Saline marsh vegetation covers the upland area behind the eroding shoreface. In the Texas Point NWR, a fillet of muddy substrate that was created by rapid deposition over approximately the last 100 years lies seaward of the chenier ridges. For the period between 1883 and 1970, the net accretion was documented

at 2,225 feet (Morton, 1975). The fillet of recent deposits recedes rapidly and disappears approximately ½ mile from the west jetty, where the Chenier Plain again fronts the Gulf until it ends about 18 miles from Sabine Pass (Pacific International Engineering [PIE], 2003).

The shoreline in the Texas Point NWR (between Sabine Pass and Sea Rim State Park) is a muddy shoreface composed of consolidated mud (King, 2007; PIE, 2003). A thin veneer of sand thrown up onto the marsh edge by storms covers some areas of the mud substrate. Farther west, the Sea Rim State Park area is a sediment transport convergence zone, and the beach typically has a substantial veneer of sand. In Louisiana, the coastline for approximately 10 miles east of the jetty contains tidal sand/mudflats, sand bars, and sandy beaches with tidal flats (PBS&J, 2006). A narrow tidal sand/mudflat, ranging from 30 to 450 feet in width, extends for about 1.5 miles east of the jetty, and then transitions to a sandy beach. These beaches vary in width from 50 to 300 feet and end at an eroded, low mud bank shoreline.

## Historical Shoreline Change in the Study Area

The northwest Gulf coast system is sand starved, and essentially no modern-day sand is being delivered to these beaches (Lee, 2003; Morton, 1977; Morang, 2006). The only coarse-grained sand reaching the Texas shores appears to originate from the erosion of underlying Pleistocene barrier-strand plain deposits, which contain lenses of fine-grained and poorly sorted sands in massive clay and silt deposits (Isphording et al., 1989). The lack of delivery of coarse-grained sand contributes significantly to shoreline erosion in the area. The very limited coarse-grained load of the Sabine and Neches rivers is deposited in bay-head deltas in Sabine Lake rather than on the coast (Mason, 1981; Morang, 2006; USACE, 1971b).

Chronic shoreline erosion is believed to be associated with the diversion of sand and other sediment resulting from channelization and regulation of the Mississippi and Atchafalaya rivers to the east, and the Sabine and Neches rivers in Texas. The Calcasieu and Mermentau also do not supply coarse-grained sediments, and the Cameron jetties deflect the little material that does exist away from the Holly Beach area, so that it accumulates to the west at Long Beach, Louisiana's westernmost sandy beach (Louisiana Department of Natural Resources [LDNR], 1997; USACE, 2000a). The Sabine Pass jetties also intercept sediment moving westward in the littoral drift, creating a wide, muddy, tidal flat next to the east jetty (PBS&J, 2006; USACE, 2000a). On the Texas side, a ½-mile-wide fillet of silt and mud immediately adjacent to the west jetty intercepts sediments moving from the west during periodic reversals near Sea Rim State Park in the dominant longshore movement (PIE, 2003).

Shoreline change has been extensive in this region. In the area between Ocean View Beach and the Sabine jetties, the shoreline prograded seaward at an average rate of +12.9 feet/year between 1883 and 1994. Recently, however, accretion has slowed to +1.2 feet/year, and the behavior of this shoreline has become erratic, with change rates varying between –13.2 and +14.7 feet/year (USACE, 2000a). On the Texas side of Sabine Pass, a ½-mile stretch of shoreline adjacent to the west jetty is aggrading at a rapid rate, but beyond this narrow zone, to the west, is an active erosion zone extending approximately 15 miles to the vicinity of Sea Rim State Park (Morang, 2006). This eroding stretch of the Jefferson County coastline is experiencing the largest erosion rate on the upper Texas coast, up to 40 to 50 feet/year (King,

2007). It has been identified as a "critical erosion area" by the Texas Coastwide Erosion Response Plan because of threats to traffic safety and wildlife habitat. Shoreline erosion has destroyed a portion of SH 87, an important hurricane evacuation route, and is eroding coastal wetland habitat at Texas Point and McFaddin NWRs (GLO, 2004, 2005).

## Sabine Pass Sediment Budget

New littoral transport rates have recently been calculated for the Sabine Pass littoral zone. The Sabine Pass sediment budget (Morang, 2006) applied shoreline change statistics that were computed from changes in sediment volume for littoral cells, using cross-shore profiles that were projected with an ERDC modeling study (King, 2007). The sediment budget focused on characterizing sediment movement in the coastal segments of the navigation channel and nearby Texas shoreline. Accurate estimates of the percentage of total transport that is suspended sediment load from the inshore area were not available. Six of the 23 cells defined for this study are relevant to this discussion – 3 cells (the Sabine Pass Channel, the Sabine Jetty Channel, and the Sabine Outer Bar Channel) were used to analyze sediment movement in the navigation channels through Sabine Pass and past the jetties; 3 other cells (the Sabine Fillet, Texas Point NWR, and Sea Rim State Beach) were used to calculate sediment movement along the littoral zone westward of the Sabine Pass. A summary of the sediment budget results is presented in Table VII-1

## Existing Project Shoaling and Sediment Transport Conditions

The following summary of shoaling and transport conditions for the existing SNWW includes all segments of the existing SNWW navigation system. The analysis of channel sections covered by the Sediment Budget (Table VII-1) is derived primarily from Morang (2006); dredging cycle lengths, velocity data, average percentages of sediment sizes, and dredging quantities (for channel reaches not covered by the Sediment Budget) were obtained from the SNWW Sediment Study (Parchure et al., 2005); other supporting analyses are identified as the data are presented. The discussion begins with the upstream end of the SNWW (the Neches River Channel), and moves downstream through the confined Sabine-Neches and Port Arthur canals, the Sabine Pass Channel, and then offshore into the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, and the Sabine Bank Channel. Finally, the interaction of the channel and adjacent shoreline sections is described.

### Neches River Channel

Dredging cycles on the Neches River Channel vary from 3 to 4 years along the eastern half of the channel near Sabine Lake to 6 years along the western segment near Beaumont. Approximately 3.1 mcy/cycle are dredged from eastern channel sections 11, 12, 13, 14, and 15 and placed into PAs 12, 13, 14, 16, 18, 21, 23, and 23A. Approximately 3.3 mcy/cycle are dredged from western channel sections 16, 17, and 18 and placed in PAs 24, 25, 25A, 26, 27A, 27C, and 27D near Beaumont. Peak ebb and flood velocities are low (0.8 foot/second and 0.3 foot/second, respectively). Bed sediments average 62 percent silt and clay and 38 percent sand.

### Sabine-Neches and Port Arthur Canals

These canals traverse the confined channel segment between the City of Port Arthur and Pleasure Island. Sabine-Neches Canal sections 9 and 10 are dredged every 4 years. Approximately 3.7 mcy/cycle are placed in PAs 8 and 11. Bed sediments average 78 percent silt and clay and 22 percent sand. Port Arthur Canal Section 7 is dredged every 3 years and approximately 1.8 mcy/cycle are placed in PA 8. Section 8 and the Taylor Bayou Channels and Basins are dredged every 2 years; approximately 2.3 mcy/cycle are placed in PAs 8, 9, and 9A. Peak ebb and flood velocities are 2.6 and 2.2 feet/second, respectively. Bed sediments average 84 percent silt and clay and 16 percent sand. The junction of the Port Arthur Canal, Taylor Bayou Channel, and the Sabine Pass Channel is an existing dredging hot spot, often requiring dredging more frequently than the 2-year cycle. This is due, at least in part, to a rapid decrease in velocity as the flows move into the much wider junction. In addition, existing erosion along the channel side of Pleasure Island may be returning sediment to the system (Parchure et al., 2005).

Table VII-1
Annual Sediment Budget for Sabine Pass (adapted from Morang, 2006)

| Cell | Sources and Quantity (1,000 cubic yards per year) | Sinks and Quantity (1,000 cubic yards per year) | PA/ODMDS and Quantity (1,000 cubic yards per year) |
|---|---|---|---|
| Sabine Pass Channel | 866.7 (approximately 20% sand) from Port Arthur Canal and Sabine Lake | 274.2 mud and sand into Jetty Channel | 592.5 into PA 5 |
| Sabine Pass Jetty Channel | 274.2 (mud and minor sand) from Sabine Pass Channel | Unknown quantity of fine-grained material carried in suspension offshore | 289.1 to ODMDS 4 (dispersed by shelf circulation, storm and tidal currents) |
| | 14.9 (mud) offshore | | |
| Sabine Outer Bar Channel | Unknown amount from Sabine Jetty Channel (possible mud input) | | 1,722.6 to ODMDS 3 (dispersed by shelf circulation, storm and tidal currents) |
| | 1,722.6 from undetermined source (littoral sediments and/or ODMDS) | | |
| Sabine Fillet | 25.1 longshore transport from Texas Point NWR (west) | 14.9 longshore transport (mud and minor sand) to Jetty Channel | |
| | | 10.2 shoreline growth at Sabine mud fillet | |
| Texas Point NWR | 434.2 from beach erosion (90+ % mud) | 152.0 overwash losses | |
| | | 173.7 mud lost offshore | |
| | | 25.1 longshore transport of mud to east | |
| | | 83.5 longshore transport to west (sand and shell) | |
| Sea Rim State Beach | 83.5 longshore transport from Texas Point NWR (east) | 117.7 beach growth at Sea Rim State Beach | |
| | 34.3 longshore transport from McFadden NWR (west) | | |

*Sediment Budget quantities are based on 25 years of data from Galveston District's Dredging Database. SNWW CIP without-project shoaling quantities are based on data from 1967 to 2001. A cross check and conversion verified that the quantities are similar.

### Sabine Pass Channel

Channel sections 5 and 6 are dredged every 3 years and approximately 1.9 mcy/cycle are placed in PA 5. Bed sediments average 70 percent silt and clay and 30 percent sand. There are no obvious sand sources because the banks of the channel are low mudflats. Little sand reaches the open coast from the Sabine and Neches rivers because Sabine Lake is an efficient sediment trap and most of its coarse material is deposited in the lake or trapped in the lower alluvial reaches of the rivers. Since the dredged material is removed from the system, some mechanism must be replenishing the sand. It may be delivered to this channel by unusually high runoff from Sabine Lake or the Port Arthur Canal. Although ebb and flood velocities are roughly equal through this section, lower velocities are present where Sabine Lake discharges into the channel; shoaling rates are higher than average around this discharge point. Peak ebb and flood velocities in the remainder of the channel are 4.0 and 3.2 feet/second, respectively. Negligible amounts of material come from the littoral system, entering the channel and moving upstream. Conversely, plumes of fine-grained material can be seen moving through the pass into the Gulf in satellite images. This material disperses over the continental shelf and does not contribute to the littoral budget.

### Sabine Pass Jetty Channel

Section 4 is self-scouring and needs far-less-frequent maintenance dredging than the other coastal reaches. Ebb velocities are high, peaking at about 3.5 feet/second, and flood velocity reaches 3.0 feet/second. Despite this jetting action, on the average about 1.1 mcy/cycle of dredged material are placed in ODMDS 4 in a 5-year dredging cycle. Sediment delivered by the Sabine Pass Channel is predominantly silt and some sand, and about 5 percent of the total transport comes from the littoral system. A small boat cut in the east jetty may allow material carried by the longshore current moving west from Louisiana to enter the channel (PBS&J, 2004a). Bed samples average 89 percent clay and silt and 11 percent sand. Before- and after-dredging bathymetry surveys have demonstrated that the material placed offshore in the ODMDSs does not accumulate; it disperses quickly after placement in the offshore environment.

### Sabine Pass Outer Bar Channel

Section 3 is the first 3.4 miles of navigation channel outside of the jetties. Ebb velocities fall rapidly as the channel discharges over the Outer Bar. Peak ebb velocities fall from about 3.5 feet/second within the jetties to 2.7 feet/second just beyond the jetties, to 1.3 feet/second near the intersection with the Sabine Bank Channel. Peak flood velocities of 3.0 feet/second within the jetties fall to 2.4 feet/second just beyond the jetties, and to 0.4 foot/second at the end of the channel reach. It appears that little material moves from the Sabine Pass Jetty Channel into the Sabine Outer Bar channel, based upon the balance of material entering versus what is removed by dredging. Yet, the shoaling rate in this section is very high. Approximately 1.9 mcy/cycle are removed yearly and placed in ODMDS 4. Bed samples average 96 percent silt and clay and 4 percent sand. The source of the sediment is undetermined. Existing and proposed ODMDSs are located west of the channel because the mean current flow in this area is westward most of the year. However, this flow reverses and moves eastward for a month or longer during the late spring (Rouse et al., 2004). During periods of reversal, sediment may drift back into the channel

from ODMDS 4. However, typical flow patterns move ebb flows to the south/south-southwest just beyond the jetties, and flood flows generally come from the east (Parchure et al., 2005). Furthermore, anecdotal accounts from Sabine Pilots report a strong east to west current crossing just outside the jetties in the vicinity of ODMDS 4 (Webb, 2003).

### Sabine Bank Channel

Sections 1 and 2 (totaling 6.6 miles long) extend the navigation channel into the open Gulf. They are dredged every 4 years and approximately 4.2 mcy/cycle is placed in ODMDSs 1 and 2. Bed sediments average 76 percent silt and clay and 24 percent sand. Ebb and flood velocities are nearly equal (ranging between 0.25 and 0.70 foot/second), but the velocity pattern is erratic. Rapid shoaling is not a problem in this reach, and no other management concerns are known.

### Adjacent Gulf Shorelines

At Louisiana Point, the littoral current has supplied sufficient sediment in the recent past to cause shoreline progradation between Ocean View Beach and the Sabine jetties (USACE, 2004), and create a wide tidal mudflat against the jetty (PBS&J, 2006). Some fine-grained sediment from this westward littoral current may be entering the Sabine Pass Jetty Channel through a small boat cut in the east jetty (PBS&J, 2004a).

All but the easternmost wedge of Texas Point (the Sabine Fillet) is undergoing severe beach erosion, with shoreline retreat of up to 1,150 feet between 1974 and 2000. Shoreface sediment losses are approximately 434,200 cubic yards/year. Longshore transport to the west carries 20 percent to Sea Rim State Beach (PIE, 2003), 35 percent is lost to overwash, and 40 percent is carried offshore. Approximately 6 percent moves eastward, carried by periodic reversals in the dominant longshore current (King, 2007; PIE, 2003). The west jetty intercepts about 40 percent of the total eastward transport, creating a ½-mile-wide fillet of silt and mud against the jetty; the remainder is carried into the Sabine Pass Jetty Channel.

In contrast to Texas Point, Sea Rim State Beach is located in a convergence zone and receives 117,700 cubic yards/year of littoral material from both the east and west. About 70 percent is carried by longshore transport from the east at Texas Point, and 30 percent comes from McFaddin NWR to the west. The accreting beach is comprised of sand (0.10 to 0.14 mm in size) and shell fragments, underlain by mud.

## VII.D ANALYSIS OF SEDIMENT-RELATED PROBLEMS AND OPPORTUNITIES

The next section describes the RSM problems and opportunities that were identified by the SNWW study area, and presents the results of a preliminary screening that was designed to identify potential cost-effective BU for the dredged material that would be generated with the Recommended Plan.

The principles of the RSM were applied to ensure that the dredged material arising from the SNWW CIP would be viewed as a valuable resource, integral to economic viability and environmental sustainability

of the region. In developing the DMMP for the project, this study searched for opportunities to achieve savings by defining sediment-related problems, coordinating projects, and identifying opportunities for BU (Martin, 2002). The large quantities of dredged material that would be generated by the Recommended Plan created an ideal opportunity for the exploration of the BU of dredged material. A series of public workshops and extensive ICT consultation evaluated a wide array of opportunities to use dredged material beneficially (Gulf Engineers and Consultants, Inc. [GEC], 2002; Turner Collie & Braden, 2003).

A variety of private stakeholders, State and Federal resource agencies, and the USACE engineering and scientific experts identified the following existing and FWOP sediment-related problems in the region:

- Lack of sand in the littoral system
- Interruption to the littoral system caused by SNWW jetties
- Extensive shoreline erosion at Texas Point
- Erratic accretion and erosion at Louisiana Point
- Rapid shoaling in the Sabine Pass Outer Bar Channel
- Rapid shoaling in the Port Arthur Junction
- Erosion of west side of Pleasure Island
- Erosion of Sabine Lake eastern shore
- Lack of sediment recharge to, and continuing loss of, sediment from emergent marshes

The following future with-project (FWP) impacts that could potentially be addressed with the BU of dredged material or other project elements were also identified:

- Project impacts associated with the creation of new ODMDSs for the Extension Channel
- Project impacts associated with the creation of new upland PAs to accommodate new work material, and increased quantities of maintenance material over the period of analysis
- Project impacts associated with a small increase in Gulf coast shore erosion within 3.5 miles of each jetty
- Project impacts to cypress-tupelo swamps and intertidal marshes from reductions in biological productivity due to project-induced salinity increases and marsh loss
- Additional advance maintenance due to a higher than average increase in shoaling in the Sabine Pass Outer Bar Channel, one section of the Sabine Pass Channel, the Port Arthur Junction, and portions of the Neches River Channel

## Preliminary Screening – Features Eliminated from Consideration

Opportunities to use dredged material beneficially to address these sediment-related concerns were suggested by public workshop participants and the ICT, and/or developed by the USACE technical studies. These suggestions resulted in the evaluation of a wide array of BU features, which could reduce

or avoid salinity impacts, restore or replace degraded wetlands, create new terrestrial or marine habitat, and return sediment to the littoral zone. Table VII-2 lists all features that were considered and eliminated during preliminary screening, and the reason for dropping them from further consideration. The incremental cost estimates presented in the table were developed during preliminary screening; they are based upon 2005 cost levels and use $2.05/gallon for marine diesel. Incremental costs are the additional costs that would be needed to use the material beneficially, over and above the normal costs of dredging and placement in designated PAs or ODMDSs. It is likely that the actual costs would be much higher than estimated here.

The feasibility of using new work and/or maintenance material was considered for all features. In the analysis for the inshore reaches, PA containment levee construction was the first priority for the use of new work material, followed by BU opportunities. In the offshore reaches, opportunities for BU of new work material were evaluated and eliminated before material was committed to existing and proposed ODMDSs. For maintenance material in both inshore and offshore reaches, priority was given to BU if it could be demonstrated to be the least-cost alternative.

Given the large amount of dredged material that would be generated with the proposed project, considerable effort was expended to identify areas that could benefit from its BU. All degraded marsh areas near the SNWW were investigated to determine whether least-cost BU features could be developed. No interior marsh areas in need of nourishment or restoration were identified adjacent to Sabine Pass in Louisiana. Areas in Louisiana that could benefit from BU of dredged material are all located in the marshes east of Sabine Lake. However, these were found to be too distant from the navigation channel to permit cost-effective use of dredged material from the SNWW navigation channels. Numerous degraded marshes in Texas with potential for BU were identified adjacent to the navigation channel. They are located in the Texas Point NWR adjacent to the Sabine Pass Channel, in the J.D. Murphree WMA adjacent to the Sabine-Neches Canal, and in areas of the Neches River WMA and private lands adjacent to the Neches River Channel. The Gulf shoreline at Texas and Louisiana Points is close enough to the navigation channel to allow cost-effective BU of dredged material. The shoreline on the Texas side of Sabine Pass was also identified as a high priority area for BU because of high ongoing erosion in this area.

Several hydrologic restoration features that were intended to prevent higher FWP salinities in portions of the study area were eliminated early in the screening process. They were modeled using the HS model and found to be either ineffective at reducing salinities or to have significant unintended impacts. For example, marsh islands constructed with new work material were proposed as a means of isolating the salinity wedge in the Sabine-Neches Canal from Sabine Lake. Modeling determined that the islands did block the flow into the lake, but forced a salinity wedge to travel up the Sabine River Channel, potentially affecting cypress-tupelo swamps in that watershed. Other proposed BU features that were unsuccessful in reducing salinities are described in Table VII-2.

Table VII-2
Preliminary Screening: Dredged Material Beneficial Use Features Eliminated from Consideration

| Feature Description | Reason for Elimination |
|---|---|
| **Hydrologic Restoration** | |
| Marsh islands isolating Sabine-Neches Canal from Sabine Lake | Increased salinities in Black Bayou and up the Sabine River |
| Marshes constricting flow at mouth of Sabine Lake (north and south of SH 82 swing bridge) | Ineffective at reducing salinities<br>Increases velocities through mouth of Sabine Lake |
| Marshes constricting flow along the side of the Port Arthur Canal | Ineffective at reducing salinities<br>High cost relative to amount of marsh acres created |
| Construction of channel islands blocking flow from bayous emptying Neches River marshes at Rose City and Bessie Heights | Potential to cause backwater flooding<br>Obstructed channel access for private landowners<br>Navigation safety concerns |
| Filling canal at Texas Bayou using new work material from Sabine Pass Channel | Ineffective at reducing salinities because access still provided by Texas Bayou |
| **Emergent Marsh Restoration** | |
| Marsh restoration using new work material from Neches River Channel to restore marsh in Rose City West | Area is being developed as a mitigation bank; no longer available for restoration |
| Marsh restoration using new work material from Neches River Channel to restore marsh in Bessie Heights West | Would be feasible but cost exceeds Traditional Placement Plan. Preliminary estimate of incremental cost – $581K. Sponsor has not been identified. |
| Marsh restoration using new work material along the east shore of PAs 8 and 11 at Pleasure Island | Unacceptable location – interferes with levee maintenance |
| Marsh restoration at Old River Cove, east of power plant inflow channel, using new work material from the Neches River Channel | Would be feasible but cost exceeds Traditional Placement Plan. Preliminary estimate of incremental cost – $472K. Sponsor has not been identified. |
| Marsh restoration north of Keith Lake using maintenance material from Port Arthur Canal | Would be feasible but cost exceeds Base Plan. Preliminary estimate of incremental cost – $300K. Sponsor has not been identified. |
| Marsh restoration in Texas Point NWR using new work material from Sabine Pass Channel to restore marsh behind subsided jetty section. | Would be feasible but cost exceeds Traditional Placement Plan. Preliminary estimate of incremental cost – $445K. Sponsor has not been identified. |
| **Wildlife Habitat Creation** | |
| Bird island constructed in Sabine Lake using new work material from Sabine-Neches Canal | Would be feasible but cost exceeds Traditional Placement Plan. Preliminary estimate of incremental cost – $1.9 million. Sponsor has not been identified. |
| **Returning Sediment to Littoral Zone** | |
| Texas or Louisiana Point shore nourishment using new work material from Section 5 of the Sabine Pass Channel | Would be feasible but cost exceeds Traditional Placement Plan. Preliminary estimate of incremental cost – $6.6 million. Sponsor has not been identified. |
| Texas or Louisiana Point shore nourishment using new work material from sections 5 and 6 of the Sabine Pass Channel | Would be feasible but cost exceeds Traditional Placement Plan. Preliminary estimate of incremental cost – $19.5 million. Sponsor has not been identified. |
| Stockpiling new work material from Extension channel for future beneficial use | Not feasible because material would disperse rapidly and not be available for use at a later date. |
| Transporting sediment from new work dredging of the Extension Channel to the Texas or Louisiana littoral zone | Would be feasible but cost exceeds Traditional Placement Plan. Preliminary estimate of incremental cost – $86.3 million. Sponsor has not been identified. |
| **Marine Habitat Restoration** | |
| Construction of topographic high in littoral zone with new work material | Topographic elevation would be temporary.<br>Incremental costs ($268 million) make it economically infeasible. |

A large number of conceptual designs for emergent marsh restoration throughout the study area were initially identified as possible compensatory mitigation measures. Because of their proximity to the navigation channel, several marsh restoration features in Texas were also evaluated to determine whether they would be less costly than traditional placement. Only the Neches River and Gulf Shore BU features were determined to be less costly than using upland PAs for new work (Traditional Placement Plan) or maintenance material (Base Plan). These features and the cost analysis are presented in detail later in this chapter. Marsh restoration features considered but eliminated included marsh restoration in Texas Point NWR using new work material from the Port Arthur Canal or the Sabine Pass Channel. Another feature used new work material for marsh restoration in the part of Old River Cove marsh that lies east of the intake canal. All were found to be feasible, but more costly that traditional upland placement. The preliminary incremental costs for these features were relatively low, ranging from $300,000 to $581,000. No sponsor has been identified to share the incremental cost of these features.

The creation of new wildlife habitat using new work material from the Sabine-Neches Canal was also explored. This feature would provide needed nesting habitat for colonial waterbird species such as cormorant, pelican, heron, egret, spoonbill, gull, tern, and skimmer. These birds regularly nest in large numbers along the Texas and Louisiana coasts, frequently on bay islands, both natural and man-made. Despite the presence of excellent waterbird habitat in the Sabine NWR, no colonies have been documented in Louisiana within the study area. The lack of isolated, predator-free islands is believed to be a primary cause for this lack of nesting habitat. It was proposed that an island be constructed in the middle of Sabine Lake with new work material from the Sabine-Neches Canal. This feature was eliminated when the cost was found to be approximately $2 million higher than the use of traditional upland PAs and no sponsor was identified to share the incremental cost.

Several features were evaluated that would return sediment normally placed in upland PAs or ODMDSs to the littoral zone. Conceptual plans were developed for shore nourishment at Texas and Louisiana Points using new work material from Section 5 or sections 5 and 6 of the Sabine Pass Channel. The features were found to be feasible but cost $6.6 and $19.5 million, respectively, more than upland placement in PA 5. Stockpiling dredged material in ODMDS 4 for later use was also investigated. Like all other SNWW ODMDSs, material placed at this site disperses quickly after placement. Although it is closest to shore, the dispersed material in ODMDS 4 is not likely to migrate into the littoral zone because it is located beyond the depth of closure. It is expected that any material stockpiled within ODMDS 4 would be unavailable for use within 3 months of placement. Since stockpiling assumes that the beneficial use needs will not be immediate or short term, it was concluded that this feature is not a viable alternative.

Transporting and discharging coarser-grained sediments from the new work dredging of the Extension Channel (stations 117+000 to 146+000) into the littoral zone offshore of Texas or Louisiana Point was also evaluated. A hopper dredge with pump-out capability could be used to dredge the channel, move as close as possible to shore, and pump the material via a connecting pipeline to a discharge point within the 14-foot depth contour. Discharging the material at or inshore of the depth of closure should guarantee the reintroduction of sediments within the littoral zone, where natural processes will beneficially distribute

the sediments. It is estimated that the incremental cost of this action would be about $86.3 million. While feasible, this BU feature is much more costly than placement in the proposed ODMDSs B and C. No sponsor has been identified to share the incremental cost of the feasible BU features discussed above.

The creation of new marine habitat in the form of a "topographic high" offshore of Louisiana Point was also investigated. This feature would involve the BU of new work material from the deepened Sabine Bank and Extension channels to create a new refuge or feeding locale for fish and shrimp. The material would be dredged as usual with a hopper dredge and then transported far enough upcurrent to prevent redeposition in the navigation channel. The material would be dropped in mounds forming a series of rows over a large area, roughly 2.0 x 2.5 miles. The actual ecological benefits of such a feature off the Texas coast have not been demonstrated. A similar feature was constructed outside of Galveston Bay, but no monitoring was conducted to determine whether any benefits accrued. In addition, the feature would be temporary because the dispersive processes acting on the ODMDSs would also be present here. It was eliminated from further consideration when it was estimated that the incremental cost of the temporary habitat would be approximately $268 million.

## Detailed Evaluation of Disposal Features

After the preliminary screening, BU features that appeared to be least-cost alternatives for the BU of dredged material in reducing with-project salinities, restoring marsh, or providing shoreline nourishment were advanced for detailed evaluation. Water and sediment sampling and bioaccumulation studies have established that dredged material from all SNWW navigation channels is suitable for BU (PBS&J, 1999, 2002, 2004b). The ecological benefits of the following BU features were evaluated and quantified using the WVA Model, and these benefits were used to offset project impacts as described below. A description of the WVA Model is provided in Section IX. In addition, numerous existing upland PAs were evaluated for use with the Recommended Plan. All BU alternatives to ODMDSs were eliminated during the preliminary screening. Existing and proposed ODMDS sites were therefore evaluated for the placement of all material from the offshore channel reaches.

### Neches River Beneficial Use Feature

Four former marsh areas on the Neches River were combined into one large management feature, called the Neches River BU Feature, to provide flexibility in the use of new work and maintenance material from the several construction reaches of the Neches River Channel. The primary objective of this combination feature would be to beneficially utilize dredged material to restore emergent marsh in an area that has suffered dramatic, widespread loss of marsh. The BU feature would utilize new work and maintenance material that would otherwise be removed from the sediment system and stored in upland, confined PAs. Figure VII-1 shows the components of the Neches River BU Feature.

Rose City East
Bessie Heights East
Old River Cove
Hydrologic Unit

0 8,750 17,500
Feet

N
W E
S

**Figure VII-1**

**Neches River**

**BU Feature**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1 inch equals 8,750 feet |
| Prepared by: 18827 | Date: 08/05/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Figures/Fig_VII_2_vr2.mxd

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The Neches River BU Feature would offset all indirect salinity impacts to Texas wetland habitats on the Neches and Sabine rivers (hydro-units TX 3 through TX 8, and TX 10 through TX 13) by restoring 2,853 acres of emergent marsh; improving 871 acres of shallow water by creating shallower ponds and interconnecting channels; and nourishing 1,234 acres of existing fringing marsh by winnowing fine-grained material from unconfined flows of dredged material effluent (Table VII-3). The BU feature thus provides benefits to a total of 4,958 acres of degraded marsh on the lower Neches River, or 53 percent of the restoration target set by the CEPRA 2004 plan update for the lower Neches River (GLO, 2004). The BU feature also offsets the direct impact of converting 86 acres of freshwater wetland to a confined placement area (PA 24A).

Table VII-3
Acreage Restored by Neches River BU Feature

| Components of the Neches River BU Feature | Restored Emergent Marsh | Improved Shallow-water Habitat | Nourished Existing Marsh | Total Influence Area |
|---|---|---|---|---|
| Rose City East | 345 | 72 | 151 | 568 |
| Bessie Heights East | 1,869 | 660 | 651 | 3,180 |
| Old River Cove West | 639 | 139 | 432 | 1,210 |
| Total | 2,853 | 871 | 1,234 | 4,958 |

### Gulf Shore Beneficial Use Feature

The use of dredged material was also evaluated for Gulf shoreline nourishment at Texas and Louisiana Points (Figure VII-2). Over the 50-year period of analysis, approximately 24 mcy of maintenance material would be hydraulically pumped from Section 5 of the adjacent Sabine Pass Channel onto a total of 6 miles of shoreline on both sides of Sabine Pass. Some material is expected to flow over existing marsh while the remainder will flow into nearshore waters. Material placement during each 3-year Sabine Pass Channel dredging cycle would alternate between Texas and Louisiana, so that material would be placed on each state's shoreline every 6 years. This recurring action would nourish eroding marsh, restore sediment to the littoral zone, minimize projected FWP shoreline impacts, and, potentially, create new marsh with the recurring placement of approximately 1.5 mcy every 3 years.

Texas Point is undergoing severe beach erosion, with shoreline retreat of up to 1,150 feet between 1974 and 2000 (King, 2007; Morang, 2006). This is the highest rate of shoreline loss on the upper Texas coast and a CEPRA "critical erosion area" (GLO, 2005). In Louisiana, persistent erosion along the shoreline between Ocean View and Holly Beach, on the order of –4.3 feet/year between 1985 and 1998, was recorded here prior to Hurricane Rita (USACE, 1971a, 2004). Nearer to Louisiana Point, significant accretion over the last 100 years has slowed to +1.2 feet/year, and the behavior of this shoreline has become erratic, with some areas eroding and some aggrading (USACE, 2004).

Historic dredging records indicate that the maintenance material from Sabine Pass will average 51 percent silt, 31 percent clay, and 18 percent fine sand (USACE dredging database). This mix of materials does not contain typical beach-quality sand, but the material types and composition are similar to what is present

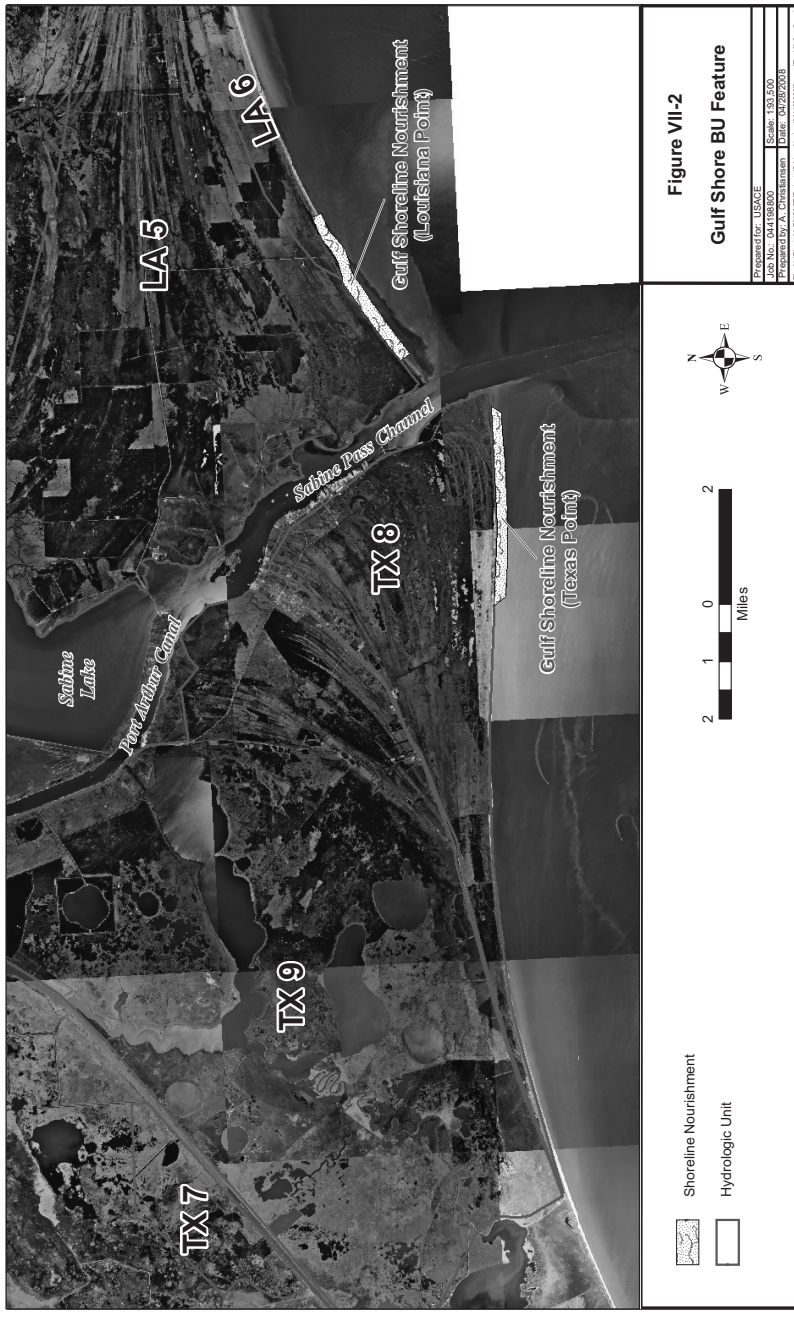
on the shorelines today. Narrow beachfronts of silt or clay lie seaward of eroding overwash marsh terraces (PBS&J, 2006). Given the unusual characteristics of this sand-starved system, returning the material to the littoral system is likely to have a net beneficial effect, regardless of material type. The longshore transport in this system contains primarily fine-grained sediments, but these sediments have been shown to accumulate in the near shore zone and result in shoreline accretion by as yet poorly understood processes (King, 2007; Morang, 2006).

The Gulf Shore BU Feature will provide a regular source of predominantly fine-grained sediment that should contribute to mudflat accretion and periodically move onshore to become shore-attached through a process described by PIE (2003). On the western Louisiana and east Texas coasts, sediments accumulate as mudflats and underwater mudshoals (or "fluid mud") in the nearshore region. Nearshore, fluid mud can be trapped against the shoreline by prevailing south and southwesterly winds, and storms carry the trapped muddy ooze onto the chenier shoreline. The northwest Gulf is a microtidal, storm-dominated environment. In a typical year there are about 20 to 30 frontal passages generating waves, surges, and wind-driven currents, with most-frequent waves from the southeast about 3 to 4.5 feet in height (PIE, 2003).

Mudflat accretion on the western Louisiana coast appears to correlate with periods of high sediment influx from the Atchafalaya River and the passage of large storm systems. Up to 1,000 feet of shoreline accretion along 4.5 miles of shoreline in western Louisiana occurred over a few days during the passage of Hurricane Audrey (Morgan et al., 1958). Another study reports that accretion in western Louisiana occurs most frequently during storms and that it can be very rapid (Wells and Kemp, 1986). Huh et al. (1991) reports that surge deposits of gel-like mud become stranded on the upper shoreface during storms. These deposits can dry and crack, forming mud cobbles that help to armor the shoreline. Fluid mud and mudflat accretion at the shoreline has also been observed on the Jefferson County shoreline. At Sea Rim State Beach in June 2002 (PIE, 2003), shoreline features were observed that resembled the storm surge deposits of fluid mud and mud cobbles reported above.

The presence of additional fine-grained sediments in the littoral system that will be provided by the BU feature should reduce the current erosion rate and minimize the small increase in shore erosion predicted with the project (Gravens and King, 2003). In systems that have an abundant supply of fine-grained sediments, the nearshore seabed can be blanketed with fluid mud. The presence of additional muddy sediment in the nearshore environment may attenuate waves and lessen wave-induced erosion (Hsiao and Shemdin, 1980; Tubman and Suhayda, 1976; Wells and Kemp, 1986). There are also anecdotal reports of Gulf areas off Louisiana and Texas Points being safe havens for vessels during storms due to the near-total attenuation of waves (Block, 1984; King, 2007; Wells and Kemp, 1986).

The BU dredged material is expected to be composed largely of unconsolidated muds. The fine-grained sediments are expected to initially be highly mobile and some portion of the material will be rapidly lost from the vicinity of the shoreline. As demonstrated by another BU project at Texas Point (USACE, 2000a), a significant percentage will also flow onshore and nourish existing marsh along the eroding


LA 5
LA 6
Gulf Shoreline Nourishment
(Louisiana Point)
Sabine Pass Channel
TX 8
Gulf Shoreline Nourishment
(Texas Point)
Sabine
Lake
Port Arthur Canal
TX 6
TX 7
Shoreline Nourishment
Hydrologic Unit
2
1
0
2
Miles
N
E
S
W
Figure VII-2
Gulf Shore BU Feature
Prepared for: USACE
Job No.: 041198.600
Prepared by: A. Christiansen
Date: 04/28/2005
Scale: 1:93,500

beachfront. Because of the prevailing wave climate, the mobile material within the surf zone should generally migrate to the west at both Texas and Louisiana Points (Wamsley, 2008). Transport processes identified by the Sabine Pass Sediment Budget (Morang, 2006) indicate that the material would move toward the eroding shoreline at Texas Point. There, the additional fine-grained sediments could lower erosion rates through the mudflat accretion and wave attenuation processes described above. A small quantity of material may migrate to the east and contribute to the Sabine fillet at the west jetty (King, 2007; Morang, 2006).

In Louisiana, the sand bar formed by BU sediments from the Sabine Pass LNG project may shelter the shoreline from wave energy sufficiently to allow fine-grained sediments to form a mudflat behind the sandbar (Nairn and Willis, 2002). While a significant percentage of the sediment will be rapidly carried offshore, some is likely to move downcoast with the littoral current, enlarging the sand and mudflat already present at the east jetty. Potential impacts of elevated levels of total suspended solids are expected to be similar to those that resulted from the Sabine Pass LNG BU project (PBS&J, 2004a). A temporary increase in suspended silt/clay was expected during the first 8–9 months following placement. After the termination of placement activities, total suspended solids were expected to decrease for about 18 months when concentrations reached background levels. Modeling conducted for the Sabine Pass project indicated that it will take 9 years before the silt and clay component of Sabine Pass LNG BU material become totally suspended and are removed from the littoral zone. Since the Gulf Shore BU Feature proposes a placement episode every 6 years, all the fine-grained sediments would not have been removed before new material is added.

This should result in the retention of some portion of the fine-grained sediment, and thus facilitate mudflat accretion through the processes described above. During and after each placement episode, most of the resuspended silt and clay are expected to enter the Sabine Pass Jetty Channel through the shallow boat cut, but deposition in the channel is not expected. It should remain in suspension and be transported back into the Gulf.

Although the BU sediments will be largely fine grained, approximately 18 percent of maintenance material is expected to be sand. Sands that are deposited onshore will nourish and stabilize eroding marshes; sand deposited in the nearshore zone should stay in the nearshore environment, moving back and forth across the shoreface (Wamsley, 2008). Sand placed at Louisiana Point should remain on the shoreface where it was deposited; no significant amounts of sand are expected to enter the Jetty Channel. On erosive mud shorelines like those in the BU area, the sand percentage should increase, and it will form sandy lenses or a veneer over the mud shoreline substrate. As the sand lenses thicken, the sands help protect the underlying mud from further erosion (Nairn, 1992). However, in smaller quantities, sand can also accelerate erosion of a mud beach. If the consolidated mud is not covered by a sand veneer, any sand that is mobilized by wave action will act as a scouring agent (King, 2007).

It is acknowledged that the behavior of the BU sediments within this complex littoral system cannot be predicted with certainty over the period of analysis, especially given the potential for strong storms to affect the coastal environment. However, there is sufficient knowledge of general processes and baseline

conditions to support evaluation of potential impacts and benefits. Furthermore, the engineering feasibility and potential environmental benefits have been demonstrated by successful recent BU projects at Texas and Louisiana Points (PBS&J, 2004a; USACE, 2000a). All of this information was used to establish explicit assumptions about the expected behavior of the BU material in the quantification of project impacts and benefits using the WVA model, as described in Appendix C of the FEIS. The WVA analysis assumed that 60 percent of the pumped quantity will remain in the existing marsh and on the shallow nearshore slope in front of the existing shorefront immediately after material placement. Since the material is unconsolidated and prone to erosion, only 50 percent of that material was assumed to remain by the end of each 6-year cycle. It was further assumed that the regular addition of material every 6 years would slow the resuspension of fine sediments, and result in the accumulation of some new marsh by the end of the period of analysis. No attempt was made to account for the effect of large storm systems.

No long-term impacts to vegetation or benthic sediments should result from nourishment episodes. The NWR personnel reported that the marsh vegetation at Texas Point rebounded quickly and with renewed vigor after being covered with up to 1 foot of material by a previous Texas Point BU project (Walther, 2005). Potential impacts to Critical Habitat for the wintering piping plover are expected to be beneficial in the long term, with short-term displacement of some birds during disposal activities. Benthic invertebrate fauna residing in the intertidal and tidal impact zones will be smothered, but studies have shown the impact to be similar to that resulting from natural events such as storms and hurricanes (Saloman and Naughton, 1977; Simon and Dauer, 1977). Following the burial, the resident species should recover quickly because of their short life cycle, high reproductive potential, and the rapid recruitment of larvae and motile macrofauna from nearby unaffected areas (Nelson and Pullen, 1988).

### Upland Placement Features

*Existing Active PAs*

Existing PAs were evaluated to determine whether they possessed sufficient capacity for new work and maintenance material over the 50-year period of analysis. All of the upland PAs were reviewed by the ICT, and no further environmental review was recommended for existing PAs that were in active use. Existing and proposed upland PAs are shown on figures VI-3 through VI-7.

*Existing Inactive PAs*

Field visits were made to existing PAs that had been inactive in recent years (PAs 23A, 25A, 26, 27C, and 27D). Inactive PAs were visited to determine whether habitat and connectivity had developed since their last use such that they were contributing to the function of adjacent wetlands. No field visits or further review of inactive PA 25A were needed; no impacts are expected because it is known to contain low-quality, upland habitat. PA 25A is included in the DMMP.

The remaining inactive PAs were evaluated for potential impacts. All of these areas have been modified extensively by past placement activities and associated levee systems, which have artificially altered the

hydrology. Surrounding containment levees hold water and isolate the areas from adjacent water bodies, preventing them from contributing to the function of the adjacent wetlands and riparian corridor. All contain degraded habitat with low habitat values, primarily roosting habitat for birds and some wildlife cover. Renewed use of PAs 23A, 26, 27C, and 27D would not constitute a significant adverse change to the existing environmental condition, and all are included in the DMMP.

*Areas Considered for PA Expansion*

The quantities of dredged material projected for the Recommended Plan necessitated additional PA capacity. Finding areas suitable for the development of new upland PAs along the inshore reaches was difficult. The majority of land adjacent to the SNWW is either covered by residential and industrial development, existing PAs, forested uplands, or wetlands. Areas adjacent to existing PAs 14, 16, 18, and 24 were evaluated to determine their suitability as PAs. Potential expansion areas were designated as PA 14A, PA 16A, PA 18A, and PA 24A.

PA 14A (82 acres) is located south of existing PA 14, on the south side of the Neches River near its mouth. It is a relatively undisturbed intermediate marsh containing numerous small ponds that are seasonally connected to the riparian corridor. It provides habitat for numerous native wildlife species. It was determined that use of this area would be a significant adverse change to existing conditions because of its value to native wildlife species and preserving water quality. Placement needs for the Neches River Channel were reevaluated and the area was dropped from further consideration for use as a PA.

PA 16A (202 acres) is located west of existing PA 16 on the south side of the Neches River near its mouth. It is covered by intermediate marsh, has excellent hydrologic connectivity to adjacent wetlands, and provides important habitat for native fish and wildlife. The EPA includes the 16A area in a preliminary area of concern for the Star Lake Canal Superfund Site (EPA, 2006); an EPA feasibility study to determine the nature and extent of contamination is underway. Due to contaminant concerns and the biological and water quality value of its wetlands, the area has been dropped from further consideration for use as a PA.

PA 18A (71 acres) is located north of existing PA 18. It is a disturbed upland area containing low-quality scrub habitat. The Habitat Workgroup reviewed an aerial photograph of the proposed expansion area and determined that no field visit would be required. PA 18A is included in the DMMP.

PA 24A (187 acres) is located north of the Maritime Administration's Reserve Fleet area. The area contains a central upland ridge with surrounding wetland components. Initially, a 331-acre tract was evaluated for use. To minimize impacts to wetlands, 144 acres of marsh-hay cordgrass in the northern section were excluded, reducing the proposed PA to 187 acres. The 187-acre area contains 85 acres of lower quality wetlands comprised primarily of California bulrush and common reed. Impacts associated with conversion to a confined PA were evaluated with the WVA model, and it was determined that the impact of –44 AAHUs is fully offset by benefits of the DMMP Neches River BU Feature. PA 24A is included in the DMMP.

### ODMDS Features

Four ODMDSs (Nos. 1–4) are currently in use for the existing SNWW project. Features for the placement of new work and maintenance material resulting from the construction of a deeper and longer offshore channel have been evaluated in an ODMDS Site Designation FEIS, which is included as Appendix B of the FEIS. Appendix B evaluates alternatives for the selection of new ODMDSs, including the use of the existing ODMDSs for the proposed CIP and BU sites. Existing and proposed ODMDSs are shown on Figure VII-3.

The existing ODMDSs were evaluated to determine whether they could accommodate all new work and maintenance material from the Recommended Plan. Although it was determined that they were large enough to hold all the material, the 13.2-mile length of the channel extension would make the cost of hauling all new work and maintenance material to existing ODMDSs prohibitively expensive. Designation of four new ODMDSs will be necessary. The best locations for the new sites were determined using the "zone of siting feasibility" screening technique, which delineates economically feasible sites that are sufficiently removed from ecologically sensitive or incompatible use areas to eliminate or minimize adverse impacts.

The ODMDS FEIS found no significant environmental impacts related to the use of existing and proposed ODMDS sites for the SNWW Recommended Plan. Analysis of northwestern Gulf of Mexico circulation patterns confirmed that the existing and proposed ODMDSs were properly located on the west side of the navigation channel. Before- and after-dredging bathymetry surveys have demonstrated that material placed offshore in the ODMDSs does not accumulate; it disperses quickly after placement in the offshore environment.

## VII.E IDENTIFYING THE LEAST-COST PLACEMENT ALTERNATIVE

### Description of Placement Alternatives

Placement features that survived the detailed evaluation were grouped into two comprehensive placement alternatives for further analysis. The Traditional Placement Alternative and the BU Alternative were compared to determine the least-cost, environmentally acceptable DMMP for both new work and maintenance material arising from the proposed 48-foot project.

In the Traditional Placement Alternative, it was assumed that management practices for the existing project would continue, adapting and expanding as needed to provide increased capacity for the proposed 48-foot project. Dredged material would be placed in the 4 existing and 4 proposed ODMDS features, the 16 existing upland PA features, and expansion cells in PAs 18A and 24A. Capacities of the existing upland PA features would be increased over the 50-year period of analysis by regular raising of containment levee heights. Without the additional capacity provided by the BU features described below, a final levee elevation of 36 feet would be required at PA 5 in Sabine Pass. On the Neches River Channel, final levee elevations at PAs 13–14, 16–18A, 21, and 23–27D would range from 17 to 47 feet. On the

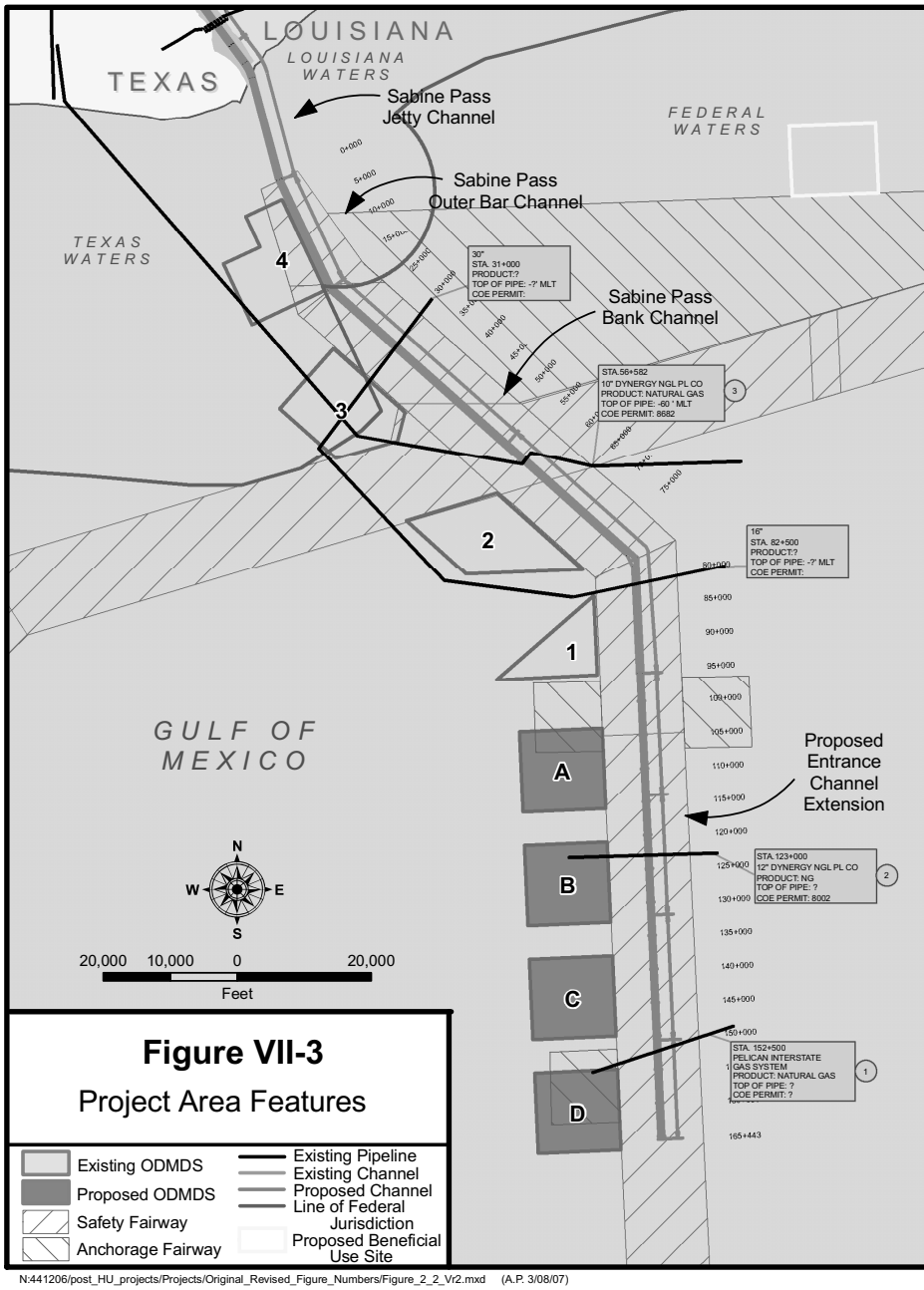



**Figure VII-3**

Project Area Features

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Port Arthur and Sabine-Neches Canals (PAs 8, 9, 11, and 12), final elevations would be the same as the Recommended Plan. It is assumed that regular dewatering management practices (DAMP) would be required on the Neches River Channel PAs to provide the required 50-year capacity. PAs requiring DAMP include PAs 12, 13, 14, 16, 25A, 27A, and 27C. The Traditional Placement Alternative includes hopper and hydraulic dredging costs to place material at ODMDSs and upland PAs, to construct and maintain higher containment levees over the 50-year period of analysis, and real estate costs to acquire property needed for proposed PAs 18A and 24A.

The BU Alternative assumed the use of the Neches River and Gulf Shore BU features, in addition to all of the upland PA and ODMDS features that are also included in the Traditional Placement Alternative. The final levee elevation at PA 5 at Sabine Pass would be 34 feet; on the Port Arthur and Sabine-Neches canals (PAs 8, 9, 11, and 12), final levee elevations would range from 23 to 42 feet; and on the Neches River Channel, final levee elevations at PAs 13–14, 16–18A, 21, and 23–27D would range from 14 to 39 feet. This alternative takes advantage of new work material provided by the channel-deepening project to build hydraulic containment levees within degraded, former areas at Rose City East and West, Bessie Heights East, and Old River Cove. Each of these areas is referred to as a component of the overall Neches River BU Feature. Marsh would be created in each component using only new work, or a combination of new work and maintenance material. Marsh would be created in Old River Cove using only new work material. The first phase of Rose City East would be constructed with new work material, and it would be completed with the first cycle of maintenance material. Bessie Heights East would be completed with maintenance material over seven cycles. In addition to costs associated with providing upland PA capacity, costs for this plan include additional pumping distances and pipe movements for the BU features and their containment structures, training levees and circulation channels; maintenance of containment structures over the multiyear marsh construction period; marsh plantings; and monitoring costs.

## Cost Comparison of Placement Alternatives

The average annual cost of new work and 50-year O&M plans for both alternatives are compared in Table VII-4. These costs were developed during the detailed design phase, using a different cost ($1.12/gallon fuel cost) and price level (October 2005). Costs have not been updated for this comparison because it is a screening phase cost comparison. Costs for both alternatives would change proportionately if they were updated with October 2009 price levels, and the difference in cost between the two plans would not be materially different. New work material is used beneficially only along the Neches River Channel. There are no differences between the new work costs for the first four channel reaches (Offshore Channels, Sabine Pass Channel, Port Arthur Canal, and Sabine-Neches Canal) because none of the new work material from these reaches would be used beneficially. New work material provided by the channel deepening is used at Rose City East, Bessie Heights East, and Old River Cove. Bessie Heights East and Rose City East would also use maintenance material from the Neches River to complete marsh restoration. These reaches exhibit differences in the O&M section of Table VII-4 because they are the only channel sections from which O&M material is proposed to be used beneficially. All of the costs have been annualized so that the time value of money is considered. Both the new work and O&M costs are

expressed as 50-year annualized costs to make them comparable. The annualizations were calculated on mid-year costs, using October 2005 price levels, and an interest rate of 4.875 percent.

Table VII-4
Average Annual Cost Comparison of Placement Plan Alternatives
for the Proposed 48-foot Project
(October 2005 Price Levels; $1.12 fuel cost; 4.875%)
(All costs in dollars)

| **Channels** | **Offshore Channels (Hopper Dredging)** | **Sabine Pass Channel** | **Port Arthur Canal** | **Sabine-Neches Canal** | **Neches River Channel** | | | **Totals** |
|---|---|---|---|---|---|---|---|---|
| **New Work Associated Beneficial Use Sites** | | | | | | | | |
| Associated Channel Sections | Sections D-A, 1–4 | Sections 5 & 6 | Sections 7 & 8 | Sections 7 & 8 | Sections 11, 12, 13 | Sections 14, 15, 16 | Sections 17 & 18 | Total |
| | | | | | Neches River Combination Feature | | | |
| Placement Plan Alternatives | | | | | Old River Cove | Bessie Heights East | Rose City East | |
| Beneficial Use Alternative | 10,048,000 | 3,469,000 | 7,696,000 | 5,655,000 | 3,961,000 | 7,631,000 | 12,094,000 | 50,554,000 |
| Traditional Placement Alternative | 10,048,000 | 3,469,000 | 7,696,000 | 5,655,000 | 4,522,000 | 7,837,000 | 12,447,000 | 51,674,000 |
| Difference | – | – | – | – | (561,000) | (206,000) | (353,000) | (1,120,000) |

| **O&M Associated Beneficial Use Sites** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Associated Channel Sections | Sections D-A, 1–4 | Sections 5 & 6 | Sections 7 & 8 | Sections 7 & 8 | Sections 11, 12, 13 | Sections 14, 15, 16 | Sections 17 & 18 | Total |
| | | | | | Neches River Combination Feature | | | |
| Placement Plan Alternatives | | Gulf Shore Feature | | | Bessie Heights East | Bessie Heights East | Rose City East | |
| Beneficial Use Alternative | 29,470,000 | 3,225,000 | 8,928,000 | 4,177,000 | 3,055,000 | 2,932,000 | 1,523,000 | 53,310,000 |
| Traditional Placement Alternative | 29,470,000 | 3,225,000 | 8,928,000 | 4,177,000 | 3,551,000 | 3,050,000 | 1,571,000 | 53,972,000 |
| Difference | – | – | – | – | (496,000) | (118,000) | (48,000) | (662,000) |

The Gulf Shore BU Feature uses maintenance material to regularly renourish shorelines and Texas and Louisiana Points every 6 years over the period of analysis. This disposal method was found to be the least-cost method of disposal for all maintenance material from Section 5 of the Sabine Pass Channel, and is included in the base disposal plan. Therefore, displayed costs for this feature are equal for both the Revised BU Alternative and the Traditional Placement Alternative. All of the costs have been annualized so that the time value of money is considered. Both the new work and O&M costs are expressed as 50-year annualized costs to make them comparable. The annualizations were calculated on mid-year costs, using October 2005 price levels, and an interest rate of 4.875 percent.

### Selection of the DMMP

The BU Alternative is recommended for adoption in the DMMP for the Recommended Plan because it is the least-cost, environmentally acceptable placement alternative. In addition to being a least-cost plan, it provides substantial ecological benefits that offset all project impacts in Texas, and some impacts in Louisiana.

## VII.F DESCRIPTION OF THE DMMP FOR THE RECOMMENDED PLAN

The DMMP for the Recommended Plan provides for the placement of both new work and maintenance material for the 50-year period of analysis. The locations of channel reaches, waterway sections, PA and ODMDS features, and BU features are shown on Engineering Drawings C-01 through C-12 (Appendix 1). A comprehensive DMMP is needed because new work material would be used to construct containment levees for BU features that would be completed with maintenance material after channel construction is completed. The DMMP, therefore, differs from the discussion of the incremental O&M cost of the Recommended Plan in later sections of this chapter, as they focus solely on O&M costs and the placement plan for maintenance material only.

### DMMP BU Features

All BU features proposed as part of the DMMP are described in Table VII-5. Details of plan implementation for each of the BU features were described above and are discussed further in the FEIS. The DMMP BU features are not being pursued as separable elements of an ecosystem restoration plan under Section 204 or 207 authorities. They are not ecosystem restoration measures, and as such, do not target a specific historical condition for the level of restoration. They are least-cost, environmentally acceptable placement features and are included as GNF of the DMMP.

### Upland PA Features

Sixteen existing PA features, and two new cells (PAs 18A and 24A) that enlarge existing PAs, are proposed for use in the Recommended Plan (Table VII-6). Existing PAs will be used to the greatest extent possible; five currently inactive PAs or PA cells (PA 23A, 25A, 26, 27C, and 27D) will be rehabilitated

and restored to active use. Non-Federal dredging is projected to contribute 4.6 percent of material placed in upland PA features. Non-Federal facilities using these PAs are located along the Port Arthur and Sabine-Neches canals and the Neches River Channel; this material will be placed in the same PAs used for material from the adjacent navigation channels.

Table VII-5
DMMP BU Features

| Beneficial Use Features | No. | Description | Size of Influence Area |
|---|---|---|---|
| Rose City East (component of Neches River BU Measure) | TX 3-1 East | Restoring 345 acres of fresh marsh, improving 72 acres of shallow-water habitat, and nourishing 151 acres of existing marsh in two construction events. New work material from Neches River Channel will be used to restore 225-acre marsh, and construct hydraulic containment levees and higher elevation features. Maintenance material from the first maintenance cycle will be used to restore an additional 120 acres of marsh. | Influence area – 568 acres |
| Bessie Heights East (component of Neches River BU Measure) | TX 5-2 | Restores 679 acres of brackish and 1,190 acres of intermediate marsh, improves 660 acres of shallow-water habitat, and nourishes 651 acres of existing marsh. Marsh will be constructed with maintenance material from Neches River Channel for 28 years. New work material is used to build hydraulic containment levee. | Influence area – 3,180 acres |
| Old River Cove (component of Neches River BU Measure) | TX 6-1 | Restores 639 acres of brackish marsh, improves 139 acres of shallow-water habitat, and nourishes 432 acres of existing marsh with new work material from Neches River Channel. New work material used to construct hydraulic containment levee. | Influence area – 1,210 acres |
| Gulf Shore BU Feature (Texas and Louisiana Points) | TX 8-11 LA 5-2/6-2 | Nourish 3 miles of Gulf shoreline on both sides of Sabine Pass, from 0.5 to 3.5 miles from east and west jetties, using maintenance material from Sabine Pass Channel. Unconfined placement of maintenance material along shoreline every 3 years for 50-year period of analysis (8 placement episodes). Assume 50:50 split of material between Texas and Louisiana accomplished by alternating placement in Texas and Louisiana. | Affected shoreline 6.0 miles total |

Table VII-6
Dredged Material Management Plan Upland Placement Areas

| Placement Area | Additional Cell(s) | Size (acres) | Associated Waterway Section** |
|---|---|---|---|
| 5 | N&S, B and C | 957 | Sabine Pass Channel (Sec. 5 and 6) |
| 8 | | 3,570 | Port Arthur Canal (Sec. 7 and 8)<br>Sabine-Neches Canal (Sec. 9) |
| 9A | B | 481 | Port Arthur Canal (Sec. 8) |
| 11 | | 2,170 | Sabine-Neches Canal (Sec. 10) |
| 12 | | 355 | Neches River Channel (Sec. 11) |
| 13 | | 140 | Neches River Channel (Sec. 11) |
| 14 | | 255 | Neches River Channel (Sec. 12) |
| 16 | | 288 | Neches River Channel (Sec. 13) |
| 17 | | 316 | Neches River Channel (Sec. 13) |
| 18 | A* | 432 | Neches River Channel (Sec. 14) |
| 21 | | 135 | Neches River Channel (Sec. 14) |
| 23 | A | 773 | Neches River Channel (Sec. 15) |
| 24 | A* | 575 | Neches River Channel (Sec. 16) |
| 25 | A | 820 | Neches River Channel (Sec. 17) |
| 26 | | 192 | Neches River Channel (Sec. 18) |
| 27 | A, C, and D | 270 | Neches River Channel (Sec. 18) |

* New cells (PAs 18A and 24A), which enlarge existing PAs.
** Waterway sections are shown on FFR Engineering Plates C-01 through C-12 (Appendix 1).

## Offshore Placement Features

The ODMDSs for the Recommended Plan are four existing (sites 1–4) and four proposed ODMDSs (sites A–D). All of the new ODMDSs are located on the west side of the channel since the littoral drift (movement of offshore sediment) is most commonly from east to west. Sizes and associated channel reach, beginning with the farthest offshore reach, are provided in Table VII-7.

Table VII-7
Existing and New ODMDSs

| Placement Area | Size (acres) | Status | Associated Waterway Section |
|---|---|---|---|
| D | 3,392 | New | Extension Channel |
| C | 3,392 | New | Extension Channel |
| B | 3,392 | New | Extension Channel |
| A | 3,392 | New | Extension Channel |
| 1 | 2,048 | Active | Section 1 |
| 2 | 4,736 | Active | Section 2 |
| 3 | 3,968 | Active | Section 3 |
| 4 | 3,456 | Active | Section 4 |

The USACE and EPA have cooperated in the preparation of an FEIS for the proposed ODMDSs; this document is Appendix B of the FEIS. Public comment on the proposed ODMDSs will be requested

concurrently with comments on the FEIS for the SNWW CIP. If the FFR and FEIS are approved by the USACE and the Recommended Plan is authorized by the U.S. Congress, the EPA will publish a rule-making in the *Federal Register* that establishes SNWW ODMDSs A, B, C, and D for use in conjunction with construction and operation of the 48-foot project.

## VII.G INCREMENTAL ENVIRONMENTAL IMPACTS AND BENEFITS OF THE DMMP

### Incremental Environmental Impacts of the DMMP

Incremental DMMP impacts of the proposed 48-foot project are discussed in detail in the FEIS, but are summarized here. The incremental impact would consist of marsh lost with construction of one new upland placement cell, and four new ODMDSs. No impacts are anticipated with improvements to existing upland PAs that are needed to provide additional capacity for the 50-year period of analysis, since improvements are limited to increasing containment levee heights. The DMMP BU features have net ecological benefits that are described below.

### Incremental Ecological Benefits of the DMMP

#### Methods and Objectives

The DMMP BU features described above provide ecological benefits that would offset project impacts. The benefits were used to offset project impacts before remaining, unavoidable impacts were quantified and compensatory mitigation was developed. The WVA Model was used to quantify impacts to all affected habitat types in the study area and establish the appropriate amount of offsetting DMMP benefits by habitat type. An HS model was used to evaluate and quantify salinity impacts and benefits of the BU plan. The WVA model is summarized in Chapter VIII and described in detail in Appendix C of the FEIS. The HS model is also summarized in Chapter VIII, but it is described in detail in Brown and Stokes (2009). Evaluation of BU alternatives was conducted within the ICT and technical workgroups in meetings conducted from 2001 to 2006. The BU plan was revised by the USACE in 2009 to reflect changes necessitated by project reformulation and revised HS modeling.

The DMMP benefits contribute to multiagency regional plans (the TPWD regional management plan for J.D. Murphree WMA, Sea Rim State Park, Texas Point NWR, and McFaddin NWR [see Keith Lake: the Texas Coastwide Erosion Response Plan [GLO 2004, 2005]; the Louisiana Comprehensive Management Plan [Louisiana Coastal Protection and Restoration Authority [LACPRA], 2007; USACE, 2008b]; the LA Coast 2050 Plan [LCWCR/WCRA, 1998], and the North American Waterfowl Plan (NAWMP Committee, 2004]), by restoring and preserving scarce and vulnerable wetlands and wildlife habitat, nourishing eroding Gulf shorelines, restoring sediment to the littoral zone, and using dredged material beneficially to the greatest extent possible. The DMMP also complies with Coastal Zone Management Plans (CZMP) for each state by sharing dredged material from the Sabine Pass Channel to accomplish regular shoreline nourishment. The Gulf Shore BU Feature shares this resource equally between the states because it is dredged from a channel that straddles the state boundary.

### Offsetting Ecological Impacts

BU features included in the DMMP provide benefits that offset all indirect and direct Texas impacts (–412 AAHUs) of the Recommended Plan (Table VII-8) and partially offset impacts in Louisiana (Table VII-9). In Texas, construction of the Neches River BU Feature and the Texas portion of the Gulf Shore BU Feature will produce benefits totaling 1,068 AAHUs. Therefore, there will be a net gain of 656 AAHUs, which more than offsets all negative impacts that occur in Texas. Impacts that are offset include the direct loss of 32 AAHUs for the conversion of fresh marsh to upland PA 24A. The majority of the offset Texas impacts are in the Neches River watershed, but approximately 16 percent are losses to cypress-tupelo swamp (–22 AAHUs) and fresh and intermediate marsh (–45 AAHUs) in the Sabine River watershed. In Louisiana, the Gulf Shore BU Feature provides benefits totaling 210 AAHUs. Given total Louisiana impacts of 1,709 AAHUs, there is a net loss of 1,499 AAHUs remaining in Louisiana after offsetting benefits of the Louisiana portion of the Gulf Shore BU Feature are applied.

It is important to note that the impacts presented here do not include all impacts of the Recommended Plan in Texas as FWP impacts in Texas's Salt Bayou (TX 9) hydro-unit are not included. This is the result of an ICT decision made in response to a USACE policy determination on a related project. During an in-progress review of the Keith Lake Fish Pass Section 1135 study, it was determined that SNWW CIP impacts to this area were being evaluated concurrently for the same area. The USACE Headquarters concluded that impacts could not be evaluated under the CIP study if they were being addressed under the Section 1135 Keith Lake Fish Pass project. The non-Federal sponsor of the Section 1135 study elected to continue that study with the understanding that the ICT review of the Recommended Plan impacts to the Salt Bayou hydro-unit would be necessary if a Section 1135 project is not approved prior to authorization of the SNWW CIP. Excess in-kind benefits associated with Texas's DMMP features (316 AAHUs) could be used to partially offset the predicted Salt Bayou AAHU loss of 658 AAHUs.

With adoption of the DMMP, all FWP impacts in Texas would be offset and no compensatory mitigation is proposed in conjunction with construction of the Recommended Plan. Impacts in Louisiana are minimized to the greatest extent possible by the DMMP, but unavoidable impacts of 1,499 AAHUs remain. When the impacts and DMMP benefits are not subdivided by state but are applied to the project as a whole, a loss of 843 AAHUs remains (Table VII-10). A mitigation plan, described in Chapter VIII, has been developed to compensate for unavoidable impacts of the Recommended Plan.

## VII.H BASE PLAN FOR THE EXISTING 40-FOOT PROJECT

A Base Plan was developed that describes the without-project practices that would accomplish the disposal of dredged material from the existing 40-foot project in the least costly, environmentally acceptable manner. A summary description of existing and proposed PAs and BU features of the Base Plan are provided below. In the next section, the cost of the Base Plan is compared to the O&M cost of the Recommended Plan to determine the incremental O&M cost of the Recommended Plan (see Table VII-12).

Table VII-8
Texas – FWP Impacts and Benefits by Habitat Type

| HU # | Hydrologic Unit (HU) Name | Offset Impacts by Acres and Habitat Type (acres) | | | Total Impacts / Benefits by Habitat Type (AAHUs) | | |
|---|---|---|---|---|---|---|---|
| | | No Effect | Impacts Offset by BU Plan | Acres Impacted | Total Loss | Offsetting Benefits of BU Plan | Net FWP Benefit |
| **Bottomland Hardwood** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 412 | | | 0 | | 0 |
| TX 2 | Neches-Lake Bayou | 1,040 | | | 0 | | 0 |
| TX 3 | Rose City | 1,775 | | | 0 | | 0 |
| TX 5 | Bessie Heights | 293 | | | 0 | | 0 |
| TX 6 | Old River Cove | 197 | | | 0 | | 0 |
| **Subtotal - Neches River** | | **3,717** | **0** | **0** | **0** | **0** | **0** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | 388 | | | 0 | | 0 |
| TX 11 | Adams Bayou | 640 | | | 0 | | 0 |
| LA/TX 1 | Sabine Island | 524 | | | 0 | | 0 |
| **Subtotal - Sabine River** | | **1,552** | **0** | **0** | **0** | **0** | **0** |
| **Total Bottomland Hardwood** | | **5,269** | **0** | **0** | **0** | **0** | **0** |
| **Cypress/Tupelo Swamp** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 2,760 | | | 0 | | 0 |
| TX 2 | Neches-Lake Bayou | 2,277 | | | 0 | | 0 |
| TX 3 | Rose City | 464 | | | 0 | | 0 |
| ***Subtotal - Neches River*** | | **5,501** | **0** | **0** | **0** | **0** | **0** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | 110 | | | 0 | | 0 |
| TX 11 | Adams Bayou | | | 115 | -4 | | -4 |
| TX 12 | Blue Elbow South | | | 689 | -18 | | -18 |
| LA/TX 1 | Sabine Island | 1,194 | | | 0 | | 0 |
| LA/TX 2 | Blue Elbow | 2,737 | | | 0 | | 0 |
| **Subtotal - Sabine River** | | **4,041** | **0** | **804** | **-22** | **0** | **-22** |
| **Total Cypress/Tupelo Swamp** | | **9,542** | **0** | **804** | **-22** | **0** | **-22** |
| **Fresh Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 436 | | | 0 | | 0 |
| TX 2 | Neches-Lake Bayou | 1,535 | | | 0 | | 0 |
| TX 3 | *Rose City PA24A** | | | 86 | -32 | | -32 |
| TX 3 | Rose City | | | 3,241 | -1 | 178 | 177 |
| TX 4 | West of Rose City | 492 | | | 0 | | 0 |
| TX 5 | Bessie Heights | 2,147 | | | 0 | | 0 |
| TX 7 | GIWW North | | | 4,806 | -140 | | -140 |
| **Subtotal - Neches River** | | **4,610** | **0** | **8,133** | **-173** | **178** | **5** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | | | 1,775 | -18 | | -18 |
| TX 11 | Adams Bayou | | | 599 | -15 | | -15 |
| **Subtotal - Sabine River** | | **0** | **0** | **2,374** | **-33** | **0** | **-33** |
| ***Total Fresh Marsh*** | | **4,610** | **0** | **10,507** | **-206** | **178** | **-28** |
| **Intermediate Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 5 | Bessie Heights | | | 6,933 | -14 | 433 | 419 |
| TX 8 | Texas Point | | | 1,742 | -19 | | -19 |
| TX 13 | Groves | | | 437 | -3 | | -3 |
| **Subtotal - Neches River** | | **0** | **0** | **9,112** | **-36** | **433** | **397** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | | | 1,144 | -12 | | -12 |
| **Subtotal - Sabine River** | | **0** | **0** | **1,144** | **-12** | **0** | **-12** |
| **Total Intermediate Marsh** | | **0** | **0** | **10,256** | **-48** | **433** | **385** |
| **Brackish Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 6 | Old River Cove | | | 8,760 | -116 | 235 | 119 |
| TX 8 | Texas Point | | | 2,546 | -7 | | -7 |
| TX 7 | GIWW North | | | 647 | -8 | | -8 |
| **Subtotal - Neches River** | | **0** | **0** | **11,953** | **-131** | **235** | **104** |
| **Total Brackish Marsh** | | **0** | **0** | **11,953** | **-131** | **235** | **104** |
| **Saline Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 8 | Texas Point | | 5,708 | | -5 | 222 | 217 |
| Subtotal - Neches River | | 0 | 5,708 | 0 | -5 | 222 | 217 |
| **Total Saline Marsh** | | **0** | **5,708** | **0** | **-5** | **222** | **217** |
| | | | | | | | |
| **Total Neches River Impacts** | | 13,828 | 5,708 | 29,198 | -345 | 1,068 | 723 |
| | | | | | | | |
| **Total Sabine River Impacts** | | 5,593 | 0 | 4,322 | -67 | 0 | -67 |
| | | | | | | | |
| **Total - All Habitats** | | **19,421** | **5,708** | **33,520** | **-412** | **1,068** | **656** |

* Direct impact associated with conversion of wetland to upland PA24A.

Table VII-9
Louisiana – FWP Impacts and Benefits by Habitat Type

| HU # | Hydrologic Unit (HU) Name | Offset Impacts by Acres and Habitat Type (acres) | | | Total Impacts / Benefits by Habitat Type (AAHUs) | | |
|---|---|---|---|---|---|---|---|
| | | No Impact | Impacts Offset by BU Plan | Acres Impacted | Total Loss | Offsetting Benefits of BU Plan | Net FWP Impact |
| All HUs in Sabine River Watershed | | | | | | | |
| **Bottomland Hardwood** | | | | | | | |
| LA 1 | Perry Ridge | 2,158 | 0 | 0 | 0 | 0 | 0 |
| LA/TX 1 | Sabine Island | 1,041 | 0 | 0 | 0 | 0 | 0 |
| | Subtotal | 3,199 | 0 | 0 | 0 | 0 | 0 |
| **Cypress/Tupelo Swamp** | | | | | | | |
| LA/TX 1 | Sabine Island | 5,998 | 0 | 0 | 0 | 0 | 0 |
| LA/TX 2 | Blue Elbow | 650 | 0 | 0 | 0 | 0 | 0 |
| | Subtotal | 6,648 | 0 | 0 | 0 | 0 | 0 |
| **Fresh Marsh** | | | | | | | |
| LA 1 | Perry Ridge | 0 | 0 | 18,859 | -65 | 0 | -65 |
| LA 7 | Southeast Sabine | 0 | 0 | 2,634 | -11 | 0 | -11 |
| LA 8 | Southwest Gum Cove | 0 | 0 | 3,615 | -2 | 0 | -2 |
| | Subtotal | 0 | 0 | 25,108 | -78 | 0 | -78 |
| **Intermediate Marsh** | | | | | | | |
| LA 1 | Perry Ridge | 0 | 0 | 4,704 | -53 | 0 | -53 |
| LA 2 | Willow Bayou | 0 | 0 | 35,109 | -328 | 0 | -328 |
| LA 3 | Black Bayou | 0 | 0 | 34,941 | -509 | 0 | -509 |
| LA 4 | West Johnsons Bayou | 0 | 0 | 11,110 | -269 | 0 | -269 |
| LA 5 | Sabine Lake Ridges | 0 | 0 | 9,270 | -218 | 0 | -218 |
| LA 7 | Southeast Sabine | 5,400 | 0 | | 0 | 0 | 0 |
| LA 8 | Southwest Gum Cove | 0 | 0 | 6,605 | -4 | 0 | -4 |
| LA 9 | East Johnsons Bayou | 0 | 0 | 26,138 | -190 | 0 | -190 |
| | Subtotal | 5,400 | 0 | 127,877 | -1,571 | 0 | -1,571 |
| **Brackish Marsh** | | | | | | | |
| LA 2 | Willow Bayou | 0 | 0 | 1,182 | -1 | 0 | -1 |
| LA 3 | Black Bayou | 0 | 0 | 3,195 | -1 | 0 | -1 |
| LA 4 | West Johnsons Bayou | 0 | 0 | 2,078 | -1 | 0 | -1 |
| LA 5 | Sabine Lake Ridges | 0 | 0 | 15,962 | -14 | 0 | -14 |
| LA 6 | Johnsons Bayou Ridge | 0 | 0 | 2,744 | -6 | 0 | -6 |
| | Subtotal | 0 | 0 | 25,161 | -23 | 0 | -23 |
| **Saline Marsh** | | | | | | | |
| LA 5 | Sabine Lake Ridges | 0 | 3,767 | 0 | -35 | 210 | 173 |
| LA 6 | Johnsons Bayou Ridge | 0 | 370 | 0 | -2 | | |
| | Subtotal | | 4,137 | 0 | -37 | 210 | 173 |
| | | | | | | | |
| Louisiana Impacts Total | | 15,247 | 4,137 | 178,146 | -1,709 | 210 | -1,499 |

Table VII-10
Net FWP Impacts for Project as a Whole (AAHUs)

| | Bottom-land Hardwood | Cypress-Tupelo Swamp | Fresh Marsh | Intrmd Marsh | Brackish Marsh | Saline Marsh | Total |
|---|---|---|---|---|---|---|---|
| | | | Impacts | | | | |
| Texas | | | | | | | |
| Neches River watershed | 0 | 0 | -173 | -36 | -131 | -5 | -345 |
| Sabine River watershed | 0 | -22 | -33 | -12 | 0 | 0 | -67 |
| Subtotal | 0 | -22 | -206 | -48 | -131 | -5 | -412 |
| Louisiana | | | | | | | |
| Sabine River watershed | 0 | 0 | -78 | -1,571 | -23 | -37 | -1,709 |
| Total Impacts | 0 | -22 | -284 | -1619 | -154 | -42 | -2121 |
| | | | DMMP Benefits | | | | |
| Texas | | | | | | | |
| Neches River watershed | | | | | | | |
| Neches River BU Feature | 0 | 0 | 178 | 305 | 363 | 0 | 846 |
| Gulf Shore BU Feature (TX Point) | 0 | 0 | 0 | 0 | 0 | 222 | 222 |
| Subtotal | 0 | 0 | 178 | 305 | 363 | 222 | 1068 |
| Louisiana | | | | | | | |
| Sabine River watershed | | | | | | | |
| Gulf Shore BU Feature (LA Point) | 0 | 0 | 0 | 0 | 0 | 210 | 210 |
| Total DMMP Benefits | 0 | 0 | 178 | 305 | 363 | 432 | 1278 |
| | | | Net SNWW CIP FWP Impacts | | | | |
| Texas | | | | | | | |
| Neches River watershed | 0 | 0 | 5 | 269 | 232 | 217 | 723 |
| Sabine River watershed | 0 | -22 | -33 | -12 | 0 | 0 | -67 |
| Net Texas Benefits (positive) | | | | | | | 656 |
| Net Louisiana Impacts (negative) | 0 | 0 | -78 | -1571 | -23 | 173 | -1499 |
| Net FWP Impacts | 0 | -22 | -106 | -1314 | 209 | 390 | -843 |

The offshore channels (Sabine Bank Channel, Sabine Pass Outer Bar Channel, and Sabine Pass Jetty Channel) would be maintained with a hopper dredge, and approximately 162 mcy of material would be placed in four existing ODMDSs. Bed sediments in the offshore channels vary from 4.3 percent sand and 95.7 percent silt plus clay in the Sabine Pass Outer Bar Channel to 24.3 percent sand and 75.7 percent silt plus clay in the Sabine Bank Channel (Parchure et al., 2005). These sites have sufficient capacity for the 50-year period of analysis as they are located in a dispersive environment where dredged material does not accumulate.

For the inshore Sabine Pass Channel, the analysis of placement alternatives conducted for this study resulted in a change from traditional upland placement at PA 5. The Gulf Shore Feature was evaluated as a BU alternative for 13.8 mcy of maintenance material from Section 5 (total of 16 cycles, 3 years each), the channel section closest to the coast (see Engineering Plates C-09 and C-10, Appendix 1). Material from channel Section 6 would continue to be placed into PA 5 (16.8 mcy total; 16 cycles of 3 years each), because the longer pumping distance to the coast makes shore nourishment cost prohibitive. The 50-year stream of costs for BU and traditional upland placement alternatives was compared for both the Base and Recommended Plans, as shown in Table VII-11. These costs were developed during the detailed design phase, using a different cost ($1.12/gallon fuel cost) and price level (October 2005). Costs have not been

updated because it is a screening phase cost comparison. No changes have been made to these alternatives since they were initially compared. Costs for both alternatives would change proportionately if they were updated with October 2009 price levels, and the difference in cost between the two plans would not be materially different. During the detailed evaluation of screened alternatives, the Gulf Shore Feature was compared to the Base Plan option. The Base Plan option entails placing all Section 5 material in upland confined PA 5, with regular raisings of the containment levee as required to contain the material. The cost analysis determined that the Gulf Shore Feature is the least-cost, environmentally acceptable alternative for the 40-foot Base Plan. It is, therefore, included in the Base Plan for the existing project. Since it is also the least-cost O&M alternative for the proposed 48-foot project, it is the preferred placement option for Sabine Pass Channel Section 5 in the Recommended Plan.

Table VII-11
Cost Comparison of Gulf Shore Beneficial Use Feature to Base Plan PA 5
(All costs in dollars)

| Placement Alternatives for Section 5 Maintenance Material | Base Plan | Selected Plan |
|---|---|---|
| Gulf Shore BU Feature | 2,006,000 | 3,225,000 |
| Upland PA 5 | 2,200,000 | 4,366,000 |
| Difference | (194,000) | (1,141,000) |

Presented as average annual costs; October 2005 price levels, $1.12 per gallon fuel cost; 4.875 percent interest rate

To contain 229.4 mcy of material from the inshore channels over the 50-year period of analysis for the project as a whole, the heights of existing PAs would be raised on a regular, recurring schedule in accordance with existing SNWW management practices. One new PA in the middle reach of the Neches River Channel (an expansion cell at PA 24A) would be needed to provide sufficient capacity for the 50-year period. On average, bed sediments vary in the inland channels from 38.3 percent sand and 61.7 percent silt plus clay in the Neches River Channel, to 16.2 percent sand and 83.8 percent silt plus clay in the Port Arthur Canal (Parchure et al., 2005). BU features are not included in the Base Plan for the inland channels because the lack of suitable material makes construction and maintenance of containment levees more expensive than placing the material in existing PAs. However, Section 204 projects will be considered on a project-by-project basis if non-Federal sponsors express an interest in paying the incremental cost for such projects.

Material from non-Federal dredging of private mooring and dock facilities would also continue to be placed in upland PAs along with the material from the Federal project. Non-Federal dredging quantities vary throughout the length of the waterway. The non-Federal dredging quantity is defined as a percentage of the channel shoaling by section and can be found within the Shoaling Parameters Table in the DMMP (FEIS, Appendix D). The quantity is based on the presence of local facilities, the square footage of the facility, and the shoaling rate of the adjacent channel. The non-Federal material is placed within the same PAs as the material from the adjacent waterway section.

The average annual cost of the 50-year Base Plan for the 40-foot project is $40,938,000. Base Plan costs are presented as average annual equivalents of the stream of maintenance costs over the 50-year period of analysis. Prices used for the comparison were developed in October 2007, with an interest rate of 4.875 percent. Costs include cyclical maintenance dredging using a hopper dredge offshore and a hydraulic pipeline dredge for the inshore reaches, regular levee raisings to provide additional capacity at inland PAs, and the purchase and development of a new upland site at PA 24A. The cost to provide additional capacity for non-Federal dredging is included in the total cost per reach.

## VII.I INCREMENTAL O&M COST OF THE PROPOSED 48-FOOT PROJECT

### Description of O&M Activities for the Recommended Plan

The 50-year O&M plan for the placement of dredged material from the Recommended Plan is also summarized in Table VII-12. The O&M placement plan for the Recommended Plan must provide significantly more PA capacity than the SNWW 40-foot Base Plan. The Recommended Plan would generate 650 mcy of maintenance material over the 50-year period of analysis, which is 60 percent higher than the base plan quantities. Forty-three percent of the maintenance quantities projected for the Recommended Plan would originate from inshore channels, and 57 percent from offshore channels. It is projected that approximately 5.2 percent of the dredged material from inshore channels will be associated with non-Federal dredging. The quantity is based on the presence of local facilities, the square footage of the facility, and the shoaling rate of the adjacent channel. The non-Federal material is placed within the same PAs as the material from the adjacent waterway section.

O&M for the Recommended Plan consists of the continued use of 4 existing ODMDSs; the creation of 4 new ODMDSs; 16 existing upland PAs; the addition of 2 new cells at existing upland sites (PAs 18A and 24A), and BU components of the Neches River Feature (Bessie Heights East and Rose City East) and Gulf Shore Feature. The existing management practice of regular, recurring containment levee lifts would continue at all upland PAs, but no DAMP would be used.

The hydraulic construction of containment levees with new work material provides a cost-effective construction method that reduces the cost of providing capacity for the new work and maintenance material on the Neches River Channel by reducing final levee elevations at upland PAs.

### Incremental O&M Cost of the Recommended Plan

The average annual cost of the 50-year O&M plan for the Recommended Plan is $68,632,000. The total O&M incremental cost for the Recommended Plan is $32,067,000. Of this total, $61,000 is the cost of providing non-Federal disposal facility capacity. The O&M costs for the Recommended Plan presented in Table VII-12 do not include new work construction costs. The non-Federal disposal facility costs are summarized per channel for the Recommended Plan in Table VII-12 to facilitate proper distribution of Federal and non-Federal project costs. Costs are presented as average annual equivalents of the stream of

Table VII-12
Incremental O&M Cost for the Recommended Plan

| Average Annual Costs, October 2009 Price Levels, 4.375% Interest Rate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 40-foot Base Plan | | | 48-foot Selected Plan | | | | | |
| Channel | Placement Sites | 50-year Quantity (mcy) | Average Annual Cost ($) | Placement Sites | 50-year Quantity (mcy) | Average Annual Cost ($) | non-Federal Disposal Facility Average Annual Cost ($) | Federal Project O&M Average Annual Costs ($) | Total Incremental O&M Average Annual Cost ($) |
| Sabine Bank Extension | ODMDSs A, B, C, D | n/a | n/a | ODMDSs A, B, C, D | 36.2 | 3,913,000 | | 3,913,000 | 3,913,000 |
| Sabine Bank Channel | ODMDSs 1 and 2 | 50.8 | 2,291,000 | ODMDSs 1 and 2 | 96.4 | 8,089,000 | | 8,089,000 | 5,798,000 |
| Sabine Pass Outer Bar Channel | ODMDS 3 | 99.7 | 10,761,000 | ODMDS 3 | 223.7 | 21,733,000 | | 21,733,000 | 10,972,000 |
| Sabine Pass Jetty Channel | ODMDS 4 | 11.4 | 1,472,000 | ODMDS 4 | 13.5 | 1,973,000 | | 1,973,000 | 501,000 |
| Sabine Pass Channel | PAs 5 (N&S), 5B, 5C, TX8-11, LA5-6 | 30.6 | 2,508,000 | PAs 5 (N&S), 5B, 5C, TX8-11, LA5-6 | 34.8 | 4,464,000 | | 4,464,000 | 1,956,000 |
| Port Arthur Canal & Taylor Bayou Basins & Channels | PAs 8, 9, 9A | 88.2 | 7,851,000 | PAs 8, 9A, 9B | 82.9 | 12,482,000 | 6,000 | 12,482,000 | 4,631,000 |
| Sabine-Neches Canal | PAs 8, 11 | 60.1 | 3,629,000 | PAs 8, 11 | 73.2 | 6,067,000 | 9,000 | 6,067,000 | 2,438,000 |
| Neches River Channel | PAs 12, 13, 14, 16, 17, 18, 21, 23, 23A, 24, 24A, 25, 25A, 26, 27A, 27C, 27D | 66.5 | 8,134,000 | PAs 12, 13, 14, 16, 17, 18, 18A, 21, 23, 23A, 24, 24A, 25, 25A, 26, 27A, 27C, 27D, TX5-2, TX3-1E | 89.7 | 9,992,000 | 46,000 | 9,992,000 | 1,858,000 |
| Totals | | 407.3 | 36,646,000 | | 650.4 | 68,713,000 | 61,000 | 68,713,000 | 32,067,000 |

Average Annual Costs, October 2009 Price Levels, 4.375% interest

maintenance costs over the 50-year period of analysis. Prices used for the comparison were developed in October 2009, with an interest rate of 4.375 percent. O&M costs for the Recommended Plan include cyclical maintenance dredging using a hopper dredge in the offshore channels and a pipeline dredge for the inshore channels; offshore placement at four existing and four new ODMDS; real estate costs to obtain and construct two new upland sites at PA 18A and PA 24A; regular levee lifts and spillway rehabilitation for upland PAs; the placement of maintenance material at Bessie Heights East (7 cycles) and Rose City East (1 cycle) components of the Neches River BU Feature and the Gulf Shore Feature (15 cycles); maintenance of containment levees at the BU sites; and monitoring of the BU sites.

# VIII. DEVELOPMENT OF THE MITIGATION PLAN

## VIII.A OVERVIEW

This chapter discusses the evaluation of mitigation measures considered during formulation of the Recommended Plan, and presents the Ecological Mitigation Plan. The Ecological Mitigation Plan compensates for unavoidable impacts to nationally significant intertidal marsh habitat. Evaluation of measures was conducted within the ICT and technical workgroups. ICT and workgroup meetings were conducted from 2001 to 2006. In 2009, changes in the proposed project and HS modeling necessitated that the WVA modeling be revised. Due to schedule constraints, the USACE performed the modeling without the ICT involvement, basing it as closely as possible on methods and assumptions used by the ICT in the original modeling. The results of this remodeling were coordinated with the ICT. A quality check was also performed for the revised worksheets. The potential for cultural resource mitigation is described at the end of this section.

## VIII.B ECOSYSTEM IMPACTS SUMMARY

The impacts of the Recommended Plan are related primarily to a decrease in the overall biological productivity of approximately 182,000 acres of marshes and forested wetlands over the 50-year period of analysis. Biological productivity of the wetlands in the affected area would decline as increases in salinity affect the productivity of marsh and cypress-tupelo swamp, and the fish and wildlife that depend upon this habitat. Indirect adverse effects could lead to the loss of marsh acreage as stressed emergent marsh converts to open water. The WVA Emergent Marsh Community Model (EMCM) predicts a loss of 691 acres of marsh in Louisiana over the period of analysis. Higher salinity would have a negligible effect on the productivity of cypress-tupelo swamp on the Sabine River near the GIWW by marginally slowing the rates of tree growth and reducing some herbaceous understory; no loss of cypress-tupelo swamp acreage would be expected. No impacts from the Recommended Plan were identified for bottomland hardwoods.

Direct effects of the Recommended Plan would be minor and temporary. These temporary, short-term impacts are associated with navigation channel improvements and the placement of dredged material. They include (1) impacts to water quality and benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats resulting from dredging to construct the navigation improvements, the creation of new offshore ODMDSs, the borrow area trench for Willow Bayou mitigation areas, and marsh restoration in shallow, open-water areas; (2) potential dredging impacts to bottom-feeding and pelagic organisms such as sea turtles; and (3) impacts to shoreline birds and their habitat from the placement of maintenance material on the Gulf shoreline.

Potential adverse affects to threatened and endangered sea turtles during hopper dredging to construct the Entrance Channel would be addressed by the adoption of reasonable and prudent measures to avoid impacts that are established in the Biological Opinion for the CIP. No other adverse effects to threatened and endangered species have been identified.

The Recommended Plan's effects on the SNWW's marsh and swamp systems were quantified using the WVA Model. In the table below, net changes in acres and AAHUs are presented for the Recommended Plan, including benefits of the DMMP BU features (Table VIII-1). The lost ecological value of all potential project impacts (prior to reduction by benefits of the BU features) is represented by –2,121 AAHUs. These impacts would be offset by adoption of the DMMP BU features that provide benefits of 1,278 AAHUs. When the impacts and DMMP benefits are applied to the project as a whole, unavoidable impacts of –843 AAHUs would remain.

Table VIII-1
Net Project Impacts and Benefits by Average Annual Habitat Units

| | Bottomland Hardwood | Swamp | Fresh Marsh | Intrmd Marsh | Brackish Marsh | Saline Marsh | Totals |
|---|---|---|---|---|---|---|---|
| Recommended Plan Impacts (negative AAHUs) | | | | | | | |
| Texas | 0 | –22 | –206 | –48 | –131 | –5 | –412 |
| Louisiana | 0 | 0 | –78 | –1,571 | –23 | –37 | –1,709 |
| Total Project Impacts | 0 | –22 | –284 | –1,619 | –154 | –42 | –2,121 |
| Recommended Plan Benefits (positive AAHUs) | | | | | | | |
| Texas | 0 | 0 | 178 | 433 | 235 | 222 | 1,068 |
| Louisiana | 0 | 0 | 0 | 0 | 0 | 210 | 210 |
| Total Project Benefits | 0 | 0 | 178 | 433 | 235 | 432 | 1,278 |
| Net Project Benefits or Impacts (AAHUs) | 0 | –22 | –106 | –1,186 | 81 | 390 | –843 |

## VIII.C PROCEDURES FOR THE FORMULATION AND ASSESSMENT OF MITIGATION MEASURES

### Compliance with Federal Requirements

Implementation guidance for Section 2036(a) of Water Resources Development Act (WRDA) 07 (Mitigation for Fish and Wildlife and Wetlands Losses), issued August 31, 2009, requires that the Recommended Plan contain a specific plan to mitigate fish and wildlife losses since it has been determined that the Recommended Plan would have unavoidable impacts after benefits of the DMMP BU features are applied. Adverse impacts to ecological resources that are caused by a proposed project must be avoided or minimized to the extent practicable, and remaining unavoidable impacts compensated to the extent justified. A Mitigation Plan has been developed for the CIP Recommended Plan, which minimizes impacts as described briefly below, and provides sufficient compensatory mitigation for significant resources such that only negligible adverse impacts remain.

Central to mitigation planning is the determination of significance, as mitigation is required only for impacts to significant resources. Significance must be based upon the contribution of the resource to the Nation's economy, and technical, institutional, and/or public recognition of the value the resource. Criteria for determining significance include, but are not limited to, scarcity or uniqueness of the resource

from a national, regional, state, or local perspective. The USFWS Habitat Stewardship Program has identified three nationally recognized "scarce and vulnerable" wetland habitats in the study area: estuarine intertidal emergent, palustrine emergent, and palustrine forested wetlands. These are the same sensitive wetland habitats (saline, brackish, intermediate and fresh marsh, cypress-tupelo swamps, and bottomland hardwoods) addressed by the CIP Mitigation Plan.

These same habitats are also considered significant and vulnerable by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), Public Law 101-646 (Title III) and the NAWMP (2004). The Texas Land and Water Resources Conservation Plan (TPWD, 2005) recognizes the Gulf coastal marshes in Tier One of high priority eco-regions, and considers these habitats to be the most threatened of the state's two high diversity eco-regions. Significant marsh habitat on the Lower Neches River and along the Texas Point shoreline has been declared "critical erosion areas" by the Texas Coastwide Erosion Response Plan. Furthermore, coastal marshes in the Louisiana portion of the study area are recognized as threatened and vulnerable by the Louisiana Coast 2050 Plan (LCWCR/WCRA, 1998), the Louisiana Coastal Areas Ecosystem Restoration Study (USACE, 2004) and the Louisiana Comprehensive Management Plan (LACPRA, 2007; USACE 2008). High population growth and associated development along the coast have fragmented wildlife habitat, changed river flows, decreased water quality, and increased sediment loads and pollutants.

The most significant trend adversely affecting the study area is the high rate of wetland loss that has occurred in recent decades (Berman, 2005; Morton, 2003; Morton et al., 2005; Shinkle and Dokka, 2004; Titus and Narayanan, 1995). In Louisiana, a net land loss of 21 percent between 1978 and 2000 has been reported in the Chenier Plain subregion of coastal Louisiana, which includes the Sabine estuary (USACE, 2004). In Texas, the most extensive losses of interior coastal wetlands in the state (12,632 acres between 1930 and 1978) have occurred in the Neches River delta. In total, over 90 percent of the emergent marshes in the Lower Neches River delta have been converted to open water (Morton and Paine, 1990; White et al., 1987), which is more than half of the total wetland loss in the State of Texas (Sutherlin, 1996).

Mitigation may include avoiding and minimizing project impacts to ecological resources, rectifying impacts by restoring the affected environment, and reducing or eliminating impacts by preservation or maintenance operations during the period of analysis. The Recommended Plan includes large DMMP BU features on the Neches River and Gulf shoreline, which replace marsh and minimize shoreline erosion that would occur as a result of the Recommended Plan. These DMMP features are described and quantified in Chapter VII. In the Mitigation Plan, replacements of ecological resources are made "in-kind" to the greatest extent possible. The WVA Model quantifies impacts to all affected habitat types in the study area and provides a means to establish the appropriate amount of compensatory mitigation by habitat type. The WVA Model and its results are described in detail in Appendix C of the FEIS.

Recommended mitigation measures are justified by an incremental analysis that is presented in detail in the FEIS; results are summarized later in this chapter. This analysis identified the best-buy mitigation plan, e.g., that plan in which the value of the last increment of losses prevented, reduced, or replaced is at

least equal to the costs of the last added increment. The incremental analysis of mitigation measures was performed with the certified version of IWR-PLAN software.

The USACE regulations (USACE, 2000b) recognize wetland resources and bottomland hardwoods for special consideration in mitigation planning; these are the primary types of ecological resources affected by the Recommended Plan. Impacts to wetlands must be fully mitigated and projects must meet the goal of "no net loss" of wetlands. Mitigation for bottomland hardwoods should be made in-kind to the extent possible. Bottomland hardwood forests should be treated as an ecological system when devising mitigation, rather than mitigating specific species that use this habitat.

The Mitigation Plan described below fulfills the special requirements for wetlands and bottomland hardwoods. These plans also contribute to several multiagency regional plans, such as the Louisiana Comprehensive Management Plan (LACPRA, 2007; USACE, 2008b), Louisiana Coast 2050 (LCWCR/WCRA, 1998), the Texas Land and Water Resources Conservation Plan (TPWD, 2005), and the NAWMP (NAWMP Plan Committee, 2004), by restoring and preserving scarce and vulnerable wetlands and wildlife habitat.

## Mitigation Planning Objectives

The following objectives were established to evaluate mitigation measures considered for the SNWW CIP. The objectives were developed by the USACE in consultation with the ICT.

- Minimize salinity impacts to the SNWW affected area;
- Maximize the use of dredged material in mitigation measures;
- Meet the national goal of "no net loss" of wetlands;
- Replace lost habitat quality on a one-to-one basis as measured by AAHUs;
- Replace habitats in-kind to the extent practicable; and
- Mitigate losses in the state where they occur

These objectives reflected the most significant expected impacts of the CIP, widespread interest in potential BU of dredged material, the national policy objective to prevent wetland loss, and the USACE requirements to fully compensate for unavoidable project adverse effects. While the FEIS evaluates impacts on the SNWW coastal and estuarine system without regard to state boundaries, the mitigation plan should comply, to the greatest extent practicable, with the CZMP for each state. Under the Coastal Zone Management Act (CZMA), states with approved coastal management programs have jurisdiction within their coastal boundaries to ensure compliance with their programs. The CZMA and its implementing regulations require that Federal activities comply to the maximum extent practicable with these programs. In Louisiana, the Louisiana State and Local Coastal Resources Management Act functions as the state coastal management program for CZMA purposes. Compensatory mitigation is used to offset any net loss of wetland ecological value after efforts have been made to avoid or minimize impacts. Furthermore, the CWPPRA requires that Federal agencies ensure that maintenance or

modification of navigation projects be consistent with the purposes of the restoration plan submitted under CWPPRA. Louisiana has adopted a Coastal Wetlands Conservation Plan under this authority with a goal of no net loss of wetlands in coastal areas of Louisiana as a result of development activities. In essence, this means that the SNWW mitigation plan for unavoidable project impacts in Louisiana would propose one-to-one compensation for all AAHU losses. There is, however, a significant exception to this requirement. Federal lands are excluded from coverage under the CZMA, and this means that compensatory mitigation for impacts to Federal lands may be developed without regard to state boundaries.

Since the CZMA does not apply to Federal lands, excess Texas BU benefits could be used to compensate for impacts to Federal lands in Louisiana. The only lands affected by this exclusion are located in the Sabine NWR. While the Texas Point and McFaddin NWRs in Texas would also be affected by salinity increases associated with the project, two DMMP BU features (the Neches River and the Gulf Shore BU features) provide benefits that offset all project impacts in Texas (including impacts to both NWRs) and provide excess benefits of 656 AAHUs. The DMMP BU features fulfill Texas's CZMP requirements to avoid and minimize impacts to the coastal zone, such that no compensatory mitigation for Texas state resources is needed.

Total SNWW project impacts to the Sabine NWR are –340 AAHUs. When these are removed from the total project impacts in Louisiana (–1,499 AAHUs), the mitigation target proposed for compliance with Louisiana's CZMP is –1,159 AAHUs. Table VIII-2 illustrates this calculation. Since all mitigation measures for the SNWW would be located in Louisiana, the new mitigation target would compensate for total project losses of –843 AAHUs by providing 1,159 AAHUs of compensatory mitigation.

Table VIII-2
FWP Compensatory Mitigation Target for Louisiana

| Units (AAHUs) | Texas | Louisiana | Project |
|---|---|---|---|
| **Net FWP Benefits/Impacts** | | | |
| Total Impacts (negative) | –412 | –1,709 | –2,121 |
| Total BU Benefits (positive) | 1,068 | 210 | 1,278 |
| Net FWP Benefits (positive) or Impacts (negative) | 656 | –1,499 | –843 |
| | | | |
| **Excess Texas Benefits Applied to Federal Lands** | | | |
| Excess Texas Benefits | 656 | | |
| Sabine National Wildlife Refuge Impacts | –340 | | |
| Net Excess Texas Benefits | 316 | | |
| | | | |
| **Compensatory Mitigation Target** | | | |
| Net Impacts by State and Project | | –1,499 | –843 |
| Federal Impacts Compensated with Texas Excess Benefits | | 340 | |
| FWP Compensatory Mitigation Target | | –1,159 | –843 |

## Models Used to Evaluate Environmental Effects and Mitigation Measures

Since the primary environmental concerns are the interrelated issues of saltwater intrusion, marsh loss, and destruction of wildlife habitat and fishery nursery areas, an engineering model was used to evaluate salinity changes and an ecological model was used to evaluate the ecological effects of the CIP. Both models played an integral role in the development of FWOP and FWP conditions and were used to compare the effectiveness of mitigation measures. The HS model used for this study is an established, three-dimensional (3-D) estuarine model adapted by the ERDC and applied to numerous deep-draft CIPs around the country over the last decade (Brown and Stokes, 2009). The WVA Model is a suite of ecological, habitat-based, community models known primarily from its use by a multiagency team of Federal and State agencies in Louisiana to evaluate proposals for coastal restoration projects (LDNR, 1993; USFWS, 2002b, 2002c, 2002d, 2002e). It has also been used for other USACE projects in Louisiana and on the upper Texas coast.

### HS Modeling

Concerns that a deeper navigation channel would increase salinity in the Sabine Lake estuarine system were addressed with a 3-D HS model that predicts changes in salinity, circulation, and water elevation due to proposed channel improvements. The ERDC's CHL worked closely with the MW to calibrate and verify the base model for use in this system. Most of the agencies on the ICT were represented in the MW and several (TPWD, TWDB, and ERDC-CHL) provided individuals with experience and expertise in HS modeling. The MW reviewed the ERDC's model calibration and verification process, provided data and information on hydrologic connectivity, marsh elevation, and bathymetry, and reviewed modeling results as part of the impacts evaluation. Baseline conditions of the channel geometry included actual depths, not authorized depths, to ensure that environmental impacts associated with changes in salinity from the existing condition versus the proposed 48-foot deep channel were captured.

The ERDC-CHL applied an established 3-D estuarine model (the ERDC-modified TABS Multi-Dimensional Numerical Modeling System) to compute hydrodynamics and salinity transport for the proposed CIP. The model includes forcing due to tides, freshwater inflows, wind, Coriolis, and density gradients due to salinity variation, and accounts for precipitation and evaporation. The code uses a finite–element formulation, which gives it great flexibility in matching complex geometry. Over the last decade, the code has been extensively used for a variety of the USACE field projects, including the Houston-Galveston Navigation Channels project; New York Harbor; St. Johns River, Florida; and Atchafalaya Bay in Louisiana. Two of the special features of the code, wetting/drying and "marsh porosity," enable successful modeling of wetlands. A description of the model and its output is provided in a draft report by the ERDC-CHL (Brown and Stokes, 2009). A detailed description of assumptions and methods underlying use of HS model output in the ecological model is provided in Appendix C of the FEIS.

The estuarine model covers the entire study area from the Salt Bayou watershed on the west to near Gum Cove Ridge in Louisiana on the east, and inland to north of IH 10. Effects were predicted by comparing the model's simulation of existing conditions and FWOP with RSLR conditions to those resulting from a

48-foot channel. The design flows were based on inflows provided by the TWDB, utilizing future demand and supply strategies from the 2007 Texas State Water Plan (TWDB, 2006). Modeling indicated that RSLR would likely increase FWOP salinities up to 2.0 ppt in portions of the project area. FWP salinities would not increase on the upper Neches and Sabine rivers but an increase of about 1.8 ppt on the Neches River near Bessie Heights, 1.4 ppt near Keith Lake Fish Pass, and about 1.4 to 1.6 ppt on the eastern shore of Sabine Lake would be likely.

### Ecological Modeling

Habitat-based ecological models were used to determine the impacts and benefits of proposed navigation channel improvements, BU features, and mitigation measures. The WVA Model employs a community approach that assumes that optimal conditions for all fish and wildlife within a specific type of coastal wetland habitat can be characterized by a group of significant variables, and that existing or future conditions can be compared to that optimum, providing an index of habitat quality similar to those developed under the well-established Habitat Evaluation Procedure (HEP). Variables utilized in the WVA Model were selected from existing, widely accepted HEP models of resident fish and wildlife species (USFWS, 1980). Appendix C of the FEIS maps and characterizes all significant habitats in the study area, explains how the WVA Model evaluates project impacts and benefits, describes the methods and assumptions used in the modeling process, assesses impacts of the Recommended Plan, and evaluates the effectiveness of DMMP BU and mitigation measures in AAHUs.

The WVA Model was chosen as the most appropriate ecological model for the SNWW project based on a number of factors. It is a quantitative, habitat-based assessment methodology developed to prioritize Louisiana coastal restoration projects submitted for funding under the CWPPRA. The WVA model applies specifically to habitat types present along the Louisiana coast, and these same types of coastal habitat (Chenier Plain, emergent coastal marsh, bottomland hardwoods, and cypress-tupelo swamp) are present throughout the Sabine-Neches coastal watershed in both Texas and Louisiana, and in fact are a continuation of the same system (Daigle et al., 2006; Griffith et al., 2004). In addition, the areas contain the same fish and wildlife communities and similar soils and topography, and the Sabine-Calcasieu basins share an interconnected hydrology. Furthermore, the types of variables measured by the WVA Model are sensitive to the types of changes that have been identified as the highest concerns by resource agencies and the general public for the SNWW project. Specifically, these are potential changes in salinity, stress and death of marsh vegetation, and further loss or degradation of already stressed coastal marshes. The variables measured by the WVA Model are recognized scientifically and technically as important in characterizing overall habitat quality. The WVA Model has community-specific models (e.g., saline marsh or cypress-tupelo swamp) each with a unique set of variables. It combines the effects of changes in habitat productivity (quality) and changes in wetland acreage (quantity) into one AAHU value. Habitat productivity is measured by changes to both terrestrial and shallow-water habitat that affect its usefulness to fish and wildlife. Variables included in the models were selected based on their importance as fish and wildlife habitat and for their sensitivity to the types of changes that have been identified as the highest concerns for this study (e.g., salinity, stress, and death of marsh vegetation, further loss or degradation of already stressed coastal marshes).

The WVA Model has been assessed for use in conjunction with the SNWW project, as required by EC 1105-2-407. The WVA Model is not a USACE corporate model, and therefore certification is not required, but the model must be approved for use. This approval was provided by the Deep-Draft Center for Expertise based upon the results of a model assessment (Louis Berger Group and Toxicological and Environmental Associates [LBG/TEA], 2008). The assessment evaluated the application of all of the model components used to quantify impacts and benefits of SNWW CIP alternatives, including BU features and compensatory mitigation. The assessment determined that the model was theoretically appropriate and correctly applied, and it has been approved for use for the SNWW study by the Deep-Draft Navigation Center of Expertise (see FEIS Appendix C, Attachment 1).

### Consideration of Environmental Mitigation Costs During Plan Formulation

During the preliminary plan formulation screening for the CIP project as a whole, ecological benefits and mitigation costs were not calculated for the nonstructural and 120-plus variations of structural plans for channel improvements. However, all plans, including the No-Action Alternative, were informally reviewed for potential effects to the environment in a nonquantitative manner, and this information was evaluated along with cost data in determining which plans would advance into detailed evaluation.

During detailed evaluation of screened CIP alternatives, the identification of the Recommended Plan was based upon technical, economic, and environmental factors. Costs were estimated for all of the alternatives and used to determine the benefit to cost ratio in the economic analysis. Included in the costs were dredging, levee construction, relocations (including utility relocations), and O&M costs for the 50-year period of analysis. Ecological mitigation costs for the six depth alternatives were estimated using HS model salinity projections for the 40-, 45- and 48-foot channel depths. Salinity was chosen as the best factor on which to base interpolations of mitigation costs because it is the primary driver in the ecological modeling that was used to determine the compensatory mitigation plan. The cost interpolation assumed that there would be a linear relationship between predicted salinities for each channel depth at the end of the period of analysis and the cost of mitigation.

## VIII.D SELECTION OF THE BEST BUY MITIGATION PLAN

A detailed description of the preliminary and final screening of potential mitigation measures is provided in the FEIS. A large number of potential mitigation measures was evaluated; measures were generally of two types: measures to reduce or avoid salinity intrusion and measures to restore or protect habitat. The purchase of credits from mitigation banks established by others was considered as an option in providing compensatory mitigation for the Recommended Plan. Only two existing mitigation banks were identified in the lower Sabine and Neches watersheds. Neither was available for use as the credits from one were sold out and the other was developed for the exclusive use of a State agency.

The recommended mitigation plan was selected using the tools of cost-effectiveness analysis and incremental cost analysis (CE/ICA) and the certified version of IWR-PLAN. The result of the incremental analysis is shown on Figure VIII-1 and Table VIII-3. Ten best buy plans were identified, with incremental

costs ranging from $2,716 to $19,935 per AAHU. A detailed explanation of this table is provided in the FEIS, Chapter 5.

Figure VIII-1. Results of the CE/ICA Analysis

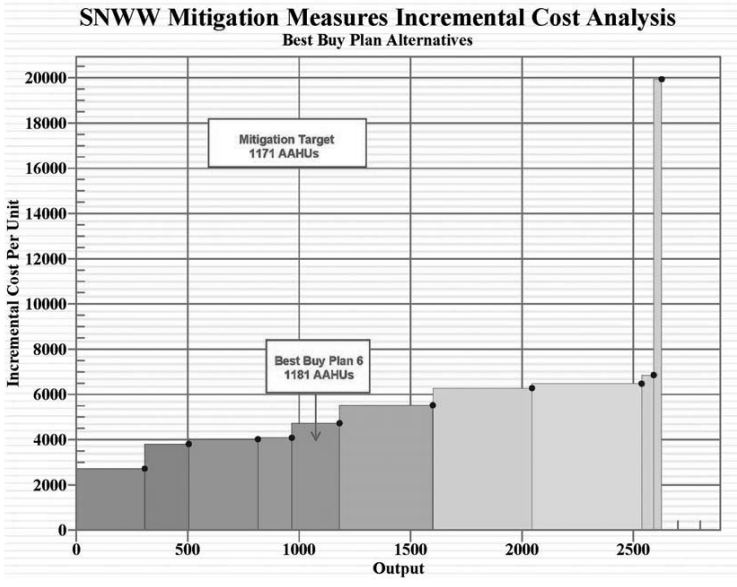


Table VIII-3
Best Buy Plans Identified by Incremental Cost Analysis (October 2005 Price Levels)

| Counter | Plan Alternative | Output (AAHU) | Cost ($1.00) | Average Cost ($1.00 / AAHU) | Incremental Cost ($1.00 / AAHU) | Inc. Output ($1.00) | Inc. Cost Per AAHU |
|---|---|---|---|---|---|---|---|
| 1 | No Action Plan | 0.00 | 0.00 | | | | |
| 2 | A0B0C0D0E0F0G0H0I0J0K1L0M0 | 307.00 | 833,787.00 | 2,715.9186 | 833,787.0000 | 307.0000 | 2,715.9186 |
| 3 | A0B0C0D0E0F0G0H1I0J0K1L0M0 | 505.00 | 1,587,504.00 | 3,143.5723 | 753,717.0000 | 198.0000 | 3,806.6515 |
| 4 | A0B0C0D0E0F0G0H1I0J0K2L0M0 | 815.00 | 2,833,144.00 | 3,476.2503 | 1,245,640.0000 | 310.0000 | 4,018.1935 |
| 5 | A0B0C0D1E0F0G0H1I0J0K2L0M0 | 967.00 | 3,454,021.00 | 3,571.8935 | 620,877.0000 | 152.0000 | 4,084.7171 |
| **6** | **A0B0C0D2E0F0G0H1I0J0K2L0M0** | **1,181.00** | **4,465,620.00** | **3,781.2193** | **1,011,599.0000** | **214.0000** | **4,727.0981** |
| 7 | A0B0C0D3E0F0G0H1I0J0K2L0M0 | 1,600.00 | 6,778,538.00 | 4,236.5863 | 2,312,918.0000 | 419.0000 | 5,520.0907 |
| 8 | A0B0C1D3E0F0G0H1I0J0K2L0M0 | 2,045.00 | 9,573,089.00 | 4,681.2171 | 2,794,551.0000 | 445.0000 | 6,279.8899 |
| 9 | A0B0C2D3E0F0G0H1I0J0K2L0M0 | 2,537.00 | 12,759,111.00 | 5,029.2121 | 3,186,022.0000 | 492.0000 | 6,475.6545 |
| 10 | A0B0C2D3E0F0G0H1I0J0K2L0M2 | 2,591.00 | 13,129,173.00 | 5,067.2223 | 370,062.0000 | 54.0000 | 6,853.0000 |
| 11 | A0B0C2D3E0F0G0H1I0J0K2L0M3 | 2,627.00 | 13,846,826.00 | 5,270.9654 | 717,653.0000 | 36.0000 | 19,934.8056 |

Best Buy Plan 6 (Solutions $D_2$, $H_1$, and $K_2$ – shown in bold in Table VIII-4) appears to be an efficient mitigation plan since it reaches the mitigation target of 1,159 AAHUs by providing a total of 1,181 AAHUs. Best Buy Plan 6 consists of emergent marsh restoration in two Willow Bayou areas (totaling 687 acres) and three areas in the Black Bayou area (totaling 2,096 acres). Best Buy Plan 7 was also evaluated to determine whether its considerable additional benefits were worth the comparatively small incremental cost. Best Buy Plan 7 provides 420 additional AAHUs (719 more acres restored in Willow Bayou) by adding Solution $D_3$ for an additional average annual cost per unit of output of $4,237 (total average annual cost of $2,312,918). Since the estimated total first cost of this increment is $39,275,000 (screening-level cost) and Best Buy Plan 6 meets the mitigation target, Best Buy Plan 7 was deemed not worth the additional investment.

Table VIII-4
Recommended Mitigation Plan

| Recommended Mitigation Plan | Mitigation AAHUs |
|---|---|
| **Willow Bayou** | |
| LA 2-18 B Marsh Restoration (Sabine Lake dredging) | 152 |
| LA 2ADD B Marsh Restoration (Sabine Lake dredging) | 214 |
| **Black Bayou West** | |
| LA 3-10R Marsh Restoration (Sabine River Channel maintenance material) | 198 |
| **Black Bayou East** | |
| LA 3-15 B Marsh Restoration (GIWW dredging) | 307 |
| LA 3-18 B Marsh Restoration (GIWW dredging) | 310 |
| Total Compensation | 1,181 |
| FWP Mitigation Target | –1,159 |
| **Net Benefits After Compensation** | **22** |

## VIII.E RECOMMENDED ECOLOGICAL MITIGATION PLAN

The CE/ICA selected Best Buy Plan 6 as the most efficient combination of mitigation measures to compensate for the indirect impacts of the Recommended Plan. It provides 1,181 AAHUs, which is 22 AAHUs more than the mitigation target. It is important to remember that additional compensatory mitigation would be provided in Louisiana beyond the total 843 AAHUs impacts of the Recommended Plan. The mitigation plan would result in a net gain of 338 AAHUs for the project as a whole.

Unavoidable impacts of the SNWW CIP remain only in Louisiana; all CIP impacts in Texas are minimized and offset by the DMMP BU and no mitigation is required. Therefore, all of the mitigation measures in Best Buy Plan 6 would be located in Louisiana. The mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana (Figure VIII-2, Table VIII-5). The reader is referred to the FEIS for a detailed description of each mitigation measure.

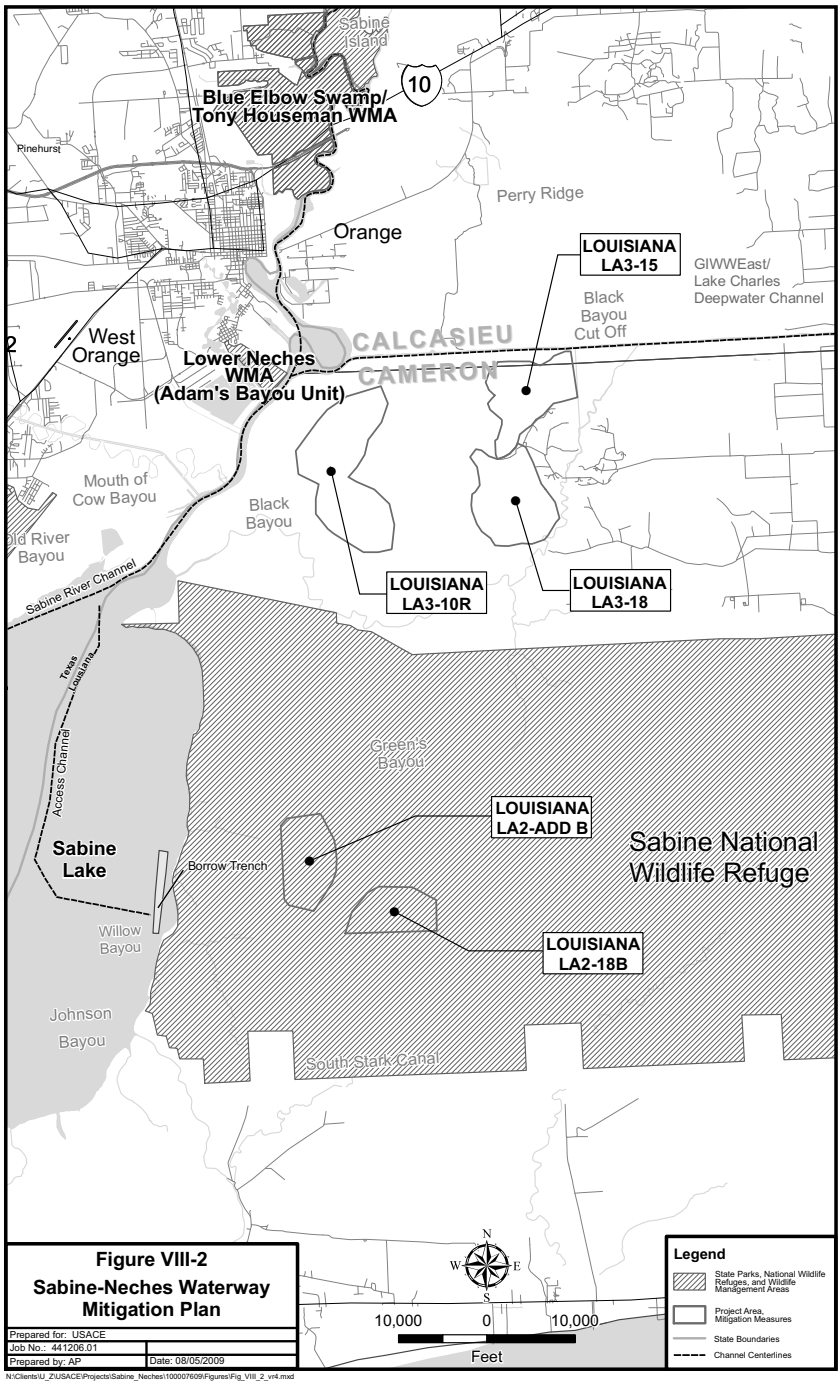


**Figure VIII-2**
**Sabine-Neches Waterway Mitigation Plan**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 441206.01 | |
| Prepared by: AP | Date: 08/05/2009 |

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Table VIII-5
Recommended Mitigation Plan – Acreage Analysis

| Mitigation Measure | AAHUs | Total Influence Area (acres) | Nourished Existing Marsh (acres) | Restored Open Water (acres) | Restored Emergent Marsh (acres) |
|---|---|---|---|---|---|
| **Willow Bayou** | | | | | |
| LA 2-18B | 152 | 681 | 367 | 63 | 251 |
| LA 2-ADD B | 21 | 1,285 | 745 | 104 | 436 |
| Subtotal | 173 | 1,966 | 1,112 | 167 | 687 |
| **Black Bayou West** | | | | | |
| LA 3-10R | 198 | 2,465 | 1,317 | 356 | 792 |
| **Black Bayou East** | | | | | |
| LA 3-15B | 307 | 1,788 | 878 | 227 | 683 |
| LA 3-18B | 310 | 1,876 | 1,048 | 207 | 621 |
| Subtotal | 617 | 3,664 | 1,926 | 434 | 1,304 |
| **Total Mitigation** | 1,181 | 8,095 | 4,355 | 957 | 2,783 |

The recommended Mitigation Plan compensates for the Recommended Plan's salinity increase and associated losses in marsh and productivity by marsh creation activities that would influence a total of 8,095 acres of Louisiana marshes in the Willow and Black Bayou watersheds. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone.

Upon authorization of the CIP, the USACE would use its Navigation Servitude to access the mitigation areas for the purposes of planning, construction, and postconstruction monitoring. Landowners would be advised for access to their property. All restored areas would remain jurisdictional wetlands and continue to be subject to the navigational servitude; therefore, conservation easements would not be required.

## Monitoring and Contingency Plans

Monitoring and contingency plans for the mitigation measures and DMMP BU features are presented in Appendix J of the FEIS. The monitoring and contingency plans for mitigation measures and BU features have been developed in accordance with recent implementing guidance for Sections 2036 (a) and 2039, respectively, of WRDA 07. The monitoring plans identify specific ecological success criteria to be used in determining if the mitigation and DMMP BU features have been successful. Appendix J presents a description of the key monitoring parameters, periodicity, costs, and responsible parties.

Periodic monitoring to determine the success of marsh mitigation measures and DMMP BU features would continue until the Division Commander determines that the ecological success criteria of the mitigation and DMMP BU features have been met. This determination would be based upon monitoring results and the ICT consultation reports provided by the District Engineer. The ICT would be consulted annually to determine progress in the planning, construction, and postconstruction evaluation of the ecological success of these features.

## VIII.F FULFILLMENT OF MITIGATION PLANNING OBJECTIVES

Adoption of the ecological mitigation plan will fulfill the second planning objective to maintain the ecological values of estuarine resources within the project area. The mitigation plan (+1,181 AAHUs) fully compensates for AAHU losses to state resources in Louisiana, and results in a net gain of 338 AAHUs for the project as a whole. Impacts to East Sabine Lake marshes are replaced in-kind by the marsh mitigation plans in Willow and Black bayous. Minor productivity impacts to cypress-tupelo swamp on the Sabine River near the GIWW are not matched in-kind. The ICT considered this to be acceptable since the loss in function is negligible. Projected FWP salinity levels are within the tolerance levels of these swamps, and the CIP causes no loss of swamp acreage.

Sediment placed in former open-water areas of the marsh would increase marsh elevations and create a higher, more-stable landform for marsh growth and long-term survival. Restored marshes would filter runoff from surrounding uplands, and improved shallow-water habitat would encourage the growth of additional submerged aquatic vegetation. The restored marshes would increase available habitat for bird and wildlife species, and the improved shallow-water habitat would provide additional nursery areas and nutrients for aquatic organisms. The Coordination Action Report (CAR) for the SNWW CIP has been prepared by the USFWS and is included in FEIS Appendix A3. The CAR affirms the USACE impact assessment and approves the proposed BU and mitigation.

## VIII.G CULTURAL RESOURCES MITIGATION

No specific cultural resource impacts requiring mitigation have been identified at this time. However, the Recommended Plan has the potential to affect significant cultural resources (e.g., historic properties) since numerous prehistoric and historic sites, structures, and shipwrecks are located adjacent to the project area. Investigations to identify historic properties that may be affected by the Recommended Plan were begun during the feasibility study, but will be completed during the PED phase in compliance with a Programmatic Agreement with the Texas and Louisiana State Historic Preservation Officers. Additional terrestrial archeological surveys and testing are anticipated for DMMP BU sites and marsh mitigation areas. Nautical archeological survey and dive assessments also must be completed for some project components. Funds for potential historic properties data recovery have also been included in the estimate and allocated in compliance with Section 7 of PL 93-291. Based upon historic properties identified to date, it is assumed that the highest potential for historic property data recovery is in the Sabine Pass Channel, the site of a significant Civil War naval battle.

# IX. RISK AND UNCERTAINTY ANALYSIS

## IX.A OVERVIEW

This chapter outlines the approach being taken for the SNWW CIP for evaluating risks, uncertainties, and consequences inherent in evaluation of alternatives and identification of the Recommended Plan. This approach involves a two-step process: (1) application of the USACE Risk and Uncertainty Analysis procedures assessing and incorporating uncertainty in the technical evaluation process; and (2) the evaluation and selection of a Recommended Plan that takes into account a wide array of economic, environmental, technical, and societal risk factors.

## IX.B GUIDANCE AND CONCEPTS

Risk and uncertainty is an important part of the USACE planning process and feasibility analyses. The "Economic and Environmental Principles for Water and Related Land Resources Implementation Studies," established pursuant to WRDA 65 (Pub. L. 89-80), as amended (42 USC 1962 a-2 and d-1), require that areas of risk and uncertainty be identified and clearly described so that public investment decisions can be informed by the degree of reliability of estimated costs, benefits, and effectiveness of alternative plans. This approach captures and quantifies the extent of risk and uncertainty in the various planning and design components of a project. The total effect of risk and uncertainty on the project's design and viability can be examined and conscious decisions made reflecting an explicit trade-off between risks and costs.

Risk-informed decision making and asset management has been emphasized as part of Goal 3 of the USACE Campaign Plan (USACE, 2009b). This policy, developed from analyses done by the Interagency Performance Evaluation Task Force in the aftermath of Hurricane Katrina (Interagency Performance Evaluation Task Force, 2007), pointed to the need for organizational changes to transform the USACE priorities, processes, and planning in an effort to improve public safety and the USACE water resources infrastructure. The USACE has committed to developing and employing risk- and reliability-based approaches that evaluate the consequences of design, construction, and management decisions, especially as they affect risks to human health and safety.

Risk and uncertainty arise from measurement errors and the underlying variability of complex natural, social, and economic situations. Plans may be subject to measurement errors if the data are imperfect or the analytical tools are crude. Some future demographic, economic, hydrologic, and meteorological events are essentially unpredictable because they are subject to random influences. However, in some cases, the randomness can be approximated by developing a probability distribution using a historical database that is applicable to the future. If there is no such historical database, the probability distribution of random future events can be described subjectively, based upon the best available insight and judgment (ER 1105-2-100.E-4.a(3)). The latter case could also be applied to situations in which there is uncertainty as to whether historical conditions can be reliably applied to the future. Such is likely the case with environmental parameters affected by global warming, such as sea level rise. None of the historical

databases in use today can reliably be used to predict future conditions in which the rates of change are clearly diverging from historical precedents (IPCC, 2007).

The degrees of risk and uncertainty also will differ among various aspects of a project, and will vary by time. Obviously, high levels of risk associated with project elements that could adversely affect human health and safety are not acceptable; while it might be acceptable to trade lower economic costs for higher levels of risk for project elements that do not affect human health or safety. In relation to time, components that may be relatively certain at the beginning of a project may be relatively uncertain at the end of the period of analysis.

A variety of specific technical terms and concepts that are employed in risk and uncertainty analysis are described below:

- "Risk" is the probability that a hazardous outcome will occur as a consequence of uncertainty. It is "conventionally defined as those (situations) in which the potential outcome can be described in reasonably well known probability distributions" (ER 1105-2-100.E-4.a. (1)). These distributions are generally based upon well-established, empirical data (historical or experimental). The best-known examples of this concept are applied in flood damage reduction projects, i.e., it is known that a river will flood to a specific elevation on the average of once in 20 years. When applied to ecological modeling and impact analysis, risk should be viewed as an inevitable consequence of the uncertainties inherent in the current state of knowledge of ecological systems.
- "Uncertainty" is a measure of imprecision of knowledge of parameters and functions used to describe the hydraulic, hydrologic, geotechnical, ecological, and economic aspects of a project. "In situations of uncertainty, potential outcomes cannot be described in objectively known probability distributions. . . . Because there are no known probability distributions to describe uncertain outcomes, uncertainty is substantially more difficult to analyze than risk" (ER 1105-2-100.E-4.a. (2)).
- "Risk-based analysis" is defined as "an approach to evaluation and decision-making that explicitly . . . incorporates consideration of risk and uncertainty to compare plans in terms of likelihood and variability of physical performance, economic success and residual risk" (ER 1105-2-100.2-4.g). Analytical evaluation is sometimes restricted by a lack of data and understanding of biological and physical processes, effectively limiting risk considerations to more-subjective comparisons.
- "Sensitivity analysis" is a technique that varies assumptions of economic, demographic, environmental, and other factors and examines the effects of varying these assumptions on outcomes of benefits and costs (ER 1105-2-100.E-4.b.(1)(b)(6)).
- "Residual risk" This concept is best understood in relation to flood damage reduction studies, i.e., residual risk is the flood risk that remains after a proposed project is implemented; or, in other words, the residual damages and potential loss of life due to exceedence of design capacity. For navigation studies, one type of residual risk might be risk that benefits are foregone in those situations where LPPs are selected over the NED Plan.

## IX.C UNCERTAINTY IN TECHNICAL EVALUATIONS

### Forecasting Tools and Analyses

Forecasting future scenarios is an important part of the USACE planning process. In order to evaluate the risks and benefits of alternatives over the period of analysis, a forecast is created based on historical and existing information as well as quantitative and qualitative assumptions about what may happen within the study area in the future. One method is to identify the 'most likely' future, or the best guess about what may happen based on observed variables and assumptions of both natural and human behaviors. Another method is to conduct scenario planning, where multiple future scenarios are created in order to evaluate what would happen if observed variables or assumptions do not happen as projected. Scenario planning attempts to answer the "what if" questions that arise when making forecasting assumptions and predictions. For the SNWW CIP, the "most likely future" method was chosen due to the size, scope, and complexity of the overall analysis.

After the identification of the most likely FWOP scenario for the SNWW CIP, the next step was the evaluation of alternative depths (i.e., the 45-, 48-, and 50-foot channel depths and various widening scenarios advanced for detailed screening) using hydrodynamic, economic, and ecological models. Other variations of these alternatives (associated with placement features and mitigation measures) were also evaluated with selected models.

A suite of engineering models was employed to evaluate future without- and with-project conditions regarding the effect of proposed channel modifications on deep-draft ship maneuverability and safety (ship simulation model); estuarine hydrology, circulation, and salinity (HS model); shoaling rates (sediment model); channel bank erosion (vessel effects model); and coastal shoreline erosion (shoreline impacts model). All of the engineering models were developed by the USACE-ERDC and applied with the support of a team of the USACE and Federal and State resource agency representatives.

Planning models that were applied in this study include economic and ecological models. Economic models consist of desktop spreadsheet models and the HarborSym model. Ecological modeling was performed using the WVA model. Developed by an interagency working grouping of resource agencies in Louisiana, the WVA model was applied with the support of the ICT, comprised of representatives from the USACE, other Federal, and Texas and Louisiana state agency representatives.

While this section paints a broad picture of the application of techniques used to address risk and uncertainty, the FFR, Economic Appendix, and the FEIS and Appendix C go into greater detail on how each discipline addressed these issues.

## Engineering Data and Models

### Data

*Hydrologic Data*

Hydrologic data needed to calibrate and verify the HS model was collected by the ERDC-CHL in a 9-month field study (Fagerburg, 2003). Long-term and short-term data-collection sites were established to provide good coverage for determination of tidal velocity magnitudes and directions, ranges of water level elevations, and changes in salinity values. In coordination with USCG, existing Aids-to-Navigation structures were used whenever possible as more-permanent platforms for the deployment of the instruments. The pressure-sensing water level recorder was fully programmable with accuracy of the sensor of ±0.01 foot. The fully programmable salinity recorders were calibrated properly at the start of monitoring. In order to assure quality data collection, the recorders were serviced regularly in 3-week intervals to download data and clean and recalibrate the instruments. Acoustic Doppler Velocity (ADV) meters had pressure sensors with an accuracy of ±0.003 foot. Two of the water level recorders were destroyed and were not replaced due to the project economic constraints and lack of vital necessity of those data. Also, any of the field data that were obviously corrupted by bio-fouling of the salinity sensors were omitted in the hydrodynamic and other analyses.

It is believed that the selected gage sites provided an adequate coverage of the study area, and the programmable data recorders had a high degree of accuracy and minimal degree of human error involved. Further, more-conservative analyses were employed in the HS model and other models to provide more-reliable results. Thus, the degree of uncertainty in the collection and use of data is diminished appreciably. As such, considering project economics, it was deemed impractical to gather additional data for a logical, risk-based analysis since it would not essentially enhance the accuracy of the results.

*New Work and Maintenance Material Data*

New work material quantities were calculated using a digital terrain model generated by the InRoads software program. Each channel or canal had its own existing template and proposed template. A model was developed and volumes were calculated. The existing template included the current allowable overdepth and advance maintenance values. The proposed new template also included a standard advance maintenance depth of 2 feet and constant 2 feet of allowable overdepth per reach. Any potential uncertainties in these calculations are addressed by incorporation of the maximum amount of allowable overdepth and advance maintenance, and by the contingencies identified in the cost risk analysis discussed later in this section.

Maintenance material estimates for the proposed project were predicted by a desktop sediment model that incorporates information from historical dredging rates, the HS model (Brown and Stokes, 2009), and a subjective evaluation of contributive shoaling factors (Parchure et al., 2005; Brown and Stokes, 2009). An extensive amount of field data for the bed and suspended sediment, salinity, and velocities was collected and analyzed by the ERDC laboratory. An increase in shoaling quantities resulting from channel

deepening and widening is attributed to many different factors including increased bottom width, decreased flow velocity due to enlarged section, modified salinity regime from greater salt penetration, and other general factors such as increased erosion from higher vessel traffic, channel bank failure, and sediment brought down by rivers. The effect of RSLR was investigated by the ERDC, and it was found to have no significant effect on projected maintenance dredging quantities.

Because of the uncertainty involved in the assumptions and calculations of water levels, velocity data, and salinity data by the HS model, the calculated shoaling quantities for the project condition is subject to a certain degree of uncertainty. It is believed that the dredging data record is good reliable data and would not be essentially improved by more data. Moreover, the prediction of shoaling rates is influenced by assumed values of shoaling factors, which are subjectively selected as stated above. Hence, the future shoaling rates as calculated are not amenable to risk-based analysis. Further, a more-accurate shoaling analysis would require detailed numerical sediment modeling, which would entail a significant amount of additional data and analysis. Because of inherent assumptions involved in an analytical full-fledged sediment modeling procedure, albeit a significant amount of extra data, increased accuracy of results would still be questionable. Thus, no further additional work is recommended.

**Models**

For lack of extensive measurable data and reliable analytical methodologies, the 'Plans' and 'Conclusions' as developed by various modeling studies by the ERDC are subject to uncertainties. Moreover, some future economic, hydrologic, and meteorological factors are essentially unpredictable. Thus, no logical probability-based analysis can be developed. However, sensitivity or a subjective analysis can be performed describing the limiting values of various factors considered.

In general, the study analyzed the 50-foot depth alternative in addition to the recommended depth of 48 feet for the enlarged future channel, and there were minimal adverse effects for the with-project condition in terms of salinity, tidal current velocities, shoreline wave heights, sediment transport, potential bank-recession/erosion, and navigational safety. Thus, the uncertainty in assumed values or the reliability of analytical procedures is essentially covered by the conservative assumptions in the study.

*Ship Simulation Model*

Ship simulation modeling reproduced real-time vessel responses to various interacting forces including water currents, wind force, bank forces, tug and bow thruster forces, and ship-to-ship interaction (Webb, 2003). The visual database provided a feeling of realism for the site and its development included the ship being simulated and other vessels, shoreline, and other landmarks. The environmental database involved channel and bathymetric surveys, currents for the existing and proposed conditions, waves, and wind velocities. For the simulation validation, experienced pilots were used in real-time runs, and then various plans for existing and proposed conditions were tested. Final results for the optimized channel were based on comparison of simulation runs for existing and proposed conditions and analyses of vessel tracks, navigation parameter plots, and pilot evaluations.

Although there is a degree of uncertainty involved in the accuracy of visual and environmental data, the real-time simulation by ship pilots essentially validated the optimal channel widths required for safe navigation. So, the real-time runs are guided by the personal experience and knowledge of the pilots, and their testing is quite subjective. As such, the risk-based analysis is somewhat inappropriate for ship simulation.

*HS Model*

A 3-D numerical modeling study of circulation and salinity impacts resulting from proposed channel deepening was conducted (Brown and Stokes, 2009). The model was also validated for hydrodynamics and salinity using field data, evaluation of proposed plan conditions, and comparison and analysis of results.

The potential for the channel deepening to increase the effects of hurricane storm surges on water elevations and flooding was simulated using the HS model. The tidal signal was generated using tide gage records from Sabine Pass during Tropical Storm Frances (September 11, 1998). This storm was selected for the simulation because it produced very high tides for an extended period of time, and caused very significant damage to the upper Texas coast in the form of beach erosion and inland flooding. The tides rose above 4 feet above mean low lower water and reached maximum levels between about 5.5 and 7 feet for 36 to 48 consecutive hours. Maximum storm surge differences occurred at or near the peak storm surge, and varied between 0 and +0.4 foot. The modeling indicated that the largest effects would occur in the upper reaches of the Neches River near Beaumont. This result must be interpreted as exceedingly conservative. The predicted increase is calculated as if no flows were allowed to leave the channel and is therefore much higher than would occur under natural conditions when storm surge flows spread over the wide, flat coastal plain.

This model was previously run for the 50-foot channel depth, which marked the worst-case scenario for possible adverse impacts. Comparing the results of 48-foot (recommended) plan and the 50-foot plan, the difference in salinity impacts at various places remained within the range of standard deviation. Thus, the analysis essentially provided conservative results for the recommended 48-foot depth plan.

*Storm Surge Model*

A sensitivity analysis using the ADCIRC model was also performed to determine what effect the proposed SNWW CIP might have on surge levels in the study area (Wamsley et al., 2010). The ADCIRC model was run to estimate water levels for two worst-case hypothetical storms, both with and without proposed SNWW CIP project features in place. Project features evaluated by the modeling are the deeper navigation channel, proposed PAs with maximum levee heights, and 2 expanded PAs. The two simulated storms exhibited minimum central pressures of 900 millibars, offshore pressure radii between 14.9 and 18.4 nautical miles, and forward speeds of 11 knots. Each produced water levels near or higher than the estimated 500-year level, and both would be considered extreme events. One storm tracked in the northwesterly direction, producing maximum surges of 18 feet near the coast at Sabine Pass and surges of 13–14 feet in Sabine Lake near Port Arthur, Texas. The second storm tracked in a north-northeasterly

direction, producing maximum surges of over 20 feet near Sabine Pass and surges of 15 to 17 feet in Sabine Lake near Port Arthur.

The sensitivity analysis concluded that the greatest changes would occur north of Port Arthur along the Neches River. These changes are primarily due to the proposed increase in depth of the navigation channel. All changes are local, and there are no project-induced increases in surges away from the immediate vicinity of the navigation channel. Water levels in the marshes and open-water areas immediately north of the river would increase on the order of 4 to 8 inches or less. The modeling indicates some interior flooding would occur within the City of Port Arthur with both storms, both with and without the project. Changes in peak surge within the city for these two events, with the project in place, are caused by a slight increase in surge elevation and/or duration causing additional overtopping of the surrounding levee or internal topographic features. Peak surges for 100-year events are estimated to be approximately 9 feet in the Port Arthur area. Although simulations of less-intense events were not made as part of this study, in light of the 14- to 24-foot levees surrounding Port Arthur, significant interior flooding is not expected for the Base condition. Any changes in peak surge on the order of inches should not cause any significant change in interior flooding for the with-project condition.

The Recommended Plan for the SNWW CIP also includes ODMDSs and marsh restoration measures. All of the existing and proposed ODMDSs are located several miles from the Gulf shoreline in water too deep to affect wave setup on the shoreline. The influences of marsh restoration on hurricane surge have been documented by Wamsley et al. (2009a, 2009b). Surges tend to slightly increase over and just seaward of the marsh as the surge propagation is slowed, which may result in reductions in peak water levels landward of marsh features. The impact of the proposed SNWW CIP marsh restoration features are relatively small and expected to modify peak surge levels locally by a minimal amount (Wamsley et al., 2010). No significant reductions or increases in surge level would be expected from either the marsh restoration or the ODMDSs.

*Sediment Model*

The needed data for computed water levels, tidal velocities, and salinity values at various nodes was provided by the HS model for the Base and Plan conditions (Parchure et al., 2005). This report deals with two problems—the first is the effect of channel modifications on the future shoaling quantities, and the second is the impact of the channel modifications on the Pleasure Island shoreline erosion. As a first step, sediment modeling requires results from a satisfactorily validated hydrodynamic model. Since fine sediment dynamics is significantly influenced by salinity, a 3-D model including salinity simulation was used to provide results for this model. For some studies, a full-fledged numerical sediment model can be used to provide increased accuracy for sediment analysis. However, huge amount of additional data needed for a project extending over several miles would become very expensive and time consuming. Hence, a desktop modeling study was used as a good alternative to detailed sediment modeling. Because estimation of future shoaling involves an unavoidable subjective element and further, the detailed sediment modeling procedure has some inherent assumptions and limitations, the desktop study was considered adequate. Moreover, the computed changes in flow velocities, salinities, and erosion rates

between base and plan conditions are quite low in relation to their effects on shoaling and erosion. As such, no additional effort is needed, and no logical risk-based analysis is warranted.

*Vessel Effects Study Model*

This study was used to estimate erosion potential resulting from increased ship waves for the plan condition for the enlarged channel (Maynord, 2005). The analysis employed a numerical model (HIVEL2D) to simulate the ship-induced velocity at the bank, using information on vessels in the existing and future fleets and on vessel speeds under both the FWOP and FWP conditions. Overall, the effect of the Recommended Plan would be to reduce the rate of erosion on inland channels relative to the FWOP condition because of the larger channel and the fewer vessel trips that are predicted with the Recommended Plan. There is some uncertainty involved in the forecasting estimate of the future vessel fleet and the accuracy of predicted erosion rates. However, the modeling used the largest vessel that can efficiently use the waterway, and assumed that all erosion effects were due to vessel wakes. Therefore, the model provides a conservatively high estimate of ship effects on erosion, and further risk analysis would not add practical value.

*Shoreline Impacts Model*

Potential wave-induced impacts of the proposed deepening of the SNWW on the open coastal shorelines adjacent to the project area were modeled by the ERDC using the STWAVE and GENESIS models (Gravens and King, 2003). These models evaluate potential impacts due to changes in wave refraction patterns, and are well-known, widely used models that represent state of the practice in forecast modeling.

The STWAVE and GENESIS are deterministic models. As presently applied, results were not placed in a risk-based context and to do so would require a significant effort. However, such additional work is not warranted, would not add practical value, and would not be expected to change the specific STWAVE/GENESIS study conclusions. The models calculated insignificant changes in the waves and longshore sediment transport rates within the study area. It is important to note that the STWAVE/ GENESIS analysis was extremely conservative in nature, and as performed the analysis overestimates any wave-induced impacts to the shoreline as a result of the channel deepening. The results are conservative since the wave dissipation due to the presence of mud and the sheltering effect of the jetties was purposely not included. Thus, the analysis as performed, without inclusion of jetties, maximized wave refraction and shoaling influence of the proposed channel deepening. Applying a risk-based type of analysis would only yield order of magnitude variability within these extremely conservative minor results, which would add no additional practical value and could not be expected to change the specific STWAVE/GENESIS study conclusions.

### Other Analyses

*Relative Sea Level Rise*

In fulfillment of requirements of Circular No. 1165-2-211, Water Resources Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs (USACE, 2009a), the sensitivity of project alternatives to the full range of potential FWOP changes in sea level has been evaluated. There are a wide range of potential effects related to the full range of RSLR, but the sensitivity of project alternatives would be more limited. In particular, alternatives were evaluated to determine if the purpose and function of navigation features could be undermined, if environmental impacts might be exacerbated, and how economic benefits and costs might be affected by sea level change. Nonstructural alternatives were evaluated but eliminated in the second screening; they are therefore not addressed in this analysis.

RSLR rates that may be appropriate for the project area are discussed in detail in Section 3.3 of FEIS, Appendix C to the FEIS. The range of RSLR was determined using both tide gage and basal peat data for the local subsidence component of RSLR. Tide gage data reflect the effects of recent historical subsidence. The average rate of RSLR measured at the Sabine Pass tide gage was 0.2 inch/year for the 48-year period between 1958 and 2006 (U.S. Department of Commerce and National Oceanic and Atmospheric Administration, 2006, 2009). However, there is significant scientific debate concerning the validity of tidal records with respect to the projection of future subsidence rates in the northwest Gulf coastal plain. The relative influence of historic anthropogenic activities in this area (e.g., oil and gas withdrawal) is difficult to quantify. If these activities contributed significantly to recent observations of subsidence, then significant reductions in these activities may result in rapid deceleration of subsidence rates, returning them to long-term average rates best represented by the basal peat data. Deriving RSLR estimates using both basal peat and tide gage data, possible RSLR rates were estimated for the period from 2019 to 2069 to range from 0.3 to 2.8 feet. Possible low, intermediate, and high rates are as follows:

- 0.3 foot, Low (1.83 mm/year), based on basal peat subsidence rates
- 0.7 foot, Intermediate (4.27 mm/year), based on basal peat subsidence rates
- 1.1 feet, Intermediate (6.71 mm/year), based on tide gage subsidence rates. (This value was used in the HS modeling of the estuary for this project.)
- 1.5 feet, Intermediate (9.14 mm/year), based on tide gage subsidence rates
- 2.2 feet, High (13.44 mm/year), based on basal peat subsidence rates
- 2.8 feet, High (17.07 mm/year), based on tide gage subsidence rates

An intermediate rate of RSLR (1.1 feet by year 2069) was used as the “most likely” estimate of RSLR in the alternative analysis for this project, in accordance with the USACE planning guidance. The following discussion describes possible ways that high and low RSLR might affect the project alternatives and the recommended action. There are relatively little data and analyses currently available that would permit a detailed, quantitative, analysis of the impacts of each of the possible RSLR scenarios on the project

alternatives. Ways in which different RSLR rates might affect project design and impacts are presented in Table IX-1.

In general, the functioning of the navigation features associated with all alternatives (channel depths of 45 through 50 feet, TB/AB, PAs/ODMDSs, and the BU features) would not be significantly affected by the full range of potential sea level change. Construction dredging would occur within 10 years and would not be affected by future rates of RSLR. While shoaling rates toward the end of the period of analysis could increase due to an enlarged cross section and greater saltwater penetration, this small effect would probably be offset by increased overall water depths. PAs and BU features have been designed to accommodate sea level changes through the high RSLR range. PAs are located at sufficiently high elevations to withstand the potential rise, and appropriate erosion control measures are included. BU features are located well inland on the Neches River, and they have been designed with erosion control features that would survive the full range of RSLR. The addition of mineral soils and higher marsh elevations would provide stable landforms. Biomass accumulation and sediment from adjacent terrace margins should enable restored marsh vegetation to maintain itself even with the high RSLR rate.

The protection of human health and improvements in safety are not project objectives and therefore potential effects on calculated risk are not applicable. RSLR does not affect the functioning of the various depth alternatives or vessel safety. At the intermediate and high rates of RSLR, a significant increase in tidal surge penetration would be expected, but this would not affect project alternatives because tidal surge protection is not a project objective. Furthermore, HS modeling has determined that little or no increase in water surface elevation would be expected due to the deeper navigation channel.

The primary impact of RSLR on this project may be its potential impact on mitigation measures proposed for the Louisiana marshes along the east side of Sabine Lake. These mitigation measures are planned for marshes that could experience submergence and erosion at the high RSLR rate. In recent decades, marshes in the study area have been able to keep up with rates of 5.6 to 6.5 mm/year, suggesting that these marshes may be able to sustain themselves through rises in the intermediate range of RSLR (4.3 to 9.1 mm/year). The high rate of RSLR (17.1 mm/year) could threaten long-term survivability. Sustainability thresholds are determined by local physical, chemical, climatologic, and hydrologic conditions and cannot be extrapolated to other regions. However, as an example, studies in the mid-Atlantic region indicate that the tipping point for coastal ecosystems could range from a RSLR of as low as 2.0 mm/year to as high as 10 mm/year (U.S. Climate Change Science Program, 2009). There are relatively little data and analyses currently available that would permit a detailed, quantitative analysis of the impacts of the full range of potential RSLR on the SNWW ecosystem and project alternatives.

A monitoring and contingency/adaptive management plan has been developed to identify corrective actions (FEIS Appendix J). Corrective actions proposed in the contingency plan assume that the low to intermediate rates of RSLR will occur; the high rate is assumed to be unlikely. If monitoring determines that the extent of vegetation coverage does not meet ecological success criteria specified in the monitoring plan, manual planting would be employed to restore the requisite acres of emergent marsh. The ICT would determine if marsh planting is needed and if so, to what extent and in which areas.

Table IX-1
RSLR Sensitivity of Project Alternatives

| Sensitivity of Design | | | | Sensitivity of Impacts | | |
|---|---|---|---|---|---|---|
| Navigation Channel Alternatives A–G | DMMP (PAs/ODMDSs) | DMMP (BU Features) | Mitigation Measures | Human Health/Safety | Environmental Impacts | Economic Costs/Benefits |
| **Low Rate (0.3 foot over 50 years)** | | | | | | |
| No significant effect for any depth alternative. Low range of future RSLR is lower than recent historical rate. | No change to existing shoaling rate and maintenance dredging expected. All PAs designed for intermediate RSLR rate. | All BU features were designed to accommodate intermediate RSLR; low rate would have no effect. | All mitigation measures were designed to accommodate intermediate RSLR; low rate would have no effect. | RSLR does not affect the functioning of the various depth alternatives or vessel safety. Small increase in tidal surge penetration due to low RSLR rate would be expected; tidal surge protection is not a project objective. No increase in tidal surge impacts due to project. | Primary project impact is result of greater salinity intrusion. Salinity difference for low RSLR is within one standard deviation of the salinity difference between FWOP and FWP. | Benefits and costs of the deepened navigation channel would be the same as FWP forecast. |
| **Intermediate Rate (0.7 to 1.5 feet over 50 years)** | | | | | | |
| No significant effect for any depth alternative. Rising water depth offset by increased shoaling. Potential impacts to Sabine Pass jetties addressed by separate O&M major rehabilitation project. | No significant increase in maintenance dredging for depths greater than 48 feet. Possible rise of water surface elevation is within range used for engineering design of all PAs. No effect to ODMDSs. | Possible RSLR rise is within range used for engineering design of all BU features. | Possible RSLR rise is within range used for engineering design of all mitigation measures. | RSLR does not affect the functioning of the various depth alternatives or vessel safety. Intermediate increase in tidal surge penetration due to RSLR rate; tidal surge protection is not a project objective. No increase in tidal surge impacts due to project. | Salinity impacts were based upon RSLR of 1.1 feet. Salinity difference for range of intermediate RSLR rates is within one standard deviation of the salinity difference between FWOP and FWP. | Benefits and costs of the deepened navigation channel for the full intermediate range would be the same as FWP forecast. |

Table IX-1 (Cont'd)

| Sensitivity of Design | | | | Sensitivity of Impacts | | |
|---|---|---|---|---|---|---|
| Navigation Channel Alternatives A–G | DMMP (PAs/ODMDSs) | DMMP (BU Features) | Mitigation Measures | Human Health/Safety | Environmental Impacts | Economic Costs/Benefits |
| **High Rate (2.8 feet over 50 years)** | | | | | | |
| No significant effect for any depth alternative. Possible small increase in maintenance dredging for all depth alternatives resulting from enlarged cross section and greater saltwater penetration. Potential impacts to Sabine Pass jetties addressed by separate O&M major rehabilitation project. | Small increase in levee heights and/or armoring may be needed for some PAs. No significant effect to ODMDSs. | Addition of mineral soils and higher marsh elevations provides more-stable landforms. Biomass accumulation may enable restored marsh vegetation to remain stable relative to high RSLR rate. Erosion control features would survive the full range of RSLR. | Addition of mineral soils and higher marsh elevations provides more-stable landforms. High rate of RSLR could result in submergence and erosion of restored marsh. Monitoring and adaptive management plan recommended to guide decisions on changes that might be needed toward the end of the period of analysis. | RSLR does not affect the functioning of the various depth alternatives or vessel safety. High rate of RSLR would increase tidal surge penetration; tidal surge protection is not a project objective. No increase in tidal surge impacts due to project. | Potential salinity increase with high range of RSLR is still within one standard deviation of the salinity difference between FWOP and FWP. No significant increase in salinity impacts would be expected. | Benefits of the deepened navigation channel would be the same as FWP forecast. No facilities used by shipping industry would be rendered ineffective by the high range of RSLR. O&M costs could increase slightly toward the end of the period of analysis, but not enough to reduce BCR below parity. |

Relocation of the mitigation areas to areas that would be protected from the potential effects of the full range of RSLR is not feasible. All intertidal marshes in the study area would be similarly affected by the sea level change because of the extremely low slope of the coastal plain. The option of purchasing credits in a mitigation bank was investigated; however, no mitigation banks exist for this area and resource type.

For the Coastal Shoreline Impacts Study (Gravens and King, 2003), the primary conclusion was that the proposed deepening project would have minimal impacts on adjacent shorelines. Actually, the project would result in a small beneficial reduction in erosion near the jetties. The changes resulting from the 2-foot increase in depth for the wave heights and wave angles would be minimal.

For the Sediment Study (Parchure et al., 2005), comparing the results of 2 feet increased depth, the overall changes in bottom velocities and bottom salinities would be insignificant. The estimated annual shoaling quantities would increase about 6 percent, but that is considered to be within uncertainty of assumptions of this estimate.

For the Vessel Effects study for Bank Recession (Maynord, 2005), based on the historical vessel traffic, vessel fleet (ship sizes and frequency of passage) was developed for the future years 2030 and 2060 for the existing and proposed waterway. The conclusion of this study was that for both sites in the Sabine-Neches Canal and Port Arthur Canal, bank recession for the FWP condition would be less than the FWOP condition because of fewer vessel trips. Impact on bank recession resulting from increased depth as a result of sea level rise is estimated to be minimal.

For the Ship Simulation Study (Webb, 2003), simulation by ship pilots essentially validates the optimal channel widths required for various reaches for safe navigation of vessels for the existing and proposed channels. So, navigable vessels are predicted to experience insignificant impacts of higher water elevation resulting from about 1.56-foot rise in sea level.

*Stability Analyses (Bridges and Port Arthur Hurricane Protection Levee)*

Limited stability evaluations were undertaken to identify potential impacts of the new channel to the HFP system, MLK Bridge, Rainbow Bridge, and Veterans Memorial Bridge and recommendations were made to accommodate a deeper channel while preserving the integrity of the above structures.

The evaluation of the HFP system, involved (1) reviewing original design documents and inspection reports of the adjacent levee system; (2) performing site reconnaissance; (3) reviewing subsurface data and soil strength parameters; (4) reviewing prior slope stability analyses methods and results; (5) evaluating cross section surveys at suspect areas; (6) performing additional slope stability analyses (using the Simplified Bishop and Simplified Janbu methods with the STABL6H computer program) of the slope configuration for new project; and (7) providing recommendations. This review indicated that the HFP levee between SNWW stations 165+00 and 240+00 would likely be impacted by the preliminary design layout of the deepened channel. Therefore, the channel was realigned and shifted away from the HFP levee. The design 2:1 slope angles for the deepened channel can be maintained if the channel is shifted far enough away from the HFP system to minimize adverse stability impacts. Acceptable factors of safety

were established for the recommendations from the slope stability analysis, and a suitable offset distance was determined and incorporated into the proposed alignment.

The evaluation of the MLK Bridge, consisted of (1) reviewing available soils data from Design Memorandum No. 2 (Sabine-Neches Waterway, Texas, 40-foot Project and Channel to Echo, Bridge Replacement at Port Arthur, dated May 1964), prepared by Modjeski and Masters, Inc.; (2) reviewing survey cross-section information taken in May 2005; (3) performing slope stability analysis using soil strength data from nearby HFP levee and empirical correlations (due to limited data provided in the DM No. 2.); and (4) providing recommendations. The analysis determined that the 48-foot channel slope would likely impact the embedment of the pile cap and the upper portions of the piles of the bridge's tower pier foundations. The degree to which this impact affects the bearing capacity of the piles or the integrity of the pile cap was beyond the scope of this study. Regardless, for this study, this anticipated impact is considered significant because the failure arc passes through the bridge foundation. Since it is necessary to maintain the 400-foot channel width beneath the bridge, the bridge piers must be protected with a hardened structure to minimize impact to the foundations. Designs and costs for construction of a bulkhead to protect the bridge foundations were developed by the Texas Department of Transportation, and the cost of this protection has been included in the project cost estimate.

The evaluation of the Rainbow Bridge involved reviewing a "Channel Stability Cut Analyses" report prepared by URS Group Inc. in the form of a memorandum with design drawings by the Texas Department of Transportation. Based on conclusions of the memorandum, no impact to the bridge foundations as a result of potential slope instability due to channel deepening is anticipated. However, URS recommended that the dolphins may need to be relocated. These design issues will be further addressed during the preconstruction engineering and design (PED) phase.

*Cost Risk Analysis*

In accordance with a July 2007 USACE memorandum (Application of Cost Risk Analysis Methods to Develop Contingencies for Civil Works Total Project Costs), a formal cost-risk analysis was performed for the SNWW CIP (FFR, Appendix 3). The cost risk analysis utilizes the MII cost estimate, along with specific project information, to develop contingencies to be used in the formulating the Total Project Cost for the project plan being recommended to Congress. The objective of using the cost risk analysis is to identify areas of high cost uncertainty and the probability that the estimated project cost will or will not be exceeded (USACE, 2007b).

Crystal Ball™, an accepted commercially available computer-based forecasting and analysis program, was used to run Monte Carlo simulations for developing the baseline contingency. The contingency simulation included estimates for all individual activities and risk variables. Since the 48-foot deepening alternative (including selective widening and TB and AB) has been identified as the Recommended Plan (and also the LPP), the Crystal Ball analysis was performed on the cost estimate for this alternative. The results of the cost risk analysis identified the contingency percentages (levels of uncertainty) in the cost estimates for specific project components (e.g., relocations, navigation ports and harbors, cultural

resources, etc.). The average contingencies determined from the cost risk analysis were 30–31 percent, which is higher than the original contingencies identified in the original project cost estimate.

The contingencies were used along with the updated estimate to revise the Total Project Cost Summary (TPCS). ATR of the TPCS for the Recommended Plan has been conducted by the USACE Center of Expertise for Cost Engineering for Civil Works. The ATR has verified that the Total Project Cost baseline, the project scope, report, cost estimate, schedule, escalation, and contingencies were developed in accordance with current cost engineering guidance.

## Economic Data and Models

### Data

The base data used to establish existing conditions and in preparation of the traffic forecasts were compiled from the sources listed in Table IX-2.

Table IX-2
Primary Data Used for SNWW Economic Analysis

| Component | Data Origin |
|---|---|
| **Historical Vessel Traffic** | USACE, Waterborne Commerce of the U.S., Part 2, 1965–2007 |
| | USACE, Waterborne Commerce of the U.S., Part 5, 1985–2007 |
| | USDA |
| | USACE, Navigation Data Center, unpublished databases |
| | U.S. Department of Energy, website access |
| | Lloyd's Register-Fairplay, 2005–2009 |
| | U.S. Department of Energy, Energy Information Administration, website access data |
| | U.S. Department of Commerce, Bureau of Economic Analysis, website access data |
| | U.S. Coast Guard's Port Arthur Marine Safety Office |
| **Forecast Data by Commodity** | |
| Petroleum and LNG | U.S. Department of Energy, 2009 Annual Energy Review, March 2009 |
| Petroleum and Other Commodities | Global Insight, The U.S. Economy, The 30-Year Focus, First Quarter 2009 |
| Grain Exports | USDA, February 2009 |
| Breakbulk and Other Cargo | Historical Trendlines; Global Insight, and Institutional Knowledge |
| Other general references | *Journal of Commerce* and other trade magazines |
| | Government Accountability Office (GAO), Report Number GAO-18–14, January 2008 |

### Risk and Uncertainty

The IWR is currently developing risk-based analysis procedures for the economic evaluation of deep-draft navigation studies. Unlike the current risk-based flood damage model, the navigation model will

integrate both benefit (related to fleet and commodity forecasts) and cost uncertainties (related to dredging and disposal costs). Districts are expected to use sensitivity analyses to evaluate risk and uncertainty until risk-based models for navigation studies are released to the field (ER 1105-2-100.E-10.a). The effects of uncertainty are addressed in terms of sensitivity analyses. An expanded sensitivity section is included in Section 8 of the Economic Appendix.

### Models

**Deepening Analysis**. The USACE-SWG spreadsheet models were used for calculation of transportation costs and evaluation of deepening benefits associated with the without- and with-project futures.

**Widening Analysis**. The HarborSym model was used in evaluation of the entrance channel widening and the Neches River TB and anchorage features. The outputs from HarborSym were aggregated into Excel spreadsheets and are summarized in this section of the report. HarborSym is a planning-level model developed by the IWR to assist in economic analyses of channel widening improvements. HarborSym is an event-driven simulation model and includes data from user-specified transit rules that the model processes with each vessel call in order to calculate delays within the system. The model is presently in the model certification process. While not yet certified, the model is scheduled for review under the USACE's certification system. The model is presently being used by several USACE district offices for channel widening studies, and the outputs of these have undergone ATR and USACE headquarters review.

## Environmental Data and Models

Uncertainty in environmental analyses is associated with the quality of data used to evaluate impacts. The quality of data used for assessments of environmental impacts in this study was assessed based on its origin as presented in Table IX-3.

### WVA Model

An analysis of risk and uncertainty associated with the WVA model application to the SNWW CIP was performed. A summary of the sensitivity analysis is presented in FEIS Section 4.2, and the complete analysis is presented in FEIS Appendix C. Uncertainty is inherent in ecosystems, and therefore unavoidable when evaluating ecological processes and impacts. There is often a lack of extensive data sets for all parameters under study, and many of the physical and biological processes are not completely understood. Ecological analyses for the study utilized input from several engineering models referenced in the table above.

Risks to human health and safety associated with ecological impacts evaluated by the model are small. The predicted loss of marsh acreage is 691 acres (less than one-half of 1 percent of the affected marsh acreage) in the interior of the large estuarine marshes east of Sabine Lake. The loss of marsh elevation would make affected areas of these wetlands more vulnerable to the salinity pulses from large tropical storms and hurricanes, but it would not affect the overall effectiveness of these coastal wetlands in

buffering inland areas from storm surge effects. The proposed compensatory mitigation plan would contribute to the long-term sustainability of these areas by adding stabilizing mineral sediments in an amount well above the predicted loss, increasing marsh elevations, and decreasing the size of open-water areas within the interior marshes.

Table IX-3
Quality of Data Used in Ecological Analyses

| Environmental Parameter | Data Origin | Data Quality |
|---|---|---|
| Hydrodynamic data on circulation, velocity, flows | Field sampling (ERDC-CHL; Brown and Stokes, 2009) | High |
| Water quality | Historical data and field sampling (ERDC-CHL; Fagerburg, 2003; PBS&J, 2004a, 2004b) | High |
| Salinity (for HS model verification) | Field sampling studies (ERDC-CHL; Fagerburg, 2003) | High |
| Salinity – FWP projections | HS Model (ERDC-CHL; Brown and Stokes, 2009) | Moderate |
| Sediment quality | Historical data, field sampling studies, and biological testing (PBS&J, 1999, 2004a, 2004b) | High |
| Gulf shoreline erosion | ERDC-CHL modeling (Gravens and King, 2003) | High |
| Inland channel erosion | ERDC-CHL modeling (Maynord, 2005; Parchure et al., 2005) | High |
| Vegetation/habitat type mapping | (TPWD, 1992, 2002, 2004; USFWS 2001a, 2001b, 2004, 2008; USFWS and GLO, 1992) and limited survey and field verification for this study | Moderate |
| Submerged aquatic vegetation | Limited field survey; best professional judgment | Low |
| Historic land loss rates | U.S. Geological Survey (USGS), TPWD and Bureau of Economic Geology GIS analyses (Britsch and Dunbar, 1992; Dunbar et al., 1992; Greco and Clark, 2005; TPWD, 2003; USGS-LDNR, 1993; White et al., 1996) | Moderate |
| Bottomland hardwoods growth rates | Professional literature (Brown and Montz, 1986; USDA, 1983, 1990) | Moderate |
| Endangered species habitat mapping | Field survey (PBS&J, 2006) | High |
| Fish and wildlife species | Professional literature (too lengthy to list; see FEIS) | Moderate |
| Oyster reef | Survey and field verification for possible channel widening (PBS&J, 2005) | High |
| Hazardous and toxic waste | Field sampling and biological testing (PBS&J) of specific areas near Superfund sites; literature and database review for entire area (PBS&J, 2002) | Moderate |
| Cultural resources-nautical | Marine remote sensing surveys (Hoyt et al., 1994; Hoyt and Schmidt, 1997; PBS&J, 2005) | Moderate |
| Cultural resources-terrestrial | Professional literature and state records searches (too lengthy to list; see FEIS) | Moderate |
| Marsh elevations in BU and mitigation areas | Field investigations in BU areas (TCB); best professional judgment in mitigation areas | Low |

There are two types of uncertainty that have been identified for the predictive ecological modeling conducted in this study—uncertainty associated with model quality and performance, and uncertainty associated with model predictions. The first type of uncertainty was evaluated by an extensive technical review of the WVA model. Application of the WVA model for the SNWW study was evaluated by an independent technical review at the Deep Draft Center of Expertise, an External Peer Review (Battelle, 2010), and a formal model assessment in conformance with EC 1105-2-407. The WVA Model Assessment (LBG/TEA, 2008) determined that the theoretical approaches behind the WVA model's application to the SNWW project are valid, and approved its use for this study. The Planning Center of Expertise for Deep-Draft Navigation approved the model for use in conjunction with this project by memo dated June 30, 2009 (see FEIS Appendix C, Attachment 1).

For evaluating the second type of uncertainty, the WVA models do not include a direct way to calculate a probability distribution that provides a statistically significant confidence level for the model projections (LBG/TEA, 2008). However, a sensitivity analysis of the model results was conducted by substituting different values in the most important variables. This sensitivity analysis measures the degree of certainty associated with model predictions, and how different predictable outcomes could affect environmental impacts, benefits, and costs. In this case, a range of possible outcomes associated with variable $V_1$ (percent of emergent marsh) in the EMCM, and variables $V_4$ and $V_5$ (salinity) in the Swamp Community Model (SCM) and EMCM, respectively, were evaluated to determine how uncertainties related to variable assumptions and values could affect impact predictions and compensatory mitigation decisions.

*Salinity Sensitivity Analysis*

The salinity sensitivity analysis of the WVA model (variables $V_4$ and $V_5$ in the SCM and EMCM) demonstrated that there is a wide range of potential outcomes in AAHU losses attributable to uncertainties in salinity predictions. These outcomes range from a loss of –340 AAHUs to a loss of –3,146 AAHUs within the 95 percent confidence range of salinities used in the analysis. The total predicted FWP loss of –1,499 AAHUs for Louisiana hydro-units is based upon forecasts of the most likely salinity levels, and takes into account the potential effects of RSLR and future freshwater inflows. The recommended compensatory mitigation plan contains sufficient mitigation to ensure that the Recommended Plan will not have more than negligible impacts on the ecological resources of the study area. It is based upon scientifically based projections of changes in habitat resulting from the predicted salinity change, and the professional judgment and knowledge of the area by the large team of natural resource and engineering professionals who applied the HS and WVA models to the SNWW CIP.

*Percent Emergent Marsh Sensitivity Analysis*

The sensitivity analysis of the variable $V_1$ (percent of emergent marsh) in the EMCM explores the effects of an assumption that underlies the valuation of emergent marsh for this variable. In this application of the WVA model, optimal vegetative coverage is assumed to be 100 percent (Suitability Index [SI] = 1.0) for all marsh types. This assumption diverges from the general biological understanding that optimal cover falls in the 60–80 percent range, but it was adopted to reflect the significance of emergent marsh in the

study area. Existing and potentially accelerated marsh loss associated with channel deepening has been identified as one of the highest concerns by resource agencies and the general public. To evaluate the effect of this assumption on the SNWW application, the EMCM was rerun using a revised formula for the variable in which optimal vegetative coverage (SI = 1.0) is assumed for a marsh coverage of 60 to 80 percent ($V_1$-Revised).

Overall, impacts using $V_1$-Revised dropped 3 percent as expressed in AAHUs. However, this reduction would be more than offset by the increase in mitigation that would result from the use of $V_1$-Revised to compute compensatory mitigation, because the amount of credit (in AAHUs) would decrease by about 30 percent. Using $V_1$-Revised to compute required compensatory mitigation for the mitigation measures, as currently designed, would increase mitigation costs by 42 percent. If the same mitigation measures were redesigned so that marsh fill was a maximum of 80 percent, compensation measured with the $V_1$-Revised formula would increase by about 10 percent. However, total cost of this revised mitigation plan would be about 3 percent greater than the recommended mitigation plan. More significantly, the modified plan would restore about 18 percent fewer acres and do less to ensure the long-term sustainability of the marsh.

The WVA Model Assessment (LBG/TEA, 2008) confirmed that the original model assumption applied for variable $V_1$-Original (e.g., optimal vegetative coverage is assumed to be 100 percent) is appropriate for the SNWW application in computing both impacts and mitigation, as it reflects the importance of emergent vegetation as habitat for this study area. Given serious existing rates of marsh loss, the predicted increase in marsh loss in the FWP condition, and uncertainties related to salinity and land loss impacts due to the project, it is reasonable and appropriate to utilize the assumption that maximizes the value of emergent marsh to the sustainability of the marsh system. Without the structure provided by the emergent marsh, the majority of the ecological benefits provided by this system disappear.

## Cultural Resources

There is uncertainty related to the potential cost of cultural resource mitigation because all areas that would be impacted by the CIP have not been assessed for their potential to contain properties eligible for NRHP listing. While no specific historic property impacts have been identified at this time, there is moderate potential to affect a significant historic shipwreck. The highest potential for historic property mitigation is associated with channel deepening through Sabine Pass, the site of a significant Civil War naval battle. To account for this uncertainty, the estimated cost for historic property data recovery has been included in the project cost estimate. More details can be found in Section 4.14 of the FEIS.

## Real Estate Data

There are 16 PAs, of which 13 are already owned by the local Sponsor and 3 are to be acquired by the non-Federal sponsor. Contaminant materials have been found in PA 17 that are unrelated to dredged material or dredging activities. Issues related to these contaminated materials must be resolved by the non-Federal sponsor before PA 17 can be used. Alternate PAs are available. The other two PAs are

available and would be acquired by the non-Federal sponsor. There are three proposed TBs on the Neches River. Of those, two would require acquisition of 12.10 available acres. All of the remaining lands are subject to Navigation Servitude. The risks to increase project costs and lengthen the project schedule are low.

## IX.D COMMUNICATION OF RISK

Extensive scoping effort allowed effective communication of public and agency perception of risks associated with potential channel deepening. The USACE and the SNND developed a public involvement plan to ensure that the USACE and SNND were responsive to the needs and concerns of all stakeholders and to ensure public involvement through an open, interactive process. The plan helped the USACE and SNND provide information to, and obtain information from, the stakeholders. A proactive outreach program ensured that the public, resource agencies, industry, local government, and other interested parties were informed about the project and that any concerns were identified and addressed. More discussion of the outreach program can be found in Chapter XII of this report and also in Appendix A of the FEIS.

Uncertainties associated with precision of data and model robustness were communicated to State and Federal resource agencies as they participated in the ICT review of data collection, model application, and model results. The risks of the various project alternatives and the Recommended Plan will be communicated to general public at public meetings held during public review of the FEIS. Public comments regarding perceptions of risk, uncertainties, and consequences will be included as part of the final feasibility report and FEIS. Potential risk and uncertainties with the CIP, and those expressed by the public will be provided to decision makers and during the Civil Works Review Board briefings.

# X. RECOMMENDED PLAN

## X.A OVERVIEW

Previous chapters described the analyses conducted during the planning study process to identify the NED Plan, the Recommended Plan, the DMMP, and Mitigation Plan with the ultimate goal of identifying the Recommended Plan. The purpose of this chapter is to describe the plan that will be recommended for implementation to the U.S. Congress.

The Recommended Plan described below addresses the problems and opportunities, identified at the beginning of the study, and satisfies the planning objectives of increasing navigational efficiency along the SNWW while maintaining the coastal and estuarine resources within the project area. The Recommended Plan is the LPP Plan, preferred by the Sponsor. Engineering Plates referenced in this section are in Appendix 1 of this document.

## X.B GENERAL NAVIGATION FEATURES OF RECOMMENDED PLAN

The Recommended Plan calls for a 48-foot-deep channel from Sabine Pass Channel to the Port of Beaumont on the Neches River Channel with no additional widening, widening and deepening of Taylor Bayou TBs and channels to 48 feet, and several TBs and ABs on the Neches River Channel (Figure X-1). The Recommended Plan would increase the existing channel depth by 8 feet, increasing the inland portion from 40 to 48 feet and increasing the existing offshore portions from 42 to 50 feet (plus overdepth and advance maintenance as needed). Two feet of overdepth and 2 feet of advance maintenance are included for the entire channel length. In high shoaling areas, additional advance maintenance is required in order to maintain current maintenance dredging cycles along the waterway. The total length of the SNWW with the proposed channel modifications would be approximately 77 miles. No modifications to the existing Sabine Pass jetties are required by the proposed project.

The following description of the recommended channel improvements to the SNWW begins at the Gulf of Mexico (offshore) channel reach and moves inland to the Beaumont TB on the Neches River. A plan view of the Recommended Plan is provided on Engineering Plate G-02, and the project dimensions are identified in Table X-1.

### Sabine Bank Extension Channel

This channel lengthens the existing offshore entrance channel approximately 13.2 miles at a bottom width of 700 feet (Engineering Plate No. C-12). The additional length is required to reach a water depth in the Gulf of Mexico equal to the proposed channel depth. The proposed offshore depth is 50 feet, but advance maintenance and allowable overdepth would add a total of 4 more feet, bringing the total dredged depth of the Extension Channel to 54 feet. It would be constructed by hopper dredge beginning at the end of the

Table X-1
Project Dimensions for Recommended Plan

| Reach | Station | to | Station | Bottom Width (feet) | Project Depth (feet) | Side Slope |
|---|---|---|---|---|---|---|
| Extension Channel | 165+443 | | 95+734 | 700 | 50 | 1V/2H |
| Sabine Bank Channel | 95+734 | | 18+000 | 700–800 | 50 | 1V/2H |
| Sabine Pass Outer Bar Channel | 18+000 | | 0+000 | 800 | 50 | 1V/10H |
| Sabine Pass Jetty Channel | –214+88 | | 0+00 | 800–500 | 48 | 1V/2H |
| Sabine Pass Channel | 0+00 | | 296+25 | 500 | 48 | 1V/2H |
| Port Arthur Canal | 0+00 | | 325+84 | 500 | 48 | 1V/2H |
| Sabine-Neches Canal | 0+00 | | 592+94 | 400 | 48 | 1V/2H |
| Neches River Channel | 0+00 | | 980+00 | 400 | 48 | 1V/2H |
| **Taylor Bayou** | | | | | | |
| Entrance Channel | 0+00 | | 25+27 | 406–764 | 48 | 1V/2H |
| East Turning Basin | 0+00 | | 17+65 | 532–354 | 48 | 1V/2H |
| West Turning Basin | 25+27 | | 41+30 | 776 | 48 | 1V/2H |
| Connecting Channel | 41+30 | | 71+50 | 470–250 | 48 | 1V/2H |
| Taylor Bayou Turning Basin | 71+50 | | 106+25 | 1000 | 48 | 1V/2H |

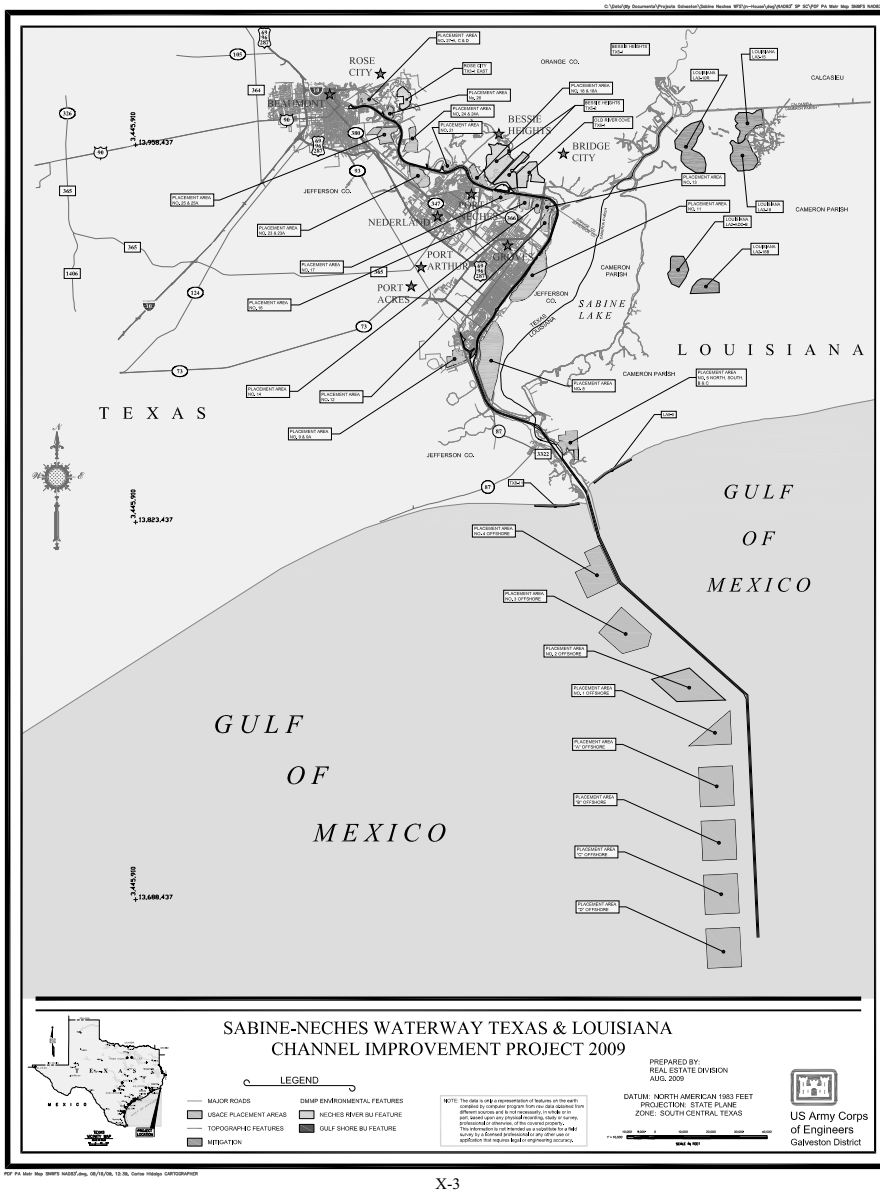
Sabine Bank Channel and it would extend into the Gulf of Mexico at the same bearing as the Sabine Bank Channel.

## Sabine Bank Channel

This 14.7-mile-long channel would be deepened from 42 to 50 feet using a hopper dredge (Engineering Plate No. C-11). When advance maintenance and allowable overdepth are added to the proposed 50-foot depth, the Sabine Bank Channel would be dredged to 54 feet. The bottom width of the Sabine Bank Channel is currently 800 feet; it would remain 800 feet wide for the first mile past the end of the Outer Bar Channel, and then it would taper from 800 to 700 feet over the next ½ mile. The Sabine Bank Channel would continue the 700-foot bottom width for approximately 13.2 miles to its connection with the Extension Channel. Since the existing channel is 800 feet wide, new channel markers would be required to mark the tapered transition and the remainder of the narrowed Sabine Bank Channel.

## Sabine Pass Outer Bar Channel

This 3.4-mile-long channel would be deepened from 42 to 50 feet using a hopper dredge. Due to high shoaling rates in this portion of the channel, advance maintenance depths would be increased to maintain current maintenance dredging cycles. Including allowable overdepth, advance maintenance, and additional advance maintenance, the Outer Bar Channel would be dredged to 58 feet. The Outer Bar Channel would remain at its current 800 feet bottom width due to strong crosscurrents just beyond the end of the SNWW jetties (Engineering Plate No. C-11).




# SABINE-NECHES WATERWAY TEXAS & LOUISIANA CHANNEL IMPROVEMENT PROJECT 2009




LEGEND

- MAJOR ROADS
- USACE PLACEMENT AREAS
- TOPOGRAPHIC FEATURES
- MITIGATION
- DMMP ENVIRONMENTAL FEATURES
- NECHES RIVER BU FEATURE
- GULF SHORE BU FEATURE

NOTE: The data is only a representation of features on the earth compiled by computer program from raw data digitized from different sources and is not necessarily, in fulfill or in part, the results of a boundary survey, a land survey, a survey, professional or otherwise, of the covered property. This information is not intended as a substitute for a field survey by a licensed professional or any other use of application that requires legal or engineering accuracy.

PREPARED BY:
REAL ESTATE DIVISION
AUG. 2009

DATUM: NORTH AMERICAN 1983 FEET
PROJECTION: STATE PLANE
ZONE: SOUTH CENTRAL TEXAS

FT. 10,000 5,000 0 10,000 20,000 30,000 40,000
SCALE IN FEET

US Army Corps of Engineers
Galveston District

PDF P4 Mstr Map SNWFS NAD87.dwg, 08/18/09, 12:39, Carlos Hidalgo CARTOGRAPHER

## Sabine Pass Jetty Channel

This 4.1-mile-long channel would be deepened to 48 feet using a hopper dredge. When advance maintenance and allowable overdepth are added, the Sabine Pass Jetty Channel would be dredged to 52 feet. The width of the channel would remain the same, the channel would gradually taper from the existing 800-foot width at the mouth of the jetties to 500 feet wide at the head of the jetties (Station 0+00). No impacts to the jetties have been identified that are associated with the proposed improvements.

## Sabine Pass Channel

This 5.6-mile-long channel begins just north of the jetties and extends upstream to Mesquite Point on Pleasure Island (Engineering Plate Nos. C-10, C-11, and C-12). It would be deepened to 48 feet and constructed with a hydraulic pipeline dredge. Shoaling rates vary in different sections of the Sabine Pass Channel, and advance maintenance and allowable overdepth vary to meet these conditions. The total dredging depth for two reaches (Station 0+00 to Station 100+00, and Station 180+00 to Station 230+00) would be 52 feet. Due to higher shoaling rates, the reach from Station 100+00 to Station 180+00 would require additional advance maintenance and be dredged to a depth of 55 feet, while the reach from Station 230+00 to the end of the Sabine Pass Channel at Station 295+61 would be dredged to a depth of 57 feet. The bottom width of the Sabine Pass Channel would remain at 500 feet with a new centerline closely following the existing centerline. The Sabine Pass Anchorage is located in this reach, and its footprint would be reduced in size because it has never been fully utilized. The width would be decreased from 1,500 to 855 feet, and the length would remain at 8,200 feet. The angle of approach would remain the same.

## Port Arthur Canal

This 6.2-mile-long canal begins near Mesquite Point and ends at the Port Arthur Junction Area with the Taylor Bayou channels (Engineering Plate Nos. C-08 and C-09). The Port Arthur Canal would be deepened to the proposed depth of 48 feet with a hydraulic pipeline dredge. The Port Arthur Junction Area serves as a TB and has a high shoaling rate due to the confluence of the GIWW and the Taylor Bayou TB with the SNWW. This confluence of water bodies decreases channel velocities resulting in increased shoaling. For these reasons, the reach from Station 0+00 to Station 290+00 would be dredged to a depth of 54 feet. The remaining part (Port Arthur Junction) between stations 290+00 and 326+37 would be dredged to a depth of 57 feet. Additional advance maintenance is required in these reaches to address high shoaling areas while keeping the current dredging frequency. The bottom width of the Port Arthur Canal would remain 500 feet.

## Taylor Bayou Channels and Turning Basins

Located at the confluence of the Port Arthur Junction Area, the GIWW, and the mouth of the original Taylor Bayou, the Taylor Bayou Channels and TB consist of several subreaches: Entrance Channel, East TB, West TB, Connecting Channel, and the Taylor Bayou TB. Several significant changes are proposed for this area. When advance maintenance and allowable overdepth are added to the proposed 48-foot

depth, the Taylor Bayou channels and TB would be dredged to 54 feet. The Taylor Bayou portion of the Junction Area, between stations 0+00 and 31+10, would be dredged to 57 feet (see additional advance maintenance explanation provided for Port Arthur Canal). The Entrance Channel and the West TB bottleneck curve would be widened, and a structural wall would protect local railroad tracks. Changes for each subreach are detailed below.

- **Entrance Channel**. The new bottom width widens on the west side of the channel. The channel would be widened to 444 feet at new Station 10+00. The new bottom width would taper back to the existing width by the end of the first curve at Station 28+38.
- **East Turning Basin**. The right side width would decrease 16 feet as the new depth extends down the existing side slope.
- **West Turning Basin**. The width of the existing bottleneck has been increased up to 120 feet on the west side, between new stations 33+00 and 55+00. The west bank of the basin would be protected by a structural wall, preventing impacts to the local railroad tracks present in this area.
- **Connecting Channel**. The West TB widening tapers back to the existing width in the Connecting Channel, between stations 55+00 and 67+00.
- **Taylor Bayou Turning Basin**. No changes would be made to the existing dimensions, but the basin would be deepened to the proposed 48-foot depth. Existing shore protection belonging to a local facility near Station 90+00 would be affected by the top-of-cut for the new depth.

## Sabine-Neches Canal

The 11.2-mile-long canal begins at the Port Arthur Junction Area and ends just south of the mouth of the Neches River (Engineering Plate Nos. C-04, C-05, C-06, and C-07). The GIWW shares this canal with the deep-draft channel. It would be deepened to the proposed depth of 48 feet with a hydraulic pipeline dredge. Additional advance maintenance (near the junction of the Port Arthur Canal and the Sabine-Neches Canal) is required since the area is a high-shoaling area, and additional advance maintenance dredging would allow current O&M dredging frequencies to be maintained. When allowable overdepth, advance maintenance, and additional advance maintenance are added, stations 0+00 to 40+00 would be dredged to 57 feet, and remainder of the canal through Station 592+91 would be dredged to 53 feet.

The bottom width of the canal would be selectively widened in three separate sections. The bottom width of the most-downstream curve (stations 0+00 to 20+00) would be widened to 500 feet on the east side of the channel, and then promptly tapered to the existing 400-foot width prior to the MLK Bridge (SH 82). The canal would be widened to 450 feet adjacent to the Port of Port Arthur, with gradual tapering upstream and downstream between stations 120+00 and 170+00. The third widening section begins to taper at Station 565+00, gradually widening to 500 feet and remaining that width to the end at Station 592+91.

Bend easing is planned for three areas in the Sabine-Neches Canal to improve ship maneuverability: stations 265+00 to 305+00, stations 350+00 to 395+00, and stations 500+00 to 520+00. The bend easing

between stations 350+00 and 395+00 eliminates a wiggle in the alignment, and shifts the footprint of the canal 10 feet east of the existing alignment up to Station 520+00.

Changes are also recommended for the canal bottom adjacent to the Port Arthur Dock and the "Eye Basin." The canal toes adjacent to the Port of Port Arthur would be moved approximately 10 feet to the right while keeping the same bottom width of 450 feet. The diameter of the existing turning point ("Eye Basin") at Station 190+00 would be decreased by 16 feet.

## Neches River Channel

This 18.5-mile-long channel begins just south of the mouth of the Neches River (Engineering Plate Nos. C-01, C-02, C-03, and C-04). It would be deepened to the proposed depth of 48 feet to Station 980+00 with a hydraulic pipeline dredge. Shoaling rates vary in different sections of the Neches River Channel, and advance maintenance and allowable overdepth would vary to meet these conditions. Between stations 0+00 and 440+00, the total dredged depth would be 52 feet; between stations 440+00 and 978+00, it would be 54 feet (due to 2 feet of additional advance maintenance). While the overall bottom width of 400 feet does not change for the majority of the channel length, the first curve at the mouth of Neches River (between stations 0+00 and 75+00) would be widened to 500 feet, and then tapered back to 400 feet prior to the SH 87 twin bridges.

Three basins would be added or enlarged on the Neches River Channel. All three would be dredged to the proposed depth of 48 feet, plus the advance maintenance and allowable overdepth associated with the specific channel reach in which they are located. One TB, Turning Basin No. 6, is an existing basin and would continue to be maintained at the existing 40-foot depth and existing advance maintenance and allowable overdepth.

- **TB and AB No. 1** is located in an old river oxbow at the east end of Texaco Island near Station 210+00. The TB enlarges the existing basin from 1,000 to 1,350 feet in diameter. A new AB, 250 by 1,100 feet in size, would be added.
- **TB and AB No. 4** enlarges an existing turning point at Station 510+00 from 1,000 to 1,350 feet in diameter. A new AB in the old river oxbow at Station 500+00 would be 250 by 1,100 feet in size.
- **AB No. 8** is new and would be located at Station 850+00. The 250 by 1,000-foot basin is located in an old river oxbow.

## DMMP

PAs would be able to accommodate material from both construction and maintenance dredging of the Federal channel over the 50-year period of analysis. They are also designed to accommodate non-Federal dredging (estimated at 5.2 percent of material to be placed in upland PAs) of private facilities on the Port Arthur and Sabine-Neches canals, and the Neches River Channel. PAs proposed as part of the Recommended Plan consist of upland PAs, ODMDS and GNF BU features (Neches River and Gulf Shore BU features) (tables X-2, X-3, and X-4). Sixteen existing and two expanded upland PAs are proposed for

use with the Recommended Plan. Offshore placement consists of four existing ODMDSs (1–4) and four new ODMDSs (A–D). More-detailed descriptions of the 50-year DMMP for the Recommended Plan can be found in Section VIII of this document and in Appendix D of the FEIS.

Table X-2
Upland Placement Areas for the Recommended Plan

| Placement Area | Additional Cell(s) | Size (acres) | Associated Waterway Section |
|---|---|---|---|
| 5 | N&S, B, C | 957 | Sabine Pass Channel (sections 5 and 6) |
| 8 | | 3,570 | Port Arthur Canal (sections 7 and 8)<br>Sabine-Neches Canal (Section 9) |
| 9A | B | 481 | Port Arthur Canal (Section 8) |
| 11 | | 2,170 | Sabine-Neches Canal (Section 10) |
| 12 | | 355 | Neches River Channel (Section 11) |
| 13 | | 140 | Neches River Channel (Section 11) |
| 14 | | 255 | Neches River Channel (Section 12) |
| 16 | | 288 | Neches River Channel (Section 13) |
| 17 | | 316 | Neches River Channel (Section 13) |
| 18 | A | 432 | Neches River Channel (Section 14) |
| 21 | | 135 | Neches River Channel (Section 14) |
| 23 | A | 773 | Neches River Channel (Section 15) |
| 24 | A | 575 | Neches River Channel (Section 16) |
| 25 | A | 820 | Neches River Channel (Section 17) |
| 26 | | 192 | Neches River Channel (Section 18) |
| 27 | A, C, D | 270 | Neches River Channel (Section 18) |

Table X-3
Ocean Dredged Material Disposal Sites for Recommended Plan

| Placement Area | Size (acres) | Status | Associated Waterway Section |
|---|---|---|---|
| A | 3,405 | New | Extension Channel |
| B | 3,405 | New | Extension Channel |
| C | 3,405 | New | Extension Channel |
| D | 3,405 | New | Extension Channel |
| 1 | 2,020 | Active | Section 1 |
| 2 | 4,738 | Active | Section 2 |
| 3 | 3,939 | Active | Section 3 |
| 4 | 3,444 | Active | Section 4 |

Table X-4
GNF Beneficial Use Features in the Recommended Plan

**Neches River BU Feature**

- **Rose City East Marsh Restoration** (Engineering Plate No. C-01)

  (TX 3-1 East) – Restoration of 345 acres of fresh marsh; improvement of 72 acres of shallow-water habitat; nourishment of 151 acres of existing marsh

- **Bessie Heights East Marsh Restoration** (Engineering Plate No. C-24)

  (TX 5-2) – Restoration of 679 acres of brackish marsh and 1,190 acres of intermediate marsh; improvement of 660 acres of shallow-water habitat; nourishment of 651 acres of existing marsh

- **Old River Cove Marsh Restoration** (Engineering Plate No. C-25)

  (TX 6-1) – Restoration of 639 acres of brackish marsh; improvement of 139 acres of shallow-water habitat; nourishment of 432 acres of existing marsh

**Gulf Shore BU Feature**

- **Texas Point Shoreline Nourishment** (Engineering Plate No. C-27)

  (TX 8-11) – Nourishment of 3 miles of Texas shoreline with maintenance material every 6 years

- **Louisiana Point Shoreline Nourishment** (Engineering Plate No. C-27)

  (LA 5-6) – Nourishment of 3 miles of Louisiana shoreline with maintenance material every 6 years

Figure X-1 identifies the location of the major features of the Recommended Plan, specifically the DMMP BU features and the mitigation measures, existing and new PAs, and the existing and new ODMDSs.

## Ecological Mitigation for the Recommended Plan

### Marsh Mitigation

Marsh mitigation for the Recommended Plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana (Table X-5). The mitigation plan compensates for the Recommended Plan's salinity increase and associated losses in biological productivity by restoring 2,783 acres of emergent marsh in existing open-water areas within degraded marsh; improving 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh; and stabilizing and nourishing 4,355 acres of existing marsh located in and around the mitigation areas. Additional details are provided in the FEIS.

Table X-5
Mitigation for Recommended Plan

| Recommended Mitigation Plan | Mitigation AAHUs |
|---|---|
| **Willow Bayou** | |
| LA 2-18 B Marsh Restoration (Sabine Lake dredging) | 152 |
| LA 2ADD B Marsh Restoration (Sabine Lake dredging) | 214 |
| **Black Bayou** | |
| LA 3-10R Marsh Restoration (Channel to Orange maintenance material) | 198 |
| LA 3-15 B Marsh Restoration (GIWW dredging) | 307 |
| LA 3-18 B Marsh Restoration (GIWW dredging) | 310 |
| Total Compensation | 1,181 |
| FWP Mitigation Target | –1,159 |
| **Net Benefits After Compensation** | **22** |

## X.C LANDS, EASEMENTS, AND RIGHTS-OF-WAY

The project Sponsor is required to furnish the LER for the proposed cost-shared project. The real estate requirements must support construction as well as operation and maintenance of the project after completion. A summary of the real estate requirements for each channel reach is provided in Table VII-6. Specific details of the real estate requirements can be found in the Real Estate Plan, Appendix 4 of this document.

## X.D RELOCATIONS

The following assumptions were made to identify pipelines that could be affected by the Recommended Plan and to develop associated costs. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. Feasibility engineering guidelines indicate that pipelines with a minimum of 8 feet of cover for trenched lines or 5 feet of cover for directionally drilled lines would not be adjusted. Pipelines that do not meet the minimum cover requirement would be required to be adjusted. The adjusted pipelines must be located 20 feet below the authorized 48-foot depth. The 20 feet includes any advance maintenance and allowable overdepth. The relocation of active pipelines is assumed to be installed with directional drilling, and bundled where possible.

A total of 104 pipelines have been identified crossing the SNWW navigation channels. Of the 104 pipelines, 46 require adjustment to meet the minimum required vertical and horizontal clearances for the CIP.

Pursuant to Section 101(a) of the WRDA 86, as amended, the Sponsor is responsible for performing, or assuring performance, of all relocations, including utility relocations, which are necessary for the CIP. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government.

The Galveston District has concluded preliminarily that 41 of the 46 lines located within the channel must be relocated and are classified as utility relocations for which the Sponsor must perform or assure performance. In accordance with Section 101(a)(4) of WRDA 86, one-half of the cost of each such relocation will be borne by the owner of the facility being relocated and one-half of the cost of each such relocation will be borne by the Sponsor. Such relocation costs will not include any cost for upgrading or improving such facilities, which is to be borne by the facility owner.

For more-specific information regarding the utility relocations, and preliminary conclusions regarding the remaining five lines that must be removed but not replaced, see the Real Estate Plan, Appendix 4, of this document.

DMMP marsh restoration at Bessie Heights and mitigation marsh restoration measures east of Sabine Lake were assumed to require no relocations. However, since oil production is active in some of these areas, additional pipeline searches and coordination with pipeline owners would be required prior to construction to avoid impacts.

No relocations would be required for overhead power utilities, highway bridges, the Port Arthur HFP Levee, or its associated pump stations and closure structures.

## X.E AIDS TO NAVIGATION

### Channel Markers

Some of the existing channel markers along the waterway would require removal and replacement. No changes in channel markers are needed upstream of the Beaumont Maneuvering Basin and in the vicinity of SH 87 on the Neches River Channel. However, channel markers along the remainder of the waterway may need to be relocated, and new markers would be required along the Extension Channel.

## X.F BRIDGE REINFORCEMENTS AND FENDERS

Channel modifications would require the removal and replacement of bridge fender systems that protect the Rainbow Bridge and the Veterans Memorial Bridge over the Neches River, and the MLK Bridge over the Sabine-Neches Canal. In addition, the existing support piers of the MLK Bridge would be hardened to prevent instability that may develop with construction of the proposed 400-foot channel width.

# XI. PLAN IMPLEMENTATION

## XI.A OVERVIEW

This chapter identifies project cost sharing responsibilities for the Government and the Sponsor for the construction and O&M of the Recommended Plan.

## XI.B DIVISION OF PLAN RESPONSIBILITIES AND COST SHARING REQUIREMENTS

The Recommended Plan would be accomplished at different cost sharing rates. Project cost sharing for the project would be as follows:

- **GNF down to 45-foot depth** – 75 percent Federal and 25 percent non-Federal
- **GNF deeper than 45-foot depth** – 50 percent Federal and 50 percent non-Federal
- **O&M down to 45-foot depth** – 100 percent Federal
- **O&M deeper than 45-foot depth** – 50 percent Federal and 50 percent non-Federal

## XI.C DESIGN PHASE COSTS FOR ALTERNATIVES SCREENING

During the detailed design phase, a different cost ($1.12/gallon fuel cost) and price level (October 2005) were used to identify the least-cost placement alternative (Section VII.E, Table VII-4). Costs have not been updated for this comparison because it was used to screen two placement plan alternatives (a Traditional Placement Alternative and the BU Alternative) during the detailed design phase. No changes have been made to the alternatives that were compared. Costs for both alternatives would change proportionately if they were updated with the most recent price levels. The difference in cost between the two plans would not be materially different, and thus the decision to adopt the BU Alternative as a GNF of the DMMP for the Recommended Plan would not be affected. An explanation of the $1.12 fuel cost estimate is included below to explain the reasoning behind its use at that time.

Large fluctuations in fuel costs that occurred during the preparation of this report raised concerns that benefits and costs, based upon different cost assumptions as required by the USACE guidance, would lead to an unanticipated bias in the BCR. The USACE Headquarters provided interim guidance requiring a different method of cost determination, which was followed in the preparation of cost screenings for the SNWW CIP until deep-draft vessel operating costs were updated (EGM #08-04). In the interim guidance, the USACE Headquarters and the IWR developed a price adjustment applicable to existing estimates of inland vessel bunkerage costs, which approximated deep-draft or coastal dredge plant costs. The guidance recommended that an estimated value of $1.12 per standard gallon be used for the economic analysis until the EGM could be updated. Subsequently, the revised EGM was issued in November 2007, and the project costs have been updated. The project cost tables presented in the sections below use the October 2009 price level and updated vessel-operating costs per EGM #08-04.

## XI.D PROJECT COSTS

Three costs were developed for evaluation of the Recommended Plan. These costs include the Total First Cost, the Recommended Plan Investment Cost, and the Fully Funded Cost. The Total First Cost is at current levels, does not include interest during construction (IDC) or expected price escalation. The Investment Cost includes all first costs and IDC. The Fully Funded Cost includes all first costs and price escalation, but does not include the IDC. All three costs include associated costs such as LER, relocations (including utility relocations), berthing area and dock modifications, and aids to navigation. All costs in the project cost tables presented in the chapter were developed using October 2009 price levels; annualized costs use an interest rate of 4.375 percent. Deep-draft vessel operating costs for the economic analysis were developed based upon EGM #08-04.

### Costs for the Recommended Plan

#### Total First Cost and Annualized O&M Costs

The Total First Cost is the cost at current levels and does not include IDC, or expected price escalation. The Total First Cost for all project components ($1,071,877,000; Table XI-1) includes implementation costs and associated costs. Implementation costs include postauthorization planning and design costs, construction costs, LER, relocations, mitigation costs, and O&M. Construction costs include costs for dredging, PA construction, aids to navigation (e.g., channel markers) and protection for MLK Bridge supports and bridge fender replacement. The USACE coordinated with the USCG to develop costs for aids to navigation, and with the Texas Department of Transportation to develop costs for bridge support protection and fender systems. Costs for compensatory fish and wildlife mitigation (including deferred construction costs for one mitigation measure) and cultural resource mitigation are also included. Associated Federal and non-Federal costs are the costs of resources directly required for project construction, but for which no project expenditure is made, such as USCG navigation aids, relocations (including utility relocations), and non-Federal berthing/dock modifications. A formal cost risk analysis was performed in accordance with Engineering and Construction Bulletin 2007-17 that developed project contingencies at the 80 percent confidence level. First costs and incremental O&M costs are expressed as total average annual costs in the bottom portion of Table XI-1. Construction funding would fund all project construction components.

*Deferred Construction Costs*

Deferred construction costs are related to one mitigation measure at West Black Bayou, Louisiana (LA 3-10R). This mitigation measure would be constructed using material from regular maintenance dredging of the Sabine River Channel to Orange over a 30-year period. The cost of the mitigation measure is the incremental cost of pumping the additional distance to Louisiana and marsh restoration activities. The first cycle of placement is included as a first cost of construction in the Recommended Plan cost estimates (Contract 14). Intermittent construction over 30 years (six additional 5-year maintenance cycles) is shown separately as an annualized deferred construction cost in tables XI-1 and XI-2. The Deferred construction would be cost shared with the non-Federal project sponsor for the SNWW CIP.

Table XI-1
Total First Cost and Annualized O&M for the Recommended Plan
(All costs in dollars)
(October 2009 price level; 4.375% interest rate)

| | |
|---|---|
| First Cost of Construction | 873,610,000 |
| Fish and Wildlife Mitigation | 77,491,000 |
| Cultural Resources Mitigation | 1,248,000 |
| Lands | 4,361,000 |
| Relocations | 41,627,000 |
| Bridge Modifications | 51,794,000 |
| Navigation Aids | 1,492,000 |
| Berthing and Dock Modifications | 20,254,000 |
| Total Project Cost | 1,071,877,000 |
| Average Annual Costs | |
| First Cost Amortization | 59,059,000 |
| Deferred Construction (Fish and Wildlife Mitigation) | 215,000 |
| Incremental O&M | |
| Total Incremental | 32,006,000 |
| non-Federal Disposal Facility Costs | 61,000 |
| Average Annual Costs | 91,341,000 |

Since the Sabine River Channel is a separate project with a different non-Federal sponsor, each Sabine River Channel maintenance cycle involving deferred construction would utilize three funding sources (Federal O&M funds from the Sabine River Channel, and Federal construction funds and Sponsor construction funds from the SNWW CIP). The Federal government and Sponsor must diligently budget for the deferred construction so that funds are available when needed to avoid any delays in channel maintenance and mitigation site construction.

*Federal O&M Costs*

The maintenance of project features would be funded through annual appropriations of the O&M program. The actual amounts would vary on a year-to-year basis because of variability in the volume of material removed during each dredging cycle and the variability of the cycles. O&M costs also vary between channel depths. In accordance with Section 101(b) of WRDA 86 (Policy Guidance Letter [PGL] 47), O&M dredging and placement costs for maintenance of the channel depths between 40 and 45 feet would be allocated as 100 percent Federal; this would be calculated as 62.5 percent of the total O&M cost, determined as described for the GNF features in the Fully Funded Cost section, below. Costs for maintenance of the channel depth below 45 feet (37.5 percent of the total O&M costs) would be allocated as 50 percent non-Federal and 50 percent Federal. Expected cost sharing for all project components is compliant with PGL 47, Dredged Material Disposal Facilities, and Dredged Material Disposal Facility Partnerships.

Table XI-2
Total Investment Cost for the Recommended Plan
(October 2009 price level; 4.375 percent interest rate)

| | |
|---|---|
| Total First Cost | 1,071,877,000 |
| Months to Construct | 96 |
| Interest During Construction | 119,382,000 |
| NED Investment Costs | 1,191,259,000 |
| Average Annual Project Cost | 59,059,000 |
| Incremental O&M | 32,067,00 |
| Deferred Construction (F&W Mitigation) | 215,000 |
| Total Annual Cost | 91,341,000 |
| Annual Benefits | 115,074,000 |
| Net Excess Benefits | 23,733,000 |
| BCR | 1.3 |

Additional PA capacity for the Recommended Plan would be constructed regularly over the 50-year period of analysis in conjunction with maintenance dredging cycles. Since established dredged material management practices for the SNWW 40-foot project include regularly recurring levee raisings and the enlargement or installation of new dewatering structures, the additional investment required to provide the increased PA capacity for the Recommended Plan and PA costs attributable to the 40-foot project Base Plan would be cost shared as O&M costs. Costs for disposal facility maintenance would be allocated as 100 percent Federal for maintenance of channel depths between 40 and 45 feet. Costs for disposal facility maintenance associated with channel deepening below 45 feet would be allocated as 50 percent non-Federal and 50 percent Federal.

*Non-Federal O&M Costs*

In the SNWW, non-Federal maintenance material has traditionally been placed into the same PAs as Federal material, at the request of the non-Federal sponsor. Additional capacity needed for the non-Federal maintenance material was therefore considered when determining improvements needed to provide capacity for the 50-year period of analysis. It is projected that approximately 5.2 percent of the 48-foot project 50-year maintenance dredging quantity to be placed in upland disposal facilities would originate from non-Federal dredging. Costs of providing the capacity needed to contain the non-Federal dredged material are a local responsibility and are shown separately from the incremental Federal O&M costs that would be cost-shared as described above.

### National Economic Development Investment Cost

The Investment Cost is expressed in current dollars with IDC added (see Table XI-2). The Investment Cost includes all of the implementation costs and non-Federal and Federal associated costs included in the First Cost as described above. First costs, incremental O&M, and deferred construction for fish and wildlife mitigation are expressed as total average annual costs in the bottom portion of Table XI-2, and then net excess benefit totals and the BCR are calculated. Total average annual costs are compared to

projected annual benefits to determine net excess benefits and the BCR. The BCR for the Recommended Plan is 1.3.

### Fully Funded Cost

Total First Costs and price escalation, calculated by estimating the midpoint of the proposed construction contracts, are combined to create the Fully Funded Cost. In order to allocate the share of construction and O&M costs between the Federal government and the Sponsor, the cost must first be allocated by depth in accordance with Section 101 of Public Law 99-662 (USACE, 2000b). Costs for the transportation and placement of material during construction of the 48-foot project are GNF costs. The GNF costs are assigned to the two depth ranges, in accordance with Section 101(a) of WRDA 86, by applying the proportion of the channel deepening that would occur within each depth range. The cost allocation by depth in first cost is shown in Table XI-3. Table XI-4 shows this cost allocation using the fully funded cost. The amount associated with deepening between 40 and 45 feet (cost shared at 25 percent non-Federal and 75 percent Federal) was calculated by using an estimate for the 45-foot project. This 45-foot cost estimate was developed to a level comparable to an MII cost estimate. The amount associated with deepening below 45 feet (cost shared at 50 percent non-Federal and 50 percent Federal) was calculated by taking the cost difference between the 48-foot alternative and the 45-foot plan. Costs for various categories such as advance maintenance and allowable overdepth dredging were included in both the 45-foot estimates and 48-foot estimates and are included in both depths in the same manner as other GNF costs. None of the existing berthing areas and docks is presently deeper than the 40-foot channel, and therefore these costs would also be allocated between the depths as are all other GNF costs. The Federal costs for lands, fish and wildlife mitigation, cultural resources, and aids to navigation are the same in both the 45-foot and 48-foot plans; therefore, there are no additional costs included in the analysis for deepening from 45 to 48 feet.

## XI.E COST SHARING ALLOCATION

The GNF costs for deepening between 40 and 45 feet are cost shared at 25 percent non-Federal and 75 percent Federal; costs for deepening below 45 feet are cost shared at 50 percent non-Federal and 50 percent Federal. The costs are separated into expected Federal and non-Federal shares and detailed in tables XI-5 and XI-6. Table XI-5 used the projects first costs while Table XI-6 is in fully funded escalated costs. Fish and wildlife mitigation is considered a GNF and is cost shared in the same manner as other GNF costs. Costs for cultural resources data recovery would be handled in accordance with PL 93-291 (Section 7), e.g., data recovery costs would be 100 percent Federal up to 1 percent of the total amount appropriated for the project. Based upon information available at this time, data recovery costs are not expected to exceed the 1 percent limitation.

The Sponsor also must pay an additional 10 percent of the GNF costs in cash over a period not to exceed 30 years. This additional 10 percent cash contribution is offset by credit for LER and relocations (including utility relocations) pursuant to Section 101(a)(2) of WRDA 86, as amended. Owners of berth and dock facilities that would require modification in conjunction with the Recommended Plan would be

responsible for 100 percent of those associated costs. The USCG is responsible for 100 percent of the cost for aids to navigation.

Table XI-3
Recommended Plan First Costs Allocation by Depth
(October 2009 Price Level)
(All costs in dollars)

| | Costs Allocated to 45-foot Depth | Costs Allocated to Increment below 45-foot Depth | Total Costs |
|---|---|---|---|
| **General Navigation Features** | | | |
| Construction Dredging and Placement Areas | 520,408,000 | 184,569,000 | 704,977,000 |
| Bridge Modifications | 45,577,000 | 6,217,000 | 51,794,000 |
| Engineering and Design | 82,895,000 | 22,817,000 | 105,712,000 |
| Construction Management | 48,425,000 | 14,496,000 | 62,921,000 |
| Lands | 744,000 | 0 | 744,000 |
| Fish and Wildlife Mitigation | 55,212,000 | 22,279,000 | 77,491,000 |
| Cultural Resources Mitigation | 1,248,000 | 0 | 1,248,000 |
| Subtotal | 754,509,000 | 250,378,000 | 1,004,887,000 |
| **Lands, Easements, Rights-of-Way, and Relocations** | | | |
| Land | 3,617,000 | 0 | 3,617,000 |
| Utility Relocations | 0 | 20,813,500 | 20,813,500 |
| Subtotal | 3,617,000 | 20,813,500 | 24,430,500 |
| **Other Federal Costs** | | | |
| Aids to Navigation - USCG Channel Markers | 1,492,000 | 0 | 1,492,000 |
| **Associated non-Federal Costs (owner cost)** | | | |
| Utility Relocations | | 20,813,500 | 20,813,500 |
| Berthing Areas & Dock Modifications | 13,187,000 | 7,067,000 | 20,254,000 |
| Subtotal | 13,187,000 | 27,880,500 | 41,067,500 |
| First Costs | 772,805,000 | 299,072,000 | 1,071,877,000 |

Table XI-4
Recommended Plan Fully Funded Costs Allocation by Depth
(October 2009 Price Level)
(All costs in dollars)

| | Costs Allocated to 45-foot Depth | Costs Allocated to Increment below 45-foot Depth | Total Costs |
|---|---|---|---|
| **General Navigation Features** | | | |
| Construction Dredging and Placement Areas | 564,466,000 | 200,193,000 | 764,659,000 |
| Bridge Modifications | 49,436,000 | 6,743,000 | 56,179,000 |
| Engineering and Design | 88,861,000 | 24,459,000 | 113,320,000 |
| Construction Management | 52,555,000 | 15,732,000 | 68,287,000 |
| Lands | 802,000 | 0 | 802,000 |
| Fish and Wildlife Mitigation | 59,928,000 | 24,181,000 | 84,109,000 |
| Cultural Resources Mitigation | 1,389,000 | 0 | 1,389,000 |
| Subtotal | 817,437,000 | 271,308,000 | 1,088,745,000 |
| **Lands, Easements, Rights-of-Way, and Relocations** | | | |
| Land | 3,864,000 | 0 | 3,864,000 |
| Utility Relocations | 0 | 22,658,500 | 22,658,500 |
| Subtotal | 3,864,000 | 22,658,500 | 26,522,500 |
| **Other Federal Costs** | | | |
| Aids to Navigation - USCG Channel Markers | 1,618,000 | 0 | 1,618,000 |
| **Associated non-Federal Costs (owner cost)** | | | |
| Utility Relocations | 0 | 22,658,500 | 22,658,500 |
| Berthing Areas & Dock Modifications | 14,212,000 | 7,616,000 | 21,828,000 |
| Subtotal | 14,212,000 | 30,274,500 | 44,486,500 |
| First Costs | 837,131,000 | 324,241,000 | 1,161,372,000 |

Table XI-5
Recommended Plan – First Costs Allocation
(October 2009 Price Level)
(All costs in dollars)

| | Costs Allocated to 45-foot Depth | | | Costs Allocated to Depth Increment below 45 feet | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| General Navigation Features | Federal Share (75% of 45-ft Costs) | non-Federal Share (25% of 45-ft Costs) | Total | Federal Share (50% of Cost - Depth Increment Greater than 45 ft) | non-Federal Share (50% of Cost - Depth Increment Greater than 45 ft) | Total | Total Federal Share | Total non-Federal Share | Total First Cost |
| Construction Dredging and Placement Areas | 390,306,000 | 130,102,000 | 520,408,000 | 92,284,500 | 92,284,500 | 184,569,000 | 482,590,500 | 222,386,500 | 704,977,000 |
| Bridge Modifications | 34,182,750 | 11,394,250 | 45,577,000 | 3,108,500 | 3,108,500 | 6,217,000 | 37,291,250 | 14,502,750 | 51,794,000 |
| Engineering and Design | 62,171,250 | 20,723,750 | 82,895,000 | 11,408,500 | 11,408,500 | 22,817,000 | 73,579,750 | 32,132,250 | 105,712,000 |
| Construction Management | 36,318,750 | 12,106,250 | 48,425,000 | 7,248,000 | 7,248,000 | 14,496,000 | 43,566,750 | 19,354,250 | 62,921,000 |
| Lands | 558,000 | 186,000 | 744,000 | – | – | – | 558,000 | 186,000 | 744,000 |
| Fish and Wildlife Mitigation | 41,409,000 | 13,803,000 | 55,212,000 | 11,139,500 | 11,139,500 | 22,279,000 | 52,548,500 | 24,942,500 | 77,491,000 |
| Cultural Resource Mitigation | | **100% Federal up to 1% Limitation** | | | **100% Federal up to 1% Limitation** | | | | |
| | 1,248,000 | – | 1,248,000 | – | – | – | 1,248,000 | – | 1,248,000 |
| Subtotal | 566,193,750 | 188,315,250 | 754,509,000 | 125,189,000 | 125,189,000 | 250,378,000 | 691,382,750 | 313,504,250 | 1,004,887,000 |
| **Lands, Easements, ROW, and Relocations (LERRs)** | | **100% non–Federal** | | | **100% non–Federal** | | | | |
| Lands | – | 3,617,000 | 3,617,000 | – | – | – | – | 3,617,000 | 3,617,000 |
| Utility Relocations | – | – | – | – | 20,813,500 | 20,813,500 | – | 20,813,500 | 20,813,500 |
| Subtotal | – | 3,617,000 | 3,617,000 | – | 20,813,500 | 20,813,500 | – | 24,430,500 | 24,430,500 |
| **Other Federal Costs** | | **100% Federal** | | | **100% Federal** | | | | |
| Aids to Navigation - USCG Channel Markers | 1,492,000 | – | 1,492,000 | – | – | – | 1,492,000 | – | 1,492,000 |
| **Associated non-Federal Costs (owner cost)** | | **100% non–Federal** | | | **100% non–Federal** | | | | |
| Utility Relocations | – | – | – | – | 20,813,500 | 20,813,500 | – | 20,813,500 | 20,813,500 |
| Berthing Areas & Dock Modifications | – | 13,187,000 | 13,187,000 | – | 7,067,000 | 7,067,000 | – | 20,254,000 | 20,254,000 |
| Subtotal | – | 13,187,000 | 13,187,000 | – | 27,880,500 | 27,880,500 | – | 41,067,500 | 41,067,500 |
| **Total First Costs** | 567,685,750 | 205,119,250 | 772,805,000 | 125,189,000 | 173,883,000 | 299,072,000 | 692,874,750 | 379,002,250 | 1,071,877,000 |

Table XI-6
Recommended Plan – Fully Funded Costs Allocation
(October 2009 Price Level)
(All costs in dollars)

| | Costs Allocated to 45-foot Depth | | | Costs Allocated to Depth Increment below 45 feet | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| General Navigation Features | Federal Share (75% of 45-ft Costs) | non-Federal Share (25% of 45-ft Costs) | Total | Federal Share (50% of Cost - Depth Increment Greater than 45 ft) | non-Federal Share (50% of Cost - Depth Increment Greater than 45 ft) | Total | Total Federal Share | Total non-Federal Share | Total Fully Funded Cost |
| Construction Dredging and Placement Areas | 423,349,500 | 141,116,500 | 564,466,000 | 100,096,500 | 100,096,500 | 200,193,000 | 523,446,000 | 241,213,000 | 764,659,000 |
| Bridge Modifications | 37,077,000 | 12,359,000 | 49,436,000 | 3,371,500 | 3,371,500 | 6,743,000 | 40,448,500 | 15,730,500 | 56,179,000 |
| Engineering and Design | 66,645,750 | 22,215,250 | 88,861,000 | 12,229,500 | 12,229,500 | 24,459,000 | 78,875,250 | 34,444,750 | 113,320,000 |
| Construction Management | 39,416,250 | 13,138,750 | 52,555,000 | 7,866,000 | 7,866,000 | 15,732,000 | 47,282,250 | 21,004,750 | 68,287,000 |
| Lands | 601,500 | 200,500 | 802,000 | – | – | – | 601,500 | 200,500 | 802,000 |
| Fish and Wildlife Mitigation | 44,946,000 | 14,982,000 | 59,928,000 | 12,090,500 | 12,090,500 | 24,181,000 | 57,036,500 | 27,072,500 | 84,109,000 |
| Cultural Resource Mitigation | | **100% Federal up to 1% Limitation** | | | **100% Federal up to 1% Limitation** | | | | |
| | 1,389,000 | – | 1,389,000 | – | – | – | 1,389,000 | – | 1,389,000 |
| Subtotal | 613,425,000 | 204,012,000 | 817,437,000 | 135,654,000 | 135,654,000 | 271,308,000 | 749,079,000 | 339,666,000 | 1,088,745,000 |
| **Lands, Easements, Rights of Way, and Relocations** | | **100% non-Federal** | | | **100% non-Federal** | | | | |
| Lands | – | 3,864,000 | 3,864,000 | – | | – | – | 3,864,000 | 3,864,000 |
| Utility Relocations | – | – | – | – | 22,658,500 | 22,658,500 | – | 22,658,500 | 22,658,500 |
| Subtotal | – | 3,864,000 | 3,864,000 | – | 22,658,500 | 22,658,500 | – | 26,522,500 | 26,522,500 |
| **Other Federal Costs** | | **100% Federal** | | | **100% Federal** | | | | |
| Aids to Navigation - USCG Channel Markers | 1,618,000 | – | 1,618,000 | – | – | – | 1,618,000 | – | 1,618,000 |
| **Associated non-Federal Costs (owner cost)** | | **100% non-Federal** | | | **100% non-Federal** | | | | |
| Utility Relocations | – | – | – | – | 22,658,500 | 22,658,500 | – | 22,658,500 | 22,658,500 |
| Berthing Areas & Dock Modifications | – | 14,212,000 | 14,212,000 | – | 7,616,000 | 7,616,000 | – | 21,828,000 | 21,828,000 |
| Subtotal | – | 14,212,000 | 14,212,000 | – | 30,274,500 | 30,274,500 | – | 44,486,500 | 44,486,500 |
| **Fully-Funded (Escalated) Costs** | 615,043,000 | 222,088,000 | 837,131,000 | 135,654,000 | 188,587,000 | 324,241,000 | 750,697,000 | 410,675,000 | 1,161,372,000 |

## XI.F ADDITIONAL NON-FEDERAL SPONSOR CASH CONTRIBUTION

For all navigation channel depths, the Sponsor must provide an additional cash contribution equal to 10 percent of fully funded GNF costs as shown below in Table XI-7 (USACE, 2000b). These costs may be paid over a period not exceeding 30 years. The Sponsor's costs for LER and relocations (including utility relocations) are credited against the additional cash contribution.

Table XI-7
Total General Navigation Features Costs and Credits
(October 2009 Price Level)
(All costs in dollars)

| | |
|---|---|
| Cost-Shared GNF | 1,088,745,000 |
| 10% of GNF | 108,874,500 |
| | |
| Creditable Land Costs | 3,864,000 |
| Relocation Costs | 22,658,500 |
| Total non-Federal Sponsor Creditable Costs | 26,522,500 |
| Creditable Difference | (82,352,000) |

## XI.G NON-FEDERAL SPONSOR VIEWS

The Sponsor for the existing project, SNND, has actively participated in the entire planning process. Their primary concern has been to provide the community with a channel design, preferably 48 feet deep, to increase navigation efficiency and prepare for future needs. The SNND fully supports the Recommended Plan and has indicated an interest in beginning construction as soon as possible.

# XII. SUMMARY OF COORDINATION

## XII.A OVERVIEW

This section identifies the coordination process used during the feasibility study to obtain comments and concerns from the general public, State and Federal resource agencies, and any other interested parties. A general summary of the comments is provided below. A more detailed description of the public involvement process and a complete list of all comments can be found in Appendix A of the FEIS.

## XII.B COORDINATION

The USACE and SNND developed a public involvement plan to be used during the feasibility phase for the SNWW CIP. The goal of the public involvement plan was to ensure that the USACE and SNND were responsive to the needs and concerns of all stakeholders and to ensure public involvement through an open, interactive process. Stakeholders include all the various publics that could be affected or might be interested in the project. The plan helped the USACE and SNND provide information to, and obtain information from, the stakeholders.

Coordination with resource agencies was conducted primarily through the ICT and technical working group meetings. Resource agencies and the study team met regularly throughout the study process. Over 30 workgroup meetings and 11 ICT meetings were held.

A proactive outreach program was initiated to ensure that the public, resource agencies, industry, local government, and other interested parties were informed about the project and that any concerns were identified and addressed. Each of the activities listed here is described individually in Appendix A of the FEIS. The outreach program included:

- Scoping meetings;
- Public workshops to obtain ideas for BU of dredged material;
- Media trips by boat down the waterway;
- Presentations at the GMFMC's Texas Habitat Protection Advisory Panel;
- Presentations at regular meetings of Southeast Texas Waterway Advisory Council,
- Meetings with SPA;
- Presentation at the 2007 South East Texas Leaders meeting; and
- Meetings with SNWW industries.

## XII.C PUBLIC/AGENCY COMMENTS

The following is an overview of the comments and concerns throughout the study process. These comments were received from the general public, State and Federal resource agencies, and other interested parties.

## Saltwater Intrusion

The primary environmental concern is the potential for the proposed CIP to increase saltwater intrusion, and for higher salinity levels to further degrade marshes and cypress swamps in both Texas and Louisiana. The combined effects of subsidence and sea level rise are expected to increase marsh submergence and worsen this trend. The public and resource agencies identified severely stressed marsh areas at Texas Point and Salt Bayou in the Sabine Pass area, in the Neches River reach between Sabine Lake and IH 10, and in the extensive marshes east of Sabine Lake.

An associated issue is the deterioration of wildlife habitat and fishery nursery areas and the destruction of fish and wildlife resources that could occur as a result of increased wetland loss. All or portions of the following federally and State-protected lands are located in sensitive habitats, which may be affected by the proposed CIP: the Sabine NWR, the McFaddin NWR, the Texas Point NWR, the J.D. Murphree WMA, the Lower Neches WMA, the Tony Houseman WMA, and the Sabine Island WMA.

It was suggested that environmental impacts as a consequence of the proposed CIP should be avoided if possible. A lock at Sabine Pass, a sill or constriction at the mouth of Sabine Lake, and smaller water control structures in the marshes east of Sabine Lake were suggested as methods to minimize or avoid impacts. Other comments warned of the potential harmful effects of water control structures, which inhibit the movement of marine organisms into and out of intertidal marshes.

## Threatened and Endangered Species

Potential impacts to threatened and endangered species are a concern, particularly dredging impacts to endangered sea turtles. The offshore channel deepening and extension would require the use of hopper dredges, which create particular hazards for sea turtles. Critical Habitat for the wintering piping plover is present in the study area.

## Contaminated Sediments

The public also expressed concern that dredging for the proposed CIP and the placement of dredged material would spread contaminated sediments or affect water quality. It is feared that new work dredging would release contaminants from past industrial discharges into the water column, or that areas selected for the BU of dredged material could be polluted.

The BU of dredged material to restore degraded marshes was encouraged by the public and resource agencies. The following sites were specifically identified as areas that could benefit: Rose City marsh, Bessie Heights marsh, Keith Lake marsh, marshes in the McFaddin NWR, east Sabine Lake marshes, and the Gulf shoreline at Texas Point and Holly Beach. Construction of a bird island in Sabine Lake was also suggested. The BU of dredged material would reduce the need for new or expanded PAs and reduce potential wetland impacts.

## Essential Fish Habitat

The proposed CIP, including the Gulf of Mexico ODMDSs, could impact EFH for red drum; brown, white, and pink shrimp; Spanish mackerel; and estuarine water column and mud/sand bottoms. Potential effects to nursery and foraging habitat for economically important marine fishery species such as spotted sea trout, flounder, Atlantic croaker, black drum, Gulf menhaden, striped mullet, and blue crab also need to be evaluated for adverse effects associated with proposed water control structures.

## Storm Surge and Erosion

Concern has been expressed that the proposed CIP could increase tidal amplitude, and increase damage during storm surges by allowing the surge to inundate areas that have not been affected by previous storms. Concerns were also expressed about the potential increased erosion along the shoreline of the channel due to increased or larger vessel traffic.

## Cultural Resources

Concern was expressed that the use of the existing PA 5 would adversely affect public access to the Sabine Lighthouse, a National Register-listed property. A road around the perimeter of the PA is currently the only access route to the Lighthouse. Changes or enlargements to this PA could limit or remove access to the historic property. Furthermore, proposed project improvements could affect the Sabine Pass Battleground Park, Fort Griffin, and associated shipwrecks along the waterway. These sites and the shipwrecks are associated with important battles during the U.S. Civil War.

## Socioeconomic and Project Costs

Considerable concern was expressed by government agencies in Louisiana that the proposed CIP would have adverse effects on their State's environment while providing no economic benefits for Louisiana. Officials at the West Calcasieu Port, Harbor and Terminal District urged that navigation improvements be evaluated on a regionwide basis, because channel improvements in Texas could put their facilities and the Port of Lake Charles at a competitive disadvantage. Cameron Parish officials expressed support for economic development that would benefit their constituents. Cameron Parish officials were also concerned that lands suitable for commercial development at Sabine Pass were being considered for use as PAs. Developable lands are limited on the Louisiana side of the SNWW, and all are needed to promote economic development.

The high concentration of petrochemical refineries and terminals in the study area means that a large number of pipelines are also present. Local industries are concerned that these pipelines would be affected by the proposed channel deepening and that they would be responsible for the cost of relocating these pipelines below a deeper channel bottom.

Several members of the general public expressed concern that the cost of this project would be large, that benefits would not be sufficient to outweigh costs, and that costs would be passed on to taxpayers in the form of higher taxes.

## Public Infrastructure

Jefferson County Drainage District #7 expressed concern that channel widening and deepening could affect the structural integrity of the Port Arthur Hurricane Protection Levee, pump stations, and closure structures. The Texas Department of Transportation expressed concern that increased erosion could adversely affect SH 82 and SH 87. Both are located immediately adjacent to the SNWW and are affected by present channel bank erosion. Additional erosion of SH 87 could destroy the only road access to the City of Sabine Pass.

# XIII. RECOMMENDATIONS

Based on the analyses and information in this document and the FEIS, it is recommended that the existing SNWW, Texas, authorized by the RHA of 1962, be modified generally as described in this report as the Recommended Plan, with such modifications as in the discretion of the Chief of Engineers may consider advisable, and subject to cost-sharing and financing arrangements satisfactory to the President of the United States and Congress, to provide deep-draft channel and selective widening improvements and continued maintenance of the SNWW Channel.

A categorical exemption for navigation projects exists to deviate from selection of the NED plan in accordance with ER 1105-2-100, E-3.b(5) that states:

> "Categorical Exemption for Flood Control and Navigation Projects. If the non-Federal sponsor identifies a constraint to maximum physical project size or a financial constraint due to limited resources, and if net benefits are increasing as the constraint is reached, the requirement to formulate larger scale plans in an effort to identify the NED plan is suspended. The constrained plan may be recommended. . . ."

The proposed project meets the requirements for a categorical exemption due to the sponsor's financial constraint and is recommended as the recommended plan. This constrained LPP consists of deepening of the channel to 48 feet as described in Section X of this report.

## XIII.A PROJECT COSTS (October 2009 Price Levels)

For the purpose of calculating the Section 902 limit, the total estimated first cost of the project is $1,029,318,000, including an estimated Federal share of $691,383,000 and an estimated non-Federal share of $337,935,000. Total First Cost of all project components in current dollars, without escalation and IDC, totals $1,071,877,000. The Fully Funded Cost for the project, which includes Total First Costs and expected escalation, is $1,161,372,000. The Investment Cost of all components totals $1,191,259,000, and includes $119,382,000 in IDC. Total annual costs for the project are $91,341,000 and total annual benefits are $115,074,000, resulting in a project BCR of 1.3.

## XIII.B REQUIREMENTS

These recommendations are made with the provision that, prior to implementation of the recommended improvements, the Sponsor shall enter into binding agreements with the Federal government to comply with the following requirements.

The SNND shall:

a. Provide 10 percent of the total cost of construction of the general navigation features (GNFs) attributable to dredging to a depth not in excess of 20 feet; plus 25 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 20 feet but not in

excess of 45 feet; plus 50 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 45 feet as further specified below:

1. Provide 25 percent of design costs allocated by the Government to commercial navigation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to commercial navigation;

3. Provide, during construction, any additional funds necessary to make its total contribution for commercial navigation equal to 10 percent of the total cost of construction of the GNFs attributable to dredging to a depth not in excess of 20 feet; plus 25 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet; plus 50 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 45 feet;

b. Provide all lands, easements, and rights-of-way (LER), including those necessary for the borrowing of material and the disposal of dredged or excavated material, and perform or ensure the performance of all relocations, including utility relocations, all as determined by the Federal Government to be necessary for the construction or operation and maintenance, of the GNFs;

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the GNFs, an additional amount equal to 10 percent of the total cost of construction of the GNFs less the amount of credit afforded by the Government for the value of the LER and relocations, including utility relocations, provided by the Sponsor for the GNF. If the amount of credit afforded by the Government for the value of the LER and relocations, including utility relocations, provided by the Sponsor equals or exceeds 10 percent of the total cost of construction of the GNFs, the Sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of LER and relocations, including utility relocations, in excess of 10 percent of the total cost of construction of the GNFs;

d. Provide, operate, maintain, repair, replace, and rehabilitate, at its own expense, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

e. Provide 50 percent of the excess cost of operation and maintenance of the project over that cost that the Federal Government determines would be incurred for operation and maintenance if the project had a depth of 45 feet;

f. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, and maintaining the GNFs;

g. Hold and save the United States free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;

h. Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of construction of the GNFs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20;

i. Perform, or ensure performance of, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601–9675, that may exist in, on, or under LER that the Federal Government determines to be necessary for the construction or operation and maintenance of the GNFs. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the Federal Government provides the Sponsor with prior specific written direction, in which case the Sponsor shall perform such investigations in accordance with such written direction;

j. Assume complete financial responsibility, as between the Federal Government and the Sponsor, for all necessary cleanup and response costs of any hazardous materials regulated under CERCLA that are located in, on, or under LER that the Federal Government determines to be necessary for the construction or operation and maintenance of the project;

k. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA;

l. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 USC 1962d-5b), and Section 101 of the WRDA 86, Public Law 99-662, as amended, which provide that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

m. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 USC 4601–4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring LER required for construction or operation and maintenance of the project; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

n. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 USC § 2000d et seq.), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army." The Sponsor is also required to comply with all applicable Federal labor standards requirements including, but not

limited to, 40 USC 3144–3148 and 40 USC 3701–3708 (revising, codifying, and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 USC 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 USC 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 USC 276c);

o. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project; and

p. Not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefor, to meet any of the Sponsor's obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that such funds are authorized to be used to carry out the project.

Construction of the recommended channel improvements is estimated to take 7 years to complete. During this period, the Government and the Sponsors shall diligently maintain the projects at their previously authorized dimensions according to the previous cooperation agreement. Maintenance materials that have accumulated in the channels at the time that "before dredging" profiles are taken for construction payment shall be considered as new work material and cost-shared according to the new cooperation agreement. Any dredging in a construction contract reach after the improvements have been completed and the construction contract closed would be considered to be maintenance material and cost-shared according to the new agreement.

## XIII.C MAINTENANCE OF NEW CHANNEL AND EXISTING CHANNEL

The portions of the SNWW channel that are deepened and widened (including any newly created areas) shall be operated and maintained according to the terms and provision of the new agreements. All other portions of the existing SNWW channel shall continue to be operated and maintained according to the existing agreement applicable to that portion of the channel. With the cost of maintenance dredging continuing to rise every year, it is imperative to fully fund the maintenance portion of this project each year. Recent fiscal year funding of $12–$15 million is insufficient and does not allow the channel to be maintained at the current authorized depth of 40 feet. This report forecasts a shoaling rate nearly double the current rate. This increased rate, combined with more fully loaded ships traversing the waterway, stresses the importance of maximum and consistent funding of O&M costs for the new project depth.

## XIII.D RECOMMENDATION

The recommendations of the Sabine-Neches CIP to deepen the waterway depth to 48 feet with selective widening, as described in Section X of this document, reflects the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels with the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorizations and

implementation funding. However, prior to transmittal to the Congress, the Sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Christopher W. Sallese
Colonel, U.S. Army Corps of Engineers
District Commander

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Date

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# FINAL FEASIBILITY REPORT
# FOR
# SABINE-NECHES WATERWAY
# CHANNEL IMPROVEMENT PROJECT
# SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

## VOLUME I

ENGINEERING PLATES (APPENDIX 1)
ECONOMICS (APPENDIX 2)
BASELINE COST ESTIMATE (APPENDIX 3)
REAL ESTATE PLAN (APPENDIX 4)

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

March 2011

# Appendix 1

# Engineering Plates

Deep Draft Navigation Channel Improvements
Sabine Neches Waterway, Texas

# ENGINEERING ADDENDUM
# FOR
# CHANNEL IMPROVEMENT STUDY
# SABINE NECHES WATERWAY
# 48' PROJECT

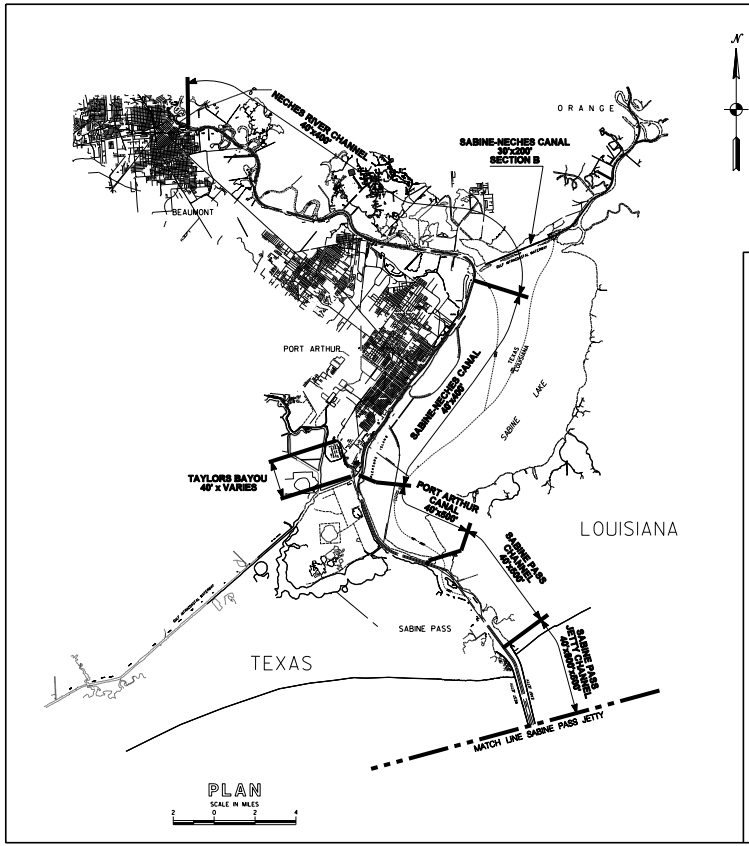
Center of Excellence

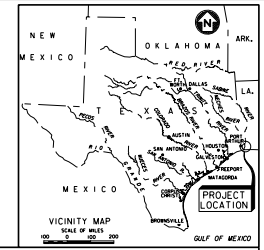
Coastal Navigation and Environmental Restoration

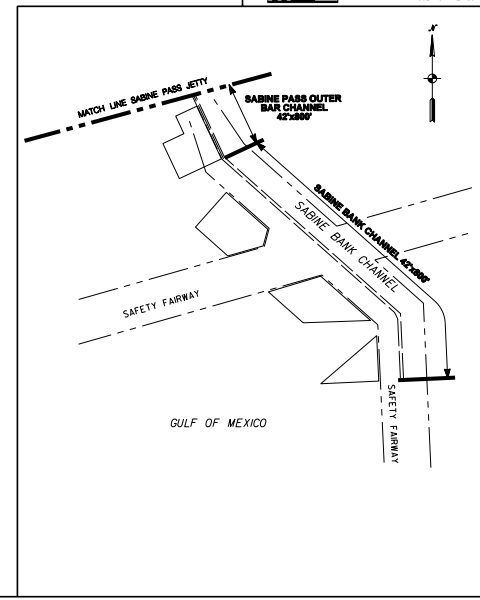
Office of the District Engineer
U. S. Army Engineer District, Galveston
Corps of Engineers
Galveston, Texas
Aug 2009

TOTAL ARMY QUALITY

PRINTED ON RECYCLED PAPER




US Army Corps of Engineers Galveston District

| Rev. | Date | Description |
|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

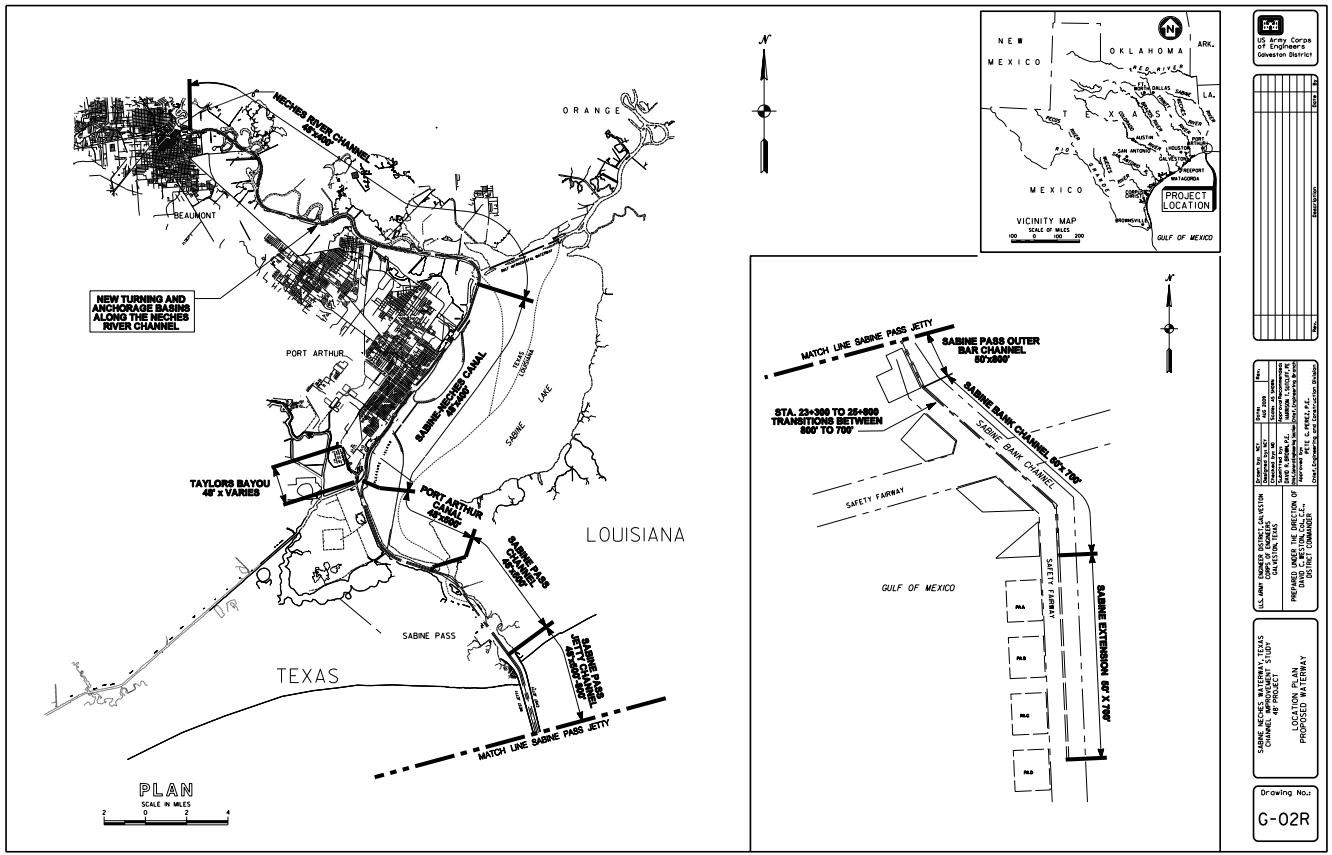
PREPARED UNDER THE DIRECTION OF
THE DISTRICT ENGINEER
DISTRICT COMMANDER

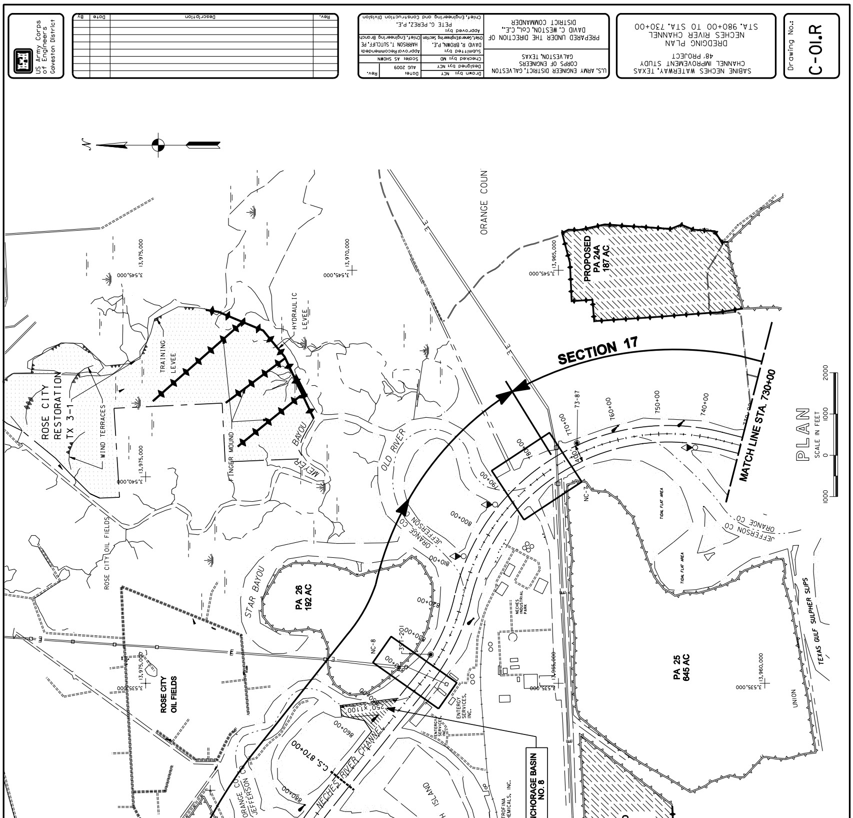
Drawn by: EBR/KJ
Checked by: KJ
Date: 1-18-02
Scale: 1:48,000
Approved by: Marcus Rhodes/PJK
Rick Sandifer/PJK
Bob Sandifer/PJK
Chief, Engineering Division

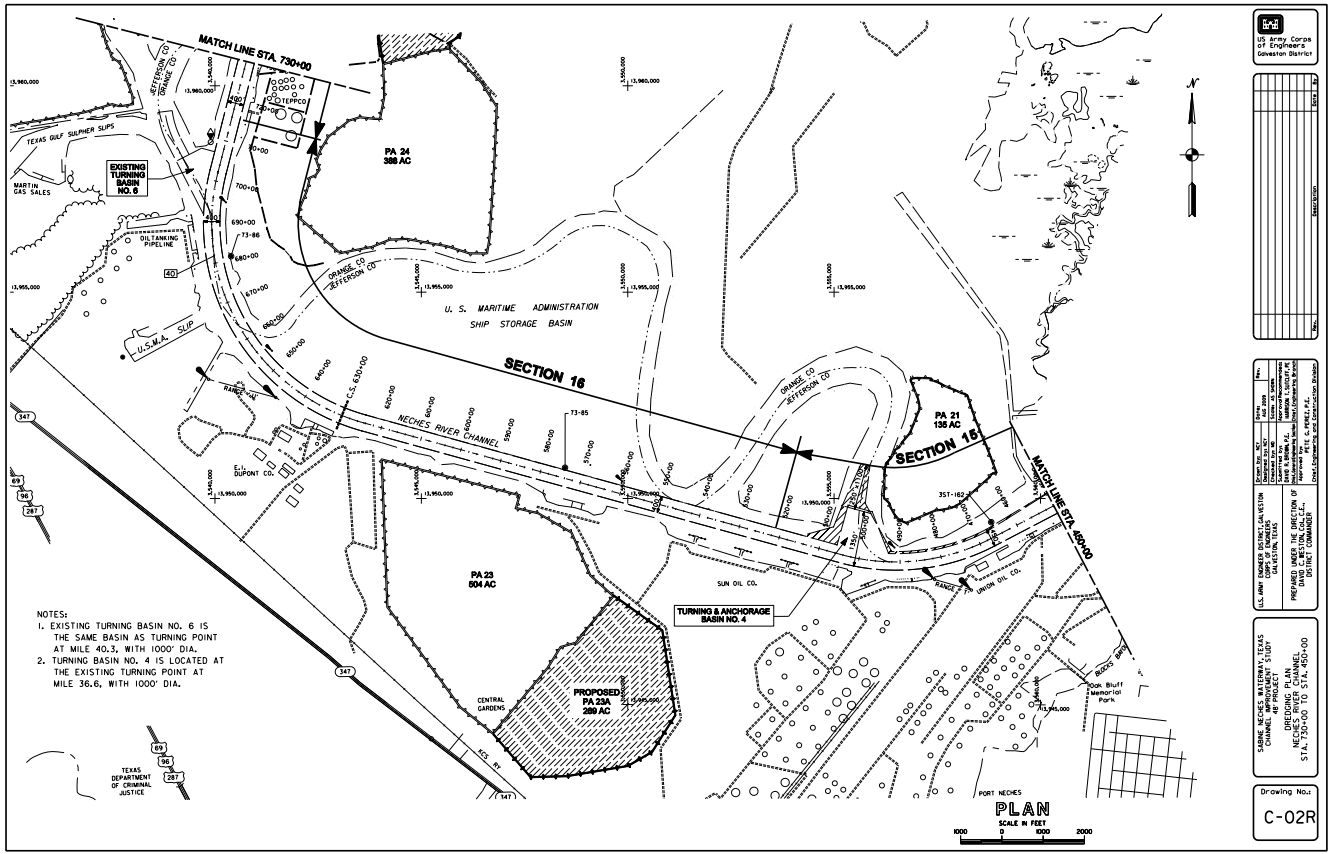
SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
US 69 PROJECT

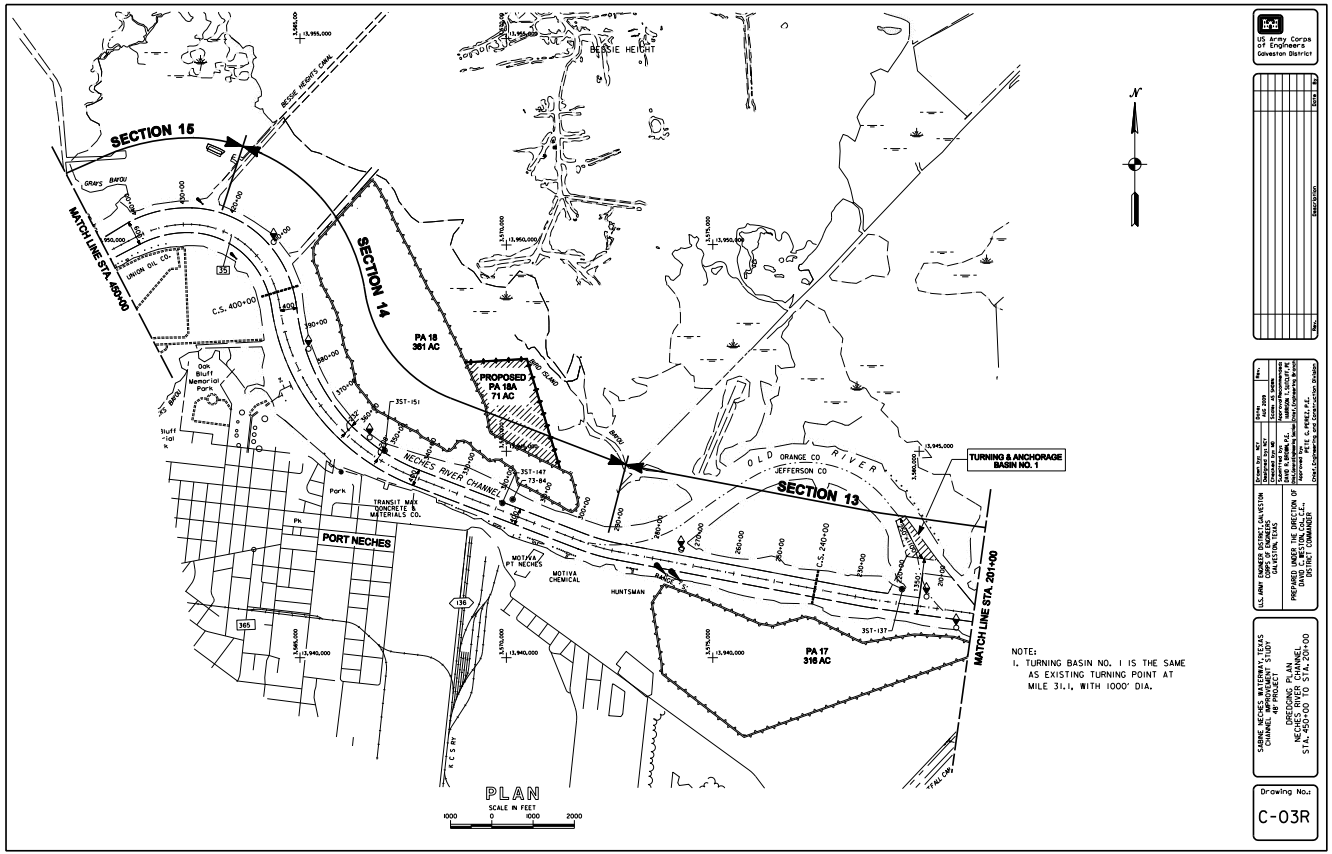
LOCATION PLAN
EXISTING WATERWAY

Drawing No.:
G-01


NECHES RIVER CHANNEL 45'x400'
ORANGE
BEAUMONT
NEW TURNING AND ANCHORAGE BASINS ALONG THE NECHES RIVER CHANNEL
PORT ARTHUR
SABINE-NECHES CANAL 45'x200'
TEXAS
LOUISIANA
SABINE LAKE
TAYLORS BAYOU 45' x VARIES
PORT ARTHUR CANAL 45'x200'
SABINE PASS CHANNEL 45'x200'
SABINE PASS
SABINE PASS JETTY CHANNEL 45'x200' 400'
MATCH LINE SABINE PASS JETTY
PLAN
SCALE IN MILES
2 0 2 4
NEW MEXICO
OKLAHOMA
ARK.
TEXAS
LA.
MEXICO
GULF OF MEXICO
PROJECT LOCATION
VICINITY MAP
SCALE OF MILES
100 0 100 200
MATCH LINE SABINE PASS JETTY
SABINE PASS OUTER BAR CHANNEL 50'x500'
STA. 23+300 TO 25+800 TRANSITIONS BETWEEN 500' TO 700'
SABINE BANK CHANNEL 50'x700'
SABINE BANK CHANNEL
SAFETY FARWAY
GULF OF MEXICO
SABINE EXTENSION 50' X 700'
US Army Corps of Engineers Galveston District
SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENTS
45' PROJECT
LOCATION PLAN
PROPOSED WATERWAY
Drawing No.:
G-02R


US Army Corps of Engineers Galveston District
U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF DAVID C. WESTON, Col., C.E., DISTRICT COMMANDER
Approved by: PETE C. PEREZ, P.E. Chief, Engineering and Construction Division
SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
48' PROJECT
DREDGING PLAN
NECHES RIVER CHANNEL
STA. 980+00 TO STA. 730+00
Drawing No.: C-01.R
ROSE CITY RESTORATION TX 3-1
WIND TERRACES
TRAINING LEVEE
HYDRAULIC LEVEE
FINGER MOUND
METEER BAYOU
OLD RIVER
ORANGE COUN
PROPOSED PA 24A 187 AC
SECTION 17
MATCH LINE STA. 730+00
PA 26 192 AC
STAR BAYOU
ROSE CITY OIL FIELDS
PA 25 645 AC
TEXAS GULF SULPHER SLIPS
UNION
NC-8
ANCHORAGE BASIN NO. 8
ENTERGY SERVICES, INC.
NECHES INDUSTRIAL PARK
C.S. 870+00
NECHES RIVER CHANNEL
SMITH ISLAND
ATROFINA CHEMICALS, INC.
PROPOSED PA 25A 175 AC
JEFFERSON COUNTY
ORANGE CO
JEFFERSON CO
SECTION 18
PA 27 A 128 AC
PROPOSED PA 27C 87 AC
PROPOSED PA 27D 55 AC
NC-9
EXXON MOBIL
EXXON MOBIL OIL DOCK
NORTH STAR TEXAS STEEL
Carroll St Park
GRAIN DOCK
MANEUVERING BASIN
PORT OF BEAUMONT TURNING BASIN
NORTHERLY LIMITS OF DREDGING STA. 980+00
RAILWAY
K C S RY
PLAN
SCALE IN FEET
LEGEND
(FOR DWGS C-01 THRU C-14)
EXISTING CHANNEL
CHANNEL STATIONING
NEW DREDGING LIMITS
PROPOSED NEW CHANNEL
PROPOSED NEW ℄
PROPOSED NEW CHANNEL
COUNTY BOUNDARY
WATERWAY MILEAGE MARKER
PROPOSED TRAINING LEVEE
EXISTING LEVEE
PROPOSED HYDRAULIC LEVEE
LEVEE BY OTHERS
CROSS SECTION LOCATION
PIPELINE X-ING
OVERHEAD ELECTRICAL LINES
NAVIGATION AIDS
SOIL BORING LOCATION
NOTES: (FOR DWGS C-01 THRU C-14)
1. FOR CROSS SECTIONS, SEE DWGS C-15 THRU C-20.
2. NAVIGATION AIDS SHOWN ARE FOR EXISTING WATERWAY, AND DO REPRESENT PROPOSED CHANGES.
3. FOR CLARITY, PIPELINES ARE NOT SHOWN ON PLANS.
4. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NAD83.


MATCH LINE STA. 730+00
MATCH LINE STA. 450+00
SECTION 16
SECTION 15
PA 24
398 AC
PA 23
504 AC
PA 21
135 AC
PROPOSED
PA 23A
289 AC
EXISTING
TURNING
BASIN
NO. 6
TURNING & ANCHORAGE
BASIN NO. 4
U. S. MARITIME ADMINISTRATION
SHIP STORAGE BASIN
NECHES RIVER CHANNEL
U.S.M.A. SLIP
TEXAS GULF SULPHER SLIPS
MARTIN
GAS SALES
OILTANKING
PIPELINE
E.I.
DUPONT CO.
SUN OIL CO.
UNION OIL CO.
CENTRAL
GARDENS
TEXAS
DEPARTMENT
OF CRIMINAL
JUSTICE
PORT NECHES
Hook Bluff
Memorial
Park
ORANGE CO
JEFFERSON CO
STEPCO
NOTES:
1. EXISTING TURNING BASIN NO. 6 IS THE SAME BASIN AS TURNING POINT AT MILE 40.3, WITH 1000' DIA.
2. TURNING BASIN NO. 4 IS LOCATED AT THE EXISTING TURNING POINT AT MILE 36.6, WITH 1000' DIA.
PLAN
SCALE IN FEET
0 1000 2000
US Army Corps of Engineers
Galveston District
SABINE NECHES WATERWAY, TEXAS
CONSTRUCTION PLAN, STAGE 4B PROJECT
DREDGING PLAN
NECHES RIVER CHANNEL
STA. 730+00 TO STA. 450+00
Drawing No.:
C-02R
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CONSTRUCTION DIVISION
GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF
DAVID G. RESTIVO, P.E.
CHIEF, CONSTRUCTION DIVISION
Date: 10 Dec 1991
Scale: 1" = 1000'
Drawn by: MC
Checked by: MC
Designed by: MC
Approved by: PETE G. PERELLI, P.E.
Chief, Engineering and Construction Division
Rev.
Date
Revision
Rev.




NOTE:
1. TURNING BASIN NO. 1 IS THE SAME AS EXISTING TURNING POINT AT MILE 31.1, WITH 1000' DIA.

US Army Corps of Engineers
Galveston District

| No. | Date | Description | Sheet No. |
|---|---|---|---|
| | | | |

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

Drawn by: MC
Date: AUG 2009
Checked by: TBY
Scale: 1" = 1000'
Submitted by: RW
Approved by: DAVID L. BERTOLINO, P.E.
CHIEF, ENGINEERING DIVISION

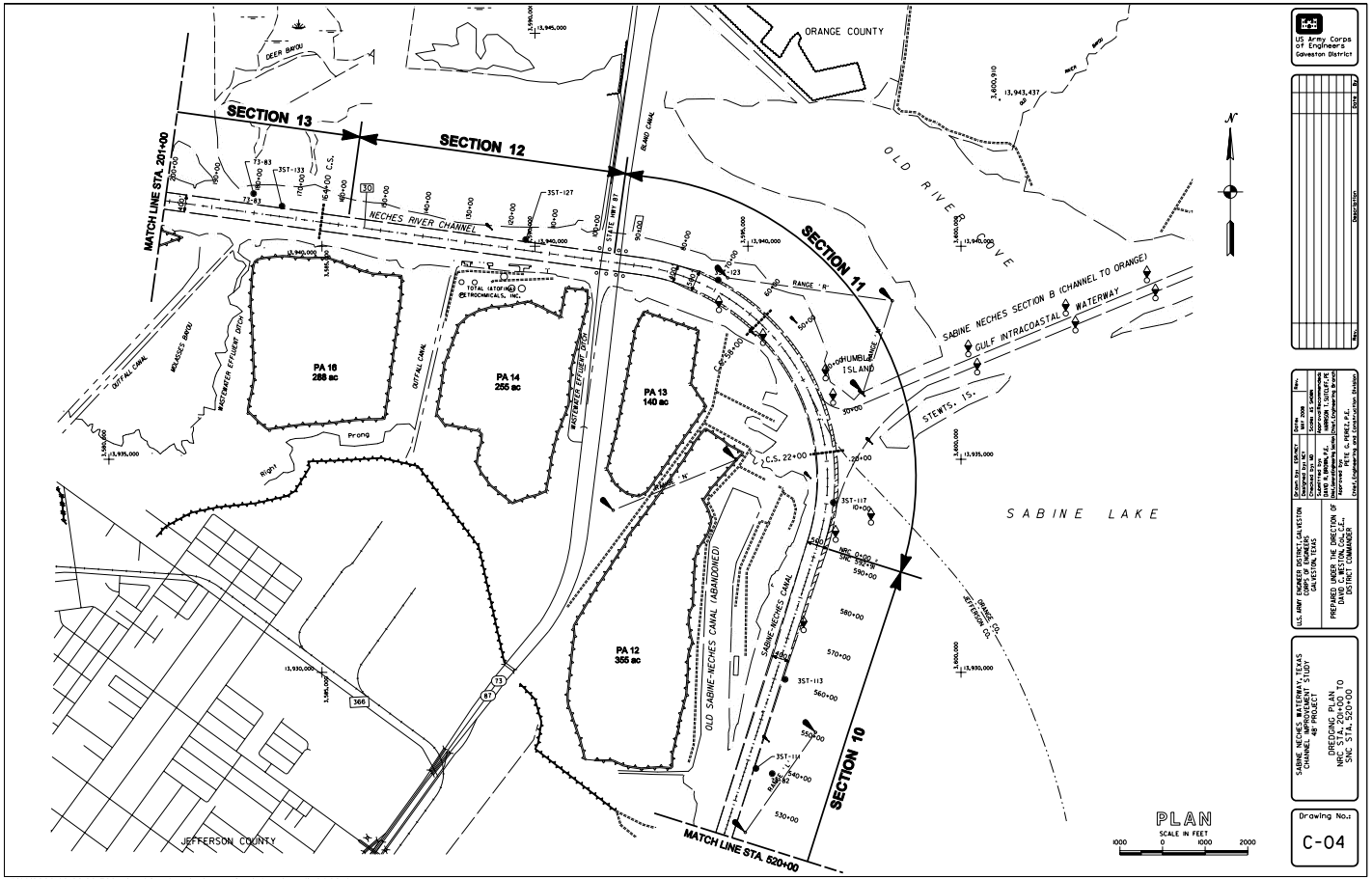
Rev.

PREPARED UNDER THE DIRECTION OF
DAVID L. BERTOLINO, P.E.
CHIEF, ENGINEERING DIVISION

SABINE-NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENTS, 1965
4B PROJECT

DREDGING PLAN
NECHES RIVER CHANNEL
STA. 450+00 TO STA. 201+00

Drawing No.:
C-03R

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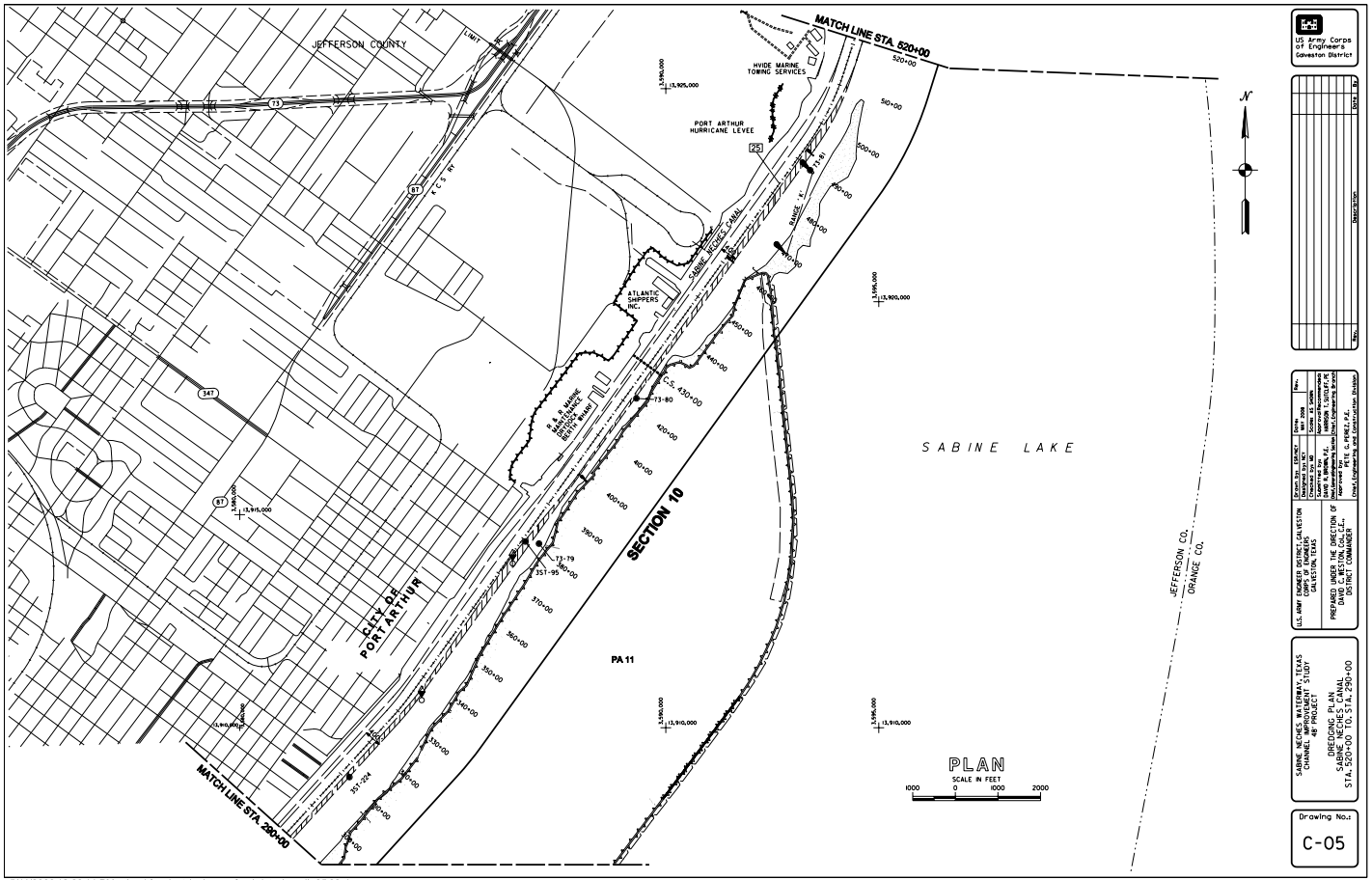
JEFFERSON COUNTY
LIMIT
MATCH LINE STA. 520+00
HYDE MARINE TOWING SERVICES
PORT ARTHUR HURRICANE LEVEE
K.C.S. RR
SABINE NECHES CANAL
CANAL "A"
ATLANTIC SHIPPERS INC.
F.A.A. & MARINE MAINTENANCE BASTROP WHARF
C.S. 430+00
T3-80
T2-79
T3-81
T3-91
T3-92
T3-93
T3-94
T3-95
T3-96
T3-97
T3-98
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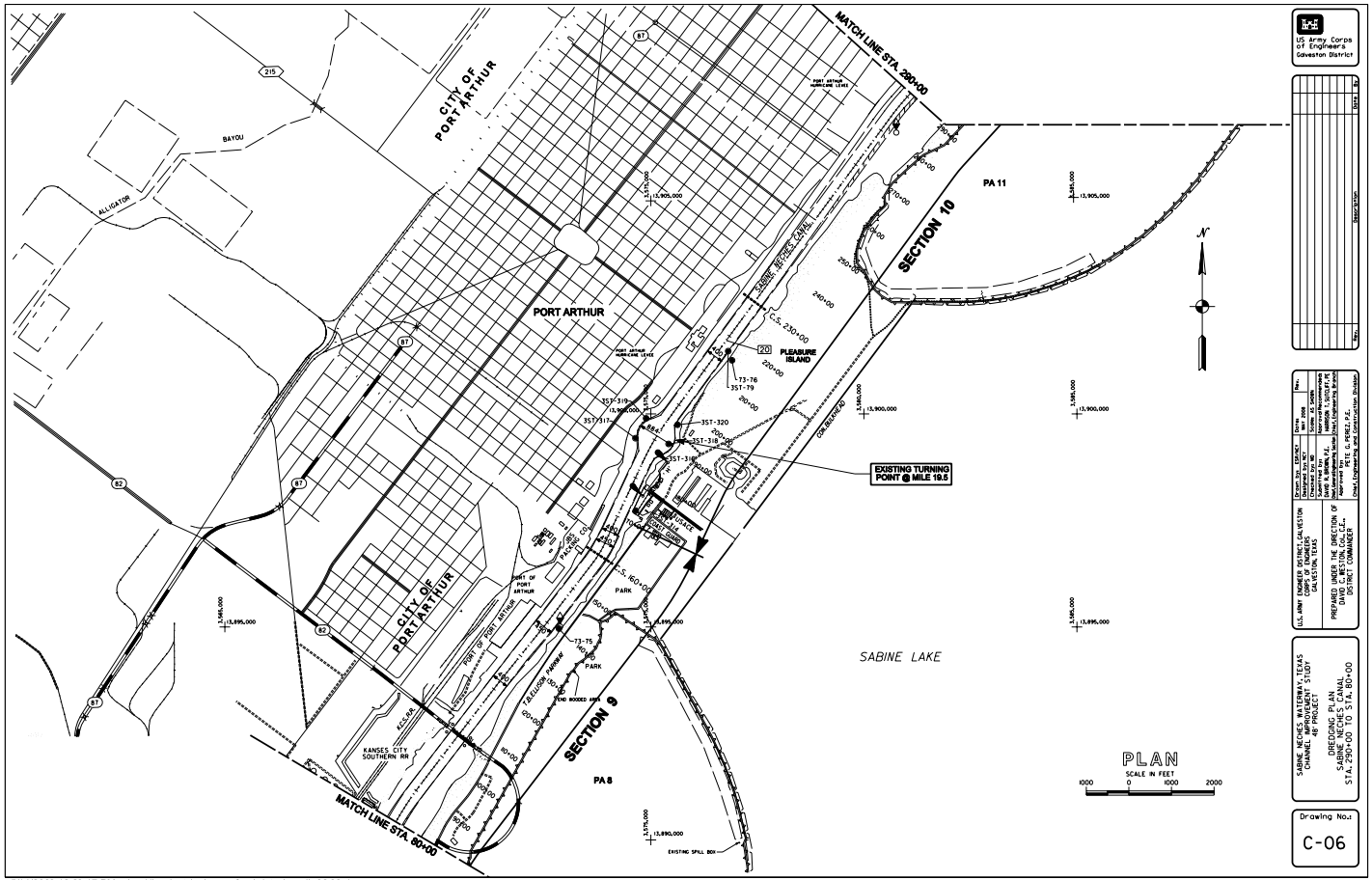
T3-128
T3-129
T3-130

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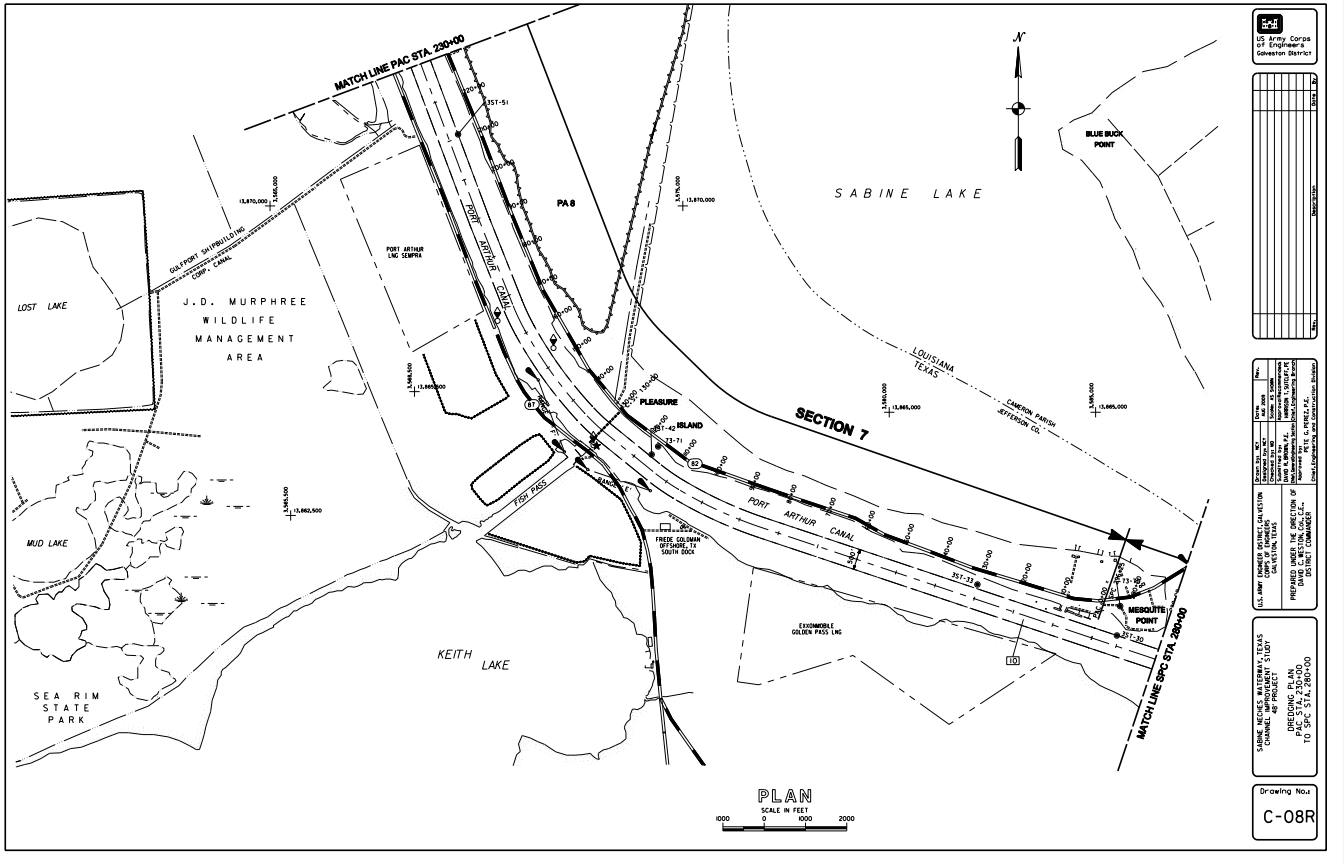
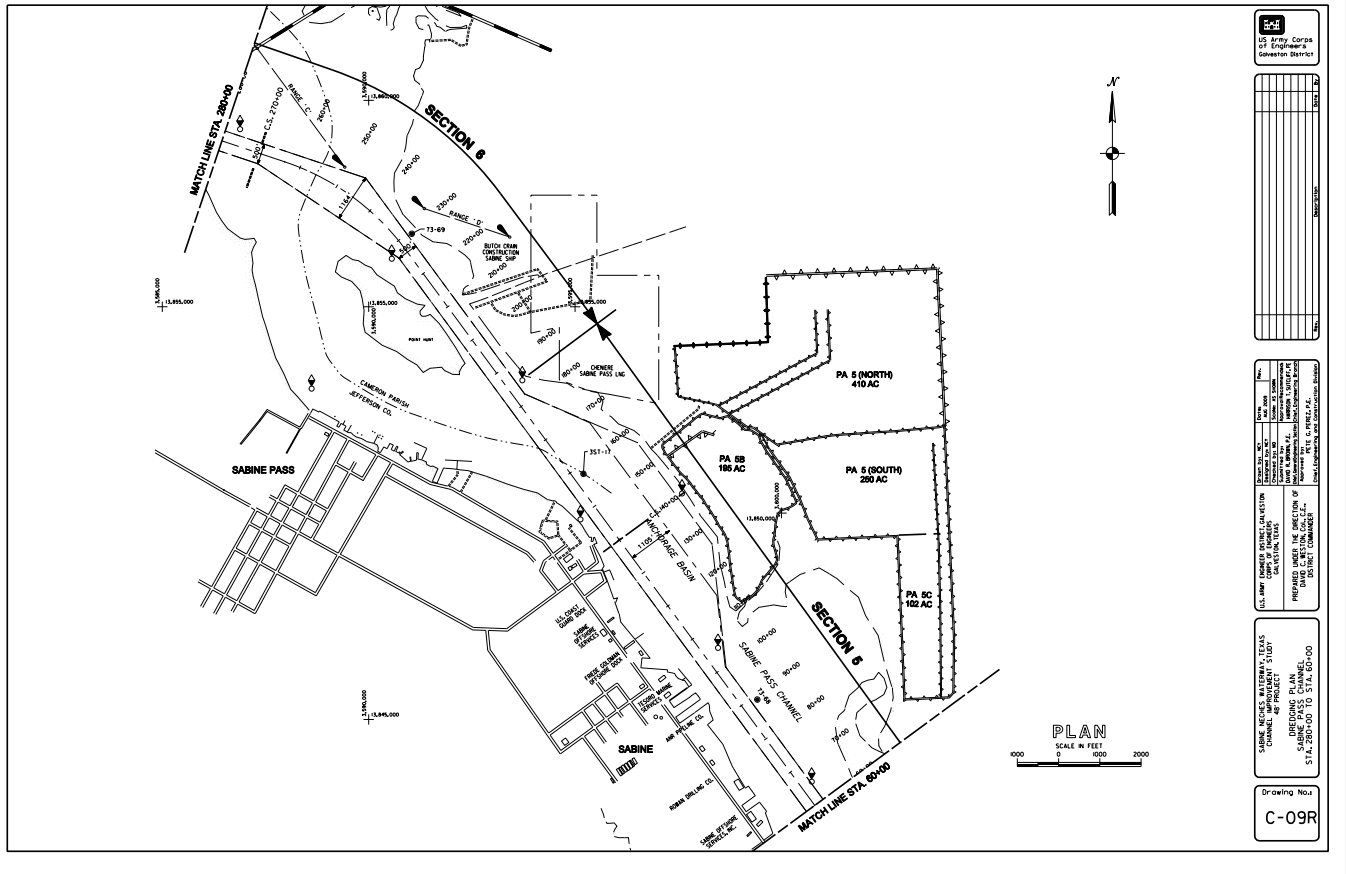
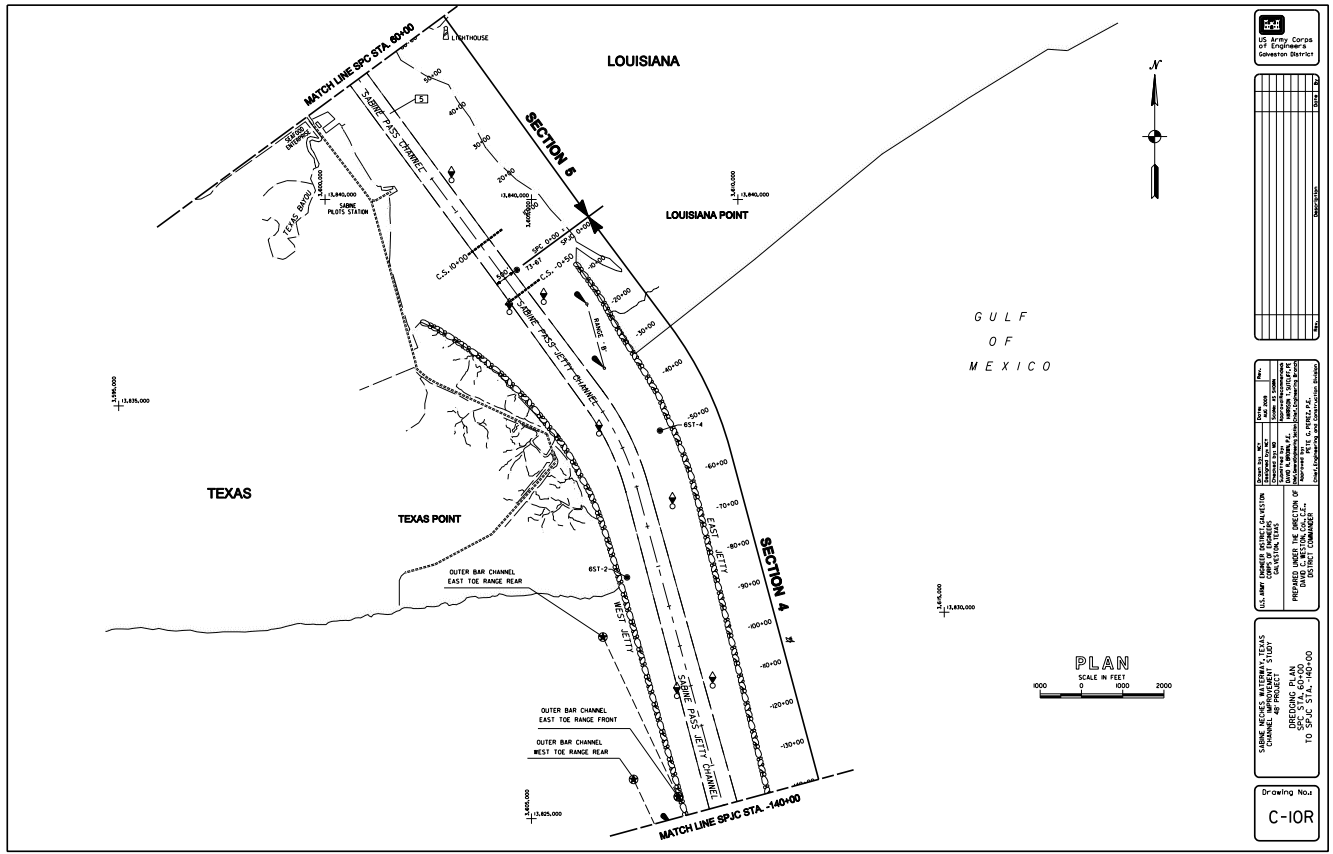
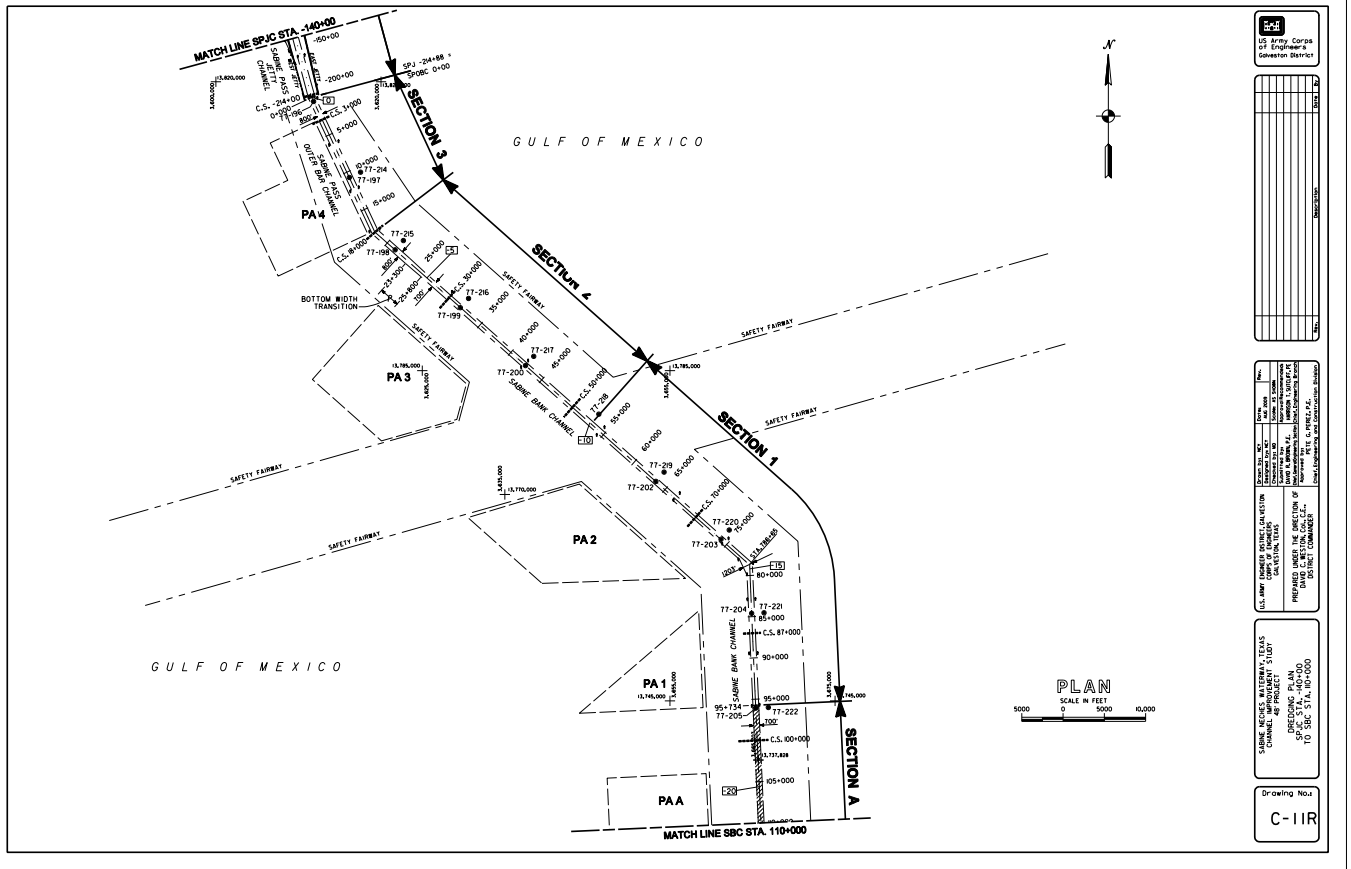
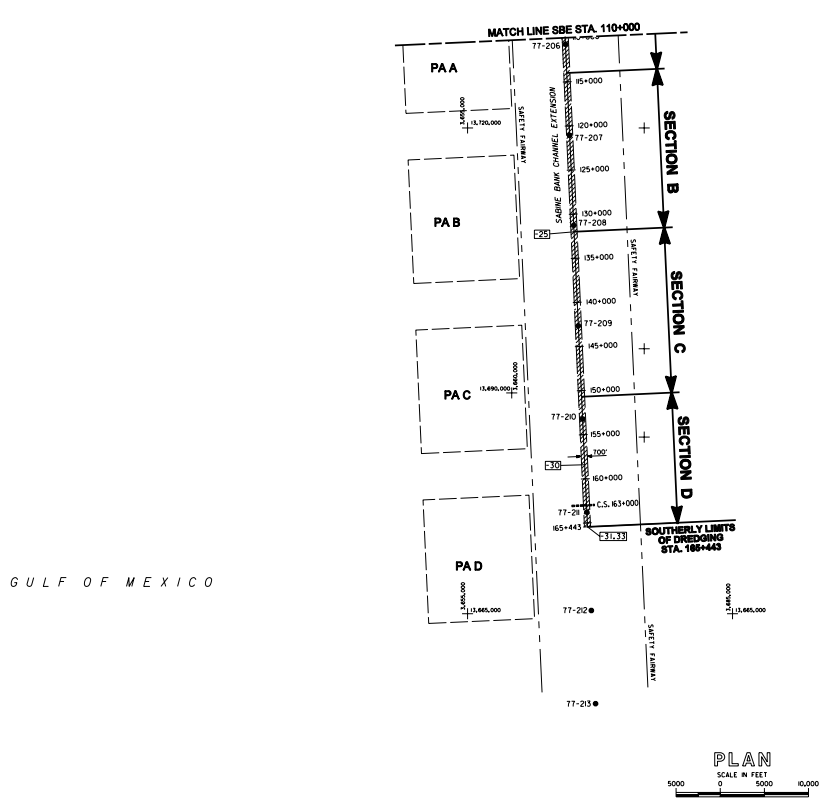
US Army Corps of Engineers Galveston District
Rev. Description Date By
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF
DAVID C. BESTONE, COL.,C.E.
DISTRICT COMMANDER
SABINE NECHES WATERWAY, TEXAS
CHANNEL MODIFICATION STUDY
4B PROJECT
DREDGING PLAN
SNC STA. 80+00
TO PAC STA.230+00
Drawing No.:
C-07R
PLAN
SCALE IN FEET
1000 0 1000 2000
NOTE:
1. FOR TAYLORS BAYOU BASIN CHANNELS
SEE DWG C-14.
PORT ARTHUR CITY LIMIT
JEFFERSON CO.
CAMERON PAR.
SECTION 9
SECTION 8
MATCH LINE STA. 80+00
MATCH LINE STA. 230+00
SABINE-NECHES CANAL
PORT ARTHUR CANAL
ROUND LAKE
JCW WMA
PA 9
PA 8A
384 AC
PA 8B
168 AC
INTRACOASTAL WATERWAY
GULF
TAYLOR BAYOU
OUTFALL CANAL
TAYLOR BAYOU TURNING BASIN
CHRISTMAS CHANNEL
CHRISTMAS CANAL
MILITARY CANAL
JEFFERSON CO.
CAMERON PAR.


MATCH LINE PAC STA. 230+00
MATCH LINE SPC STA. 280+00
SABINE LAKE
LOST LAKE
J.D. MURPHREE WILDLIFE MANAGEMENT AREA
PORT ARTHUR LNG SEMPRA
PORT ARTHUR CANAL
GULFPORT SHIPBUILDING CORP. CANAL
PA 8
PLEASURE ISLAND
SECTION 7
LOUISIANA
TEXAS
CAMERON PARISH
JEFFERSON CO.
BLUE BUCK POINT
MESQUITE POINT
FISH PASS
FREEPORT
FREEPORT COLDWATER OFFSHORE, TX SOUTH DOCK
EXXONMOBILE GOLDEN PASS LNG
MUD LAKE
KEITH LAKE
SEA RIM STATE PARK
N
PLAN
SCALE IN FEET
1000 0 1000 2000
US Army Corps of Engineers Galveston District
SABINE NECHES WATERWAY, TEXAS CHANNEL IMPROVEMENT STUDY JEFFERSON COUNTY
DIRECTIONAL PLAN PAC STA. 230+00 TO SPC STA. 280+00
U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF THE DISTRICT ENGINEER
DISTRICT COMMANDER
Drawing No.:
C-08R


MATCH LINE STA. 280+00
SECTION 6
SECTION 5
MATCH LINE STA. 50+00
SABINE PASS
SABINE
CAMERON PARISH
JEFFERSON CO.
PA 5B
195 AC
PA 5 (NORTH)
410 AC
PA 5 (SOUTH)
250 AC
PA 5C
102 AC
SABINE PASS CHANNEL
MARCHBANK BASIN
CHENIERE SABINE PASS LNG
BUTCH CRAIN CONSTRUCTION SABINE SHIP
POINT HART
U.S. COAST GUARD BASE
SABINE STEVEDORE SERVICE CO.
FIRE CRAIN STEVEDORE BASE
SABINE PILOTS SERVICE
ANR PIPELINE CO.
ROBIN DRILLING CO.
SABINE OIL STEVEDORE SERVICE INC.
RANGE "C"
RANGE "D"
73-69
73-68
ZST-1
PLAN
SCALE IN FEET
1000 0 1000 2000
N
US Army Corps of Engineers Galveston District
SABINE NECHES WATERWAY, TEXAS CHANNEL IMPROVEMENT STUDY JEFFERSON COUNTY
DREDGING PLAN SABINE PASS CHANNEL STA. 280+00 TO STA. 50+00
U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF THE DISTRICT ENGINEER
DISTRICT COMMANDER
Drawing No.:
C-09R


MATCH LINE SPC STA. 60+00
LIGHTHOUSE
LOUISIANA
SABINE PASS CHANNEL
SECTION 5
LOUISIANA POINT
TEXAS BAYOU
SABINE PILOTS STATION
C.S.-0+00
C.S.-0+50
SPC 0+00
SABINE PASS JETTY CHANNEL
RANGE 1A
GULF
OF
MEXICO
TEXAS
TEXAS POINT
EAST JETTY
WEST JETTY
SECTION 4
OUTER BAR CHANNEL
EAST TOE RANGE REAR
OUTER BAR CHANNEL
EAST TOE RANGE FRONT
OUTER BAR CHANNEL
WEST TOE RANGE REAR
MATCH LINE SPJC STA. -140+00
PLAN
SCALE IN FEET
1000 0 1000 2000
US Army Corps of Engineers Galveston District
SABINE NECHES WATERWAY, TEXAS CHANNEL IMPROVEMENT STUDY
DREDGING PLAN SPC STA. 60+00 TO SPJC STA. -140+00
Drawing No.:
C-10R


MATCH LINE SPJC STA. -140+00
SECTION 3
SECTION 4
SECTION 1
SECTION A
GULF OF MEXICO
GULF OF MEXICO
PA 4
PA 3
PA 2
PA 1
PA A
SABINE PASS OUTER BAR CHANNEL
SABINE PASS SAFETY CHANNEL
SABINE BANK CHANNEL
SAFETY FAIRWAY
BOTTOM WIDTH TRANSITION
MATCH LINE SBC STA. 110+000
PLAN
SCALE IN FEET
5000 0 5000 10,000
US Army Corps of Engineers Galveston District
SABINE NECHES WATERWAY, TEXAS CHANNEL IMPROVEMENT STUDY JEFFERSON COUNTY
DREDGING PLAN
SPJC STA. -140+00 TO SBC STA. 110+000
U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF: PETE A. PEREZ, P.E. DISTRICT COMMANDER
Drawing No.:
C-11R




US Army Corps of Engineers Galveston District

| No. | Description | Date & By |
|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID C. BESTON, COL, C.E.
DISTRICT COMMANDER

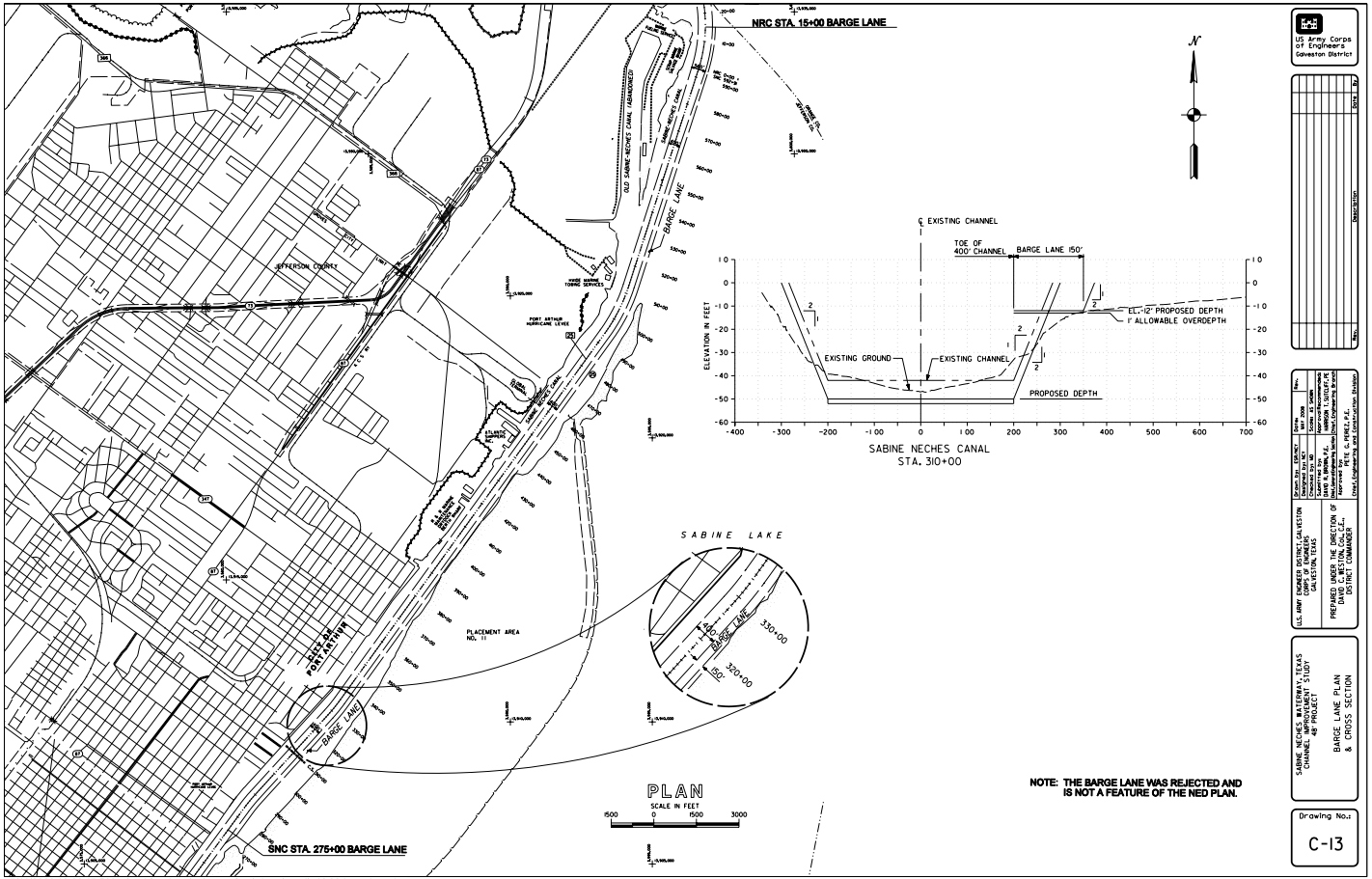
Designed by: J. DUNCAN
Drawn by: J. DUNCAN
Checked by: KD
Date: APR 2008
Scale: N.S.NOTED
Rev.
Approved by: BETT. C. PIRELL P.E.
Chief, Engineering and Construction Division

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
GR PROJECT

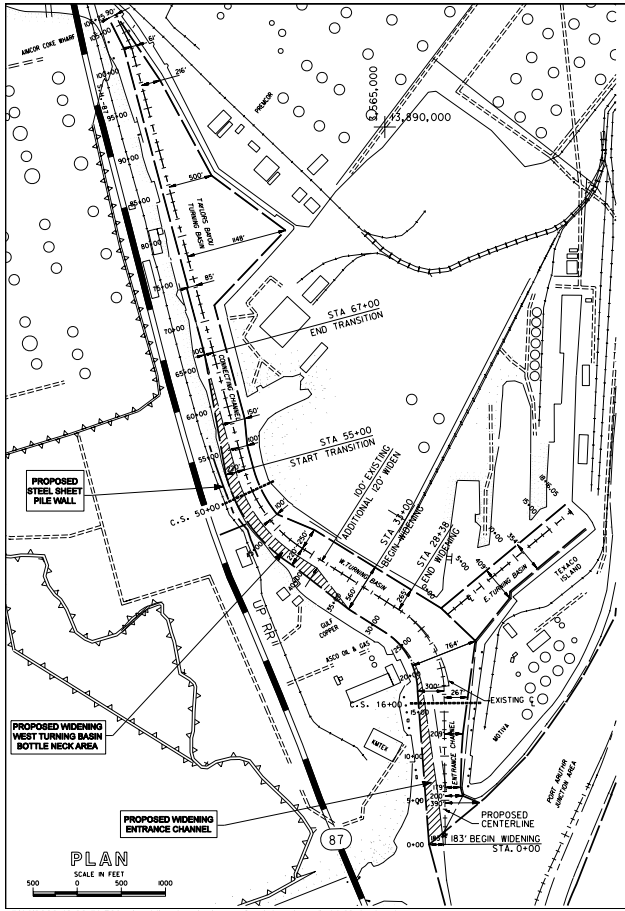
DREDGING PLAN
SABINE BANK CHANNEL EXTENSION
STA. 110+000 TO STA. 165+000

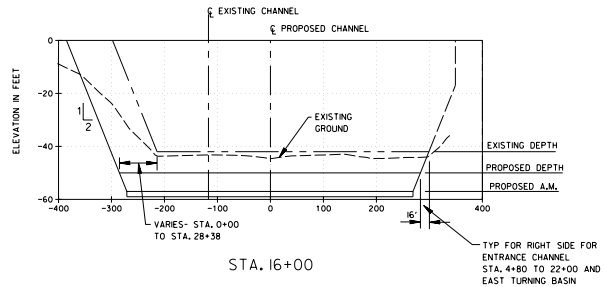
Drawing No.:
C-12

5/14/2008 12:23:44 PM w:\cadd\projects\sn\snww feas\plates\ea pl\c12 83.dgn

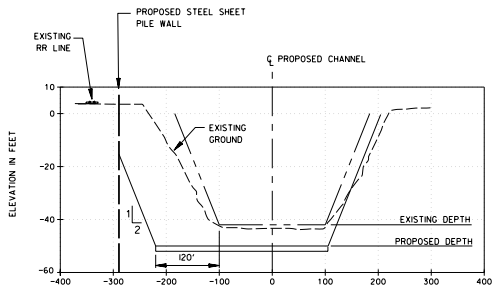



5/14/2008 12:23:47 PM w:\caddprojects\sn\snww feas\plates\ea pl\c13 83 bargelane.dgn




STA. 16+00




STA. 50+00

NOTES:
1. NEW STATIONING WITH NEW ALIGNMENT. WILL NOT MATCH EXISTING CHANNEL STATIONING.
2. EXISTING GROUND AS SHOWN IS APPROXIMATE.
3. CHANNEL SIDE SLOPES REMAIN THE SAME.
4. FOR ADVANCE MAINTENANCE DETAILS, SEE DWG C-21.
5. REFER TO DWG C-01 FOR LEGEND.

US Army Corps of Engineers Galveston District

| Rev. | Date | By | Description |
|---|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS

PREPARED UNDER THE DIRECTION OF: COL. ANTHONY C. PIETZ, P.E. DISTRICT COMMANDER

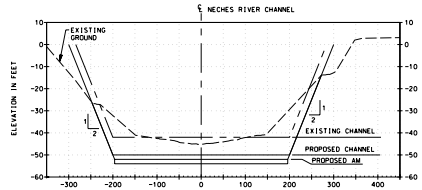
Drawn by: J. BANCK
Designed by: M. PETE, P.E.
Checked by: M. PETE, P.E.
Date: 2008
Scale: AS SHOWN
Horizontal: 1:120(FLAT)
Vertical: 1:120(FLAT)
Recommended by: DAVID A. BRUNA, P.E. Chief, Engineering Division
Approved by: ANTHONY C. PIETZ, P.E. District Engineer

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
JEFFERSON COUNTY

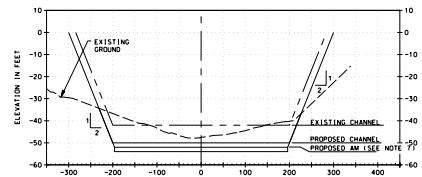
TAYLORS BAYOU
PROPOSED CURVE
AND MOUTH WIDENING

Drawing No.:
C-14

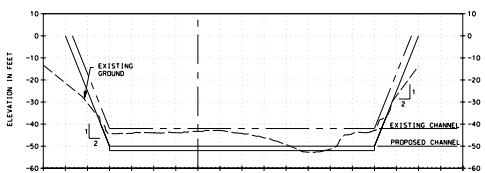
5/14/2008 12:23:51 PM w:\cadd\projects\sn\snww feas\plates\ea pl\c14 83 tb plan.dgn




NRC STA. 870+00




NRC STA. 630+00

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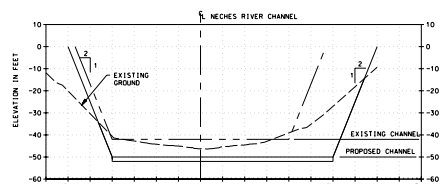
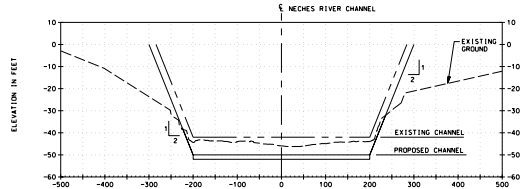
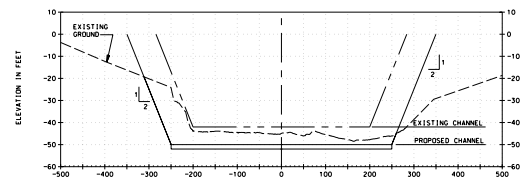


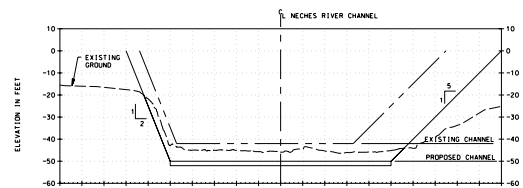

NRC STA. 240+00




NRC STA. 164+00




NRC STA. 58+00




NRC STA. 22+00

NOTES: (FOR DWGS C-13 THRU C-20)

1. EXISTING GROUND IS REPRESENTATIVE OF ACTUAL CONDITIONS AFTER DREDGING UP TO -30 ELEVATION.
2. CROSS SECTIONS WERE GENERATED FROM A DIGITAL TERRAIN MODEL (DTM) AND MAY NOT REFLECT ACTUAL BANK TOPO ABOVE -30 ELEVATION.
3. CROSS SECTIONS ARE SHOWN LOOKING UPSTREAM AND ARE PERPENDICULAR TO CENTERLINE.
4. REFER TO PLAN VIEWS FOR CROSS SECTION LOCATIONS.
5. CENTERLINE SHOWN IS FOR PROPOSED CHANNEL AND DOES NOT ALWAYS MATCH WITH EXISTING CHANNEL CENTERLINE.
6. VERTICAL DATUM SHOWN IS MEAN LOW TIDE (MLT).
7. THE FIRST TWO FEET OF ADVANCE MAINTENANCE IS INCLUDED WITHIN THE NEW TEMPLATE. ADDITIONAL REQUIRED ADVANCE MAINTENANCE IS BELOW THIS FIRST 2 FEET, AND IS CALCULATED TO BE DOWN THE SIDE SLOPE TO THE NEEDED DEPTH. THIS IS A TYPICAL APPLICATION FOR ALL CROSS SECTIONS WITH ADVANCE MAINTENANCE MORE THAN 2'.

US Army Corps of Engineers
Galveston District

| No. | Description | Date | By |
|---|---|---|---|

Drawn By: LEONEL
Designed By: JCC
Checked By: MJ
Date: 2008
Scale: AS SHOWN
Contract No. W912HN-07-D-0002 TO 0003
DAVID A. BROWN, P.E.
Chief, Engineering & Construction Division
Approved By: DAVID C. RESTON, COL, C.E.
District Commander

U.S. ARMY ENGINEER DISTRICT, GALVESTON
DEPARTMENT OF THE ARMY
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID C. RESTON, COL, C.E.
DISTRICT COMMANDER

SABINE NECHES WATERWAY, TEXAS
NECHES RIVER
CHANNEL 48' PROJECT STUDY

NECHES RIVER CHANNEL
CROSS SECTIONS

Drawing No.:
C-15



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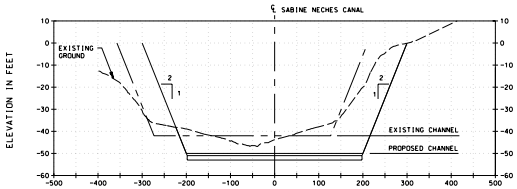
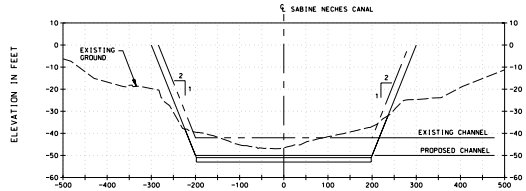
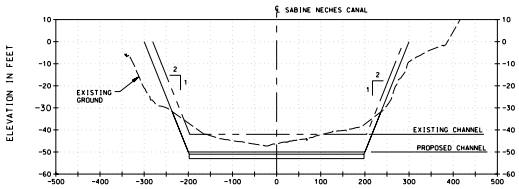


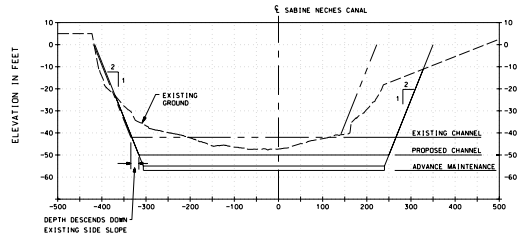

SNC STA. 430+00



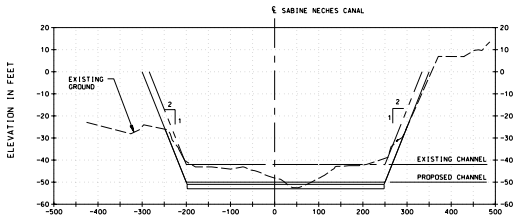

SNC STA. 57+16




SNC STA. 230+00




SNC STA. 20+00




SNC STA. 160+00

NOTES: (FOR DWGS C-16 THRU C-21)

1. THE FIRST TWO FEET OF ADVANCE MAINTENANCE IS INCLUDED WITHIN THE NEW TEMPLATE. ADDITIONAL REQUIRED ADVANCE MAINTENANCE IS BELOW THIS FIRST 2 FEET, AND IS CALCULATED TO BE DOWN THE SIDE SLOPE TO THE NEEDED DEPTH. THIS IS A TYPICAL APPLICATION FOR ALL CROSS SECTIONS WITH ADVANCE MAINTENANCE MORE THAN 2'.

US Army Corps of Engineers
Galveston District

| Rev. | Date | Description | By |
|---|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID C. BESTING, COL, C.E.
DISTRICT COMMANDER

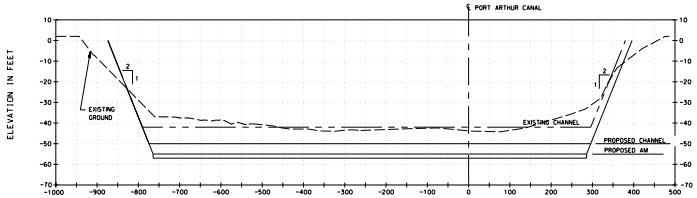
Drawn By: J. BONACI
Designed By: J. W.
Checked By: MD
Date: MAY 2008
Scale: AS SHOWN
Approved By: DAVID A. BROWN, P.E.
Chief, Engineering and Construction Division
Rev.

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENTS STUDY
AR PROJECT

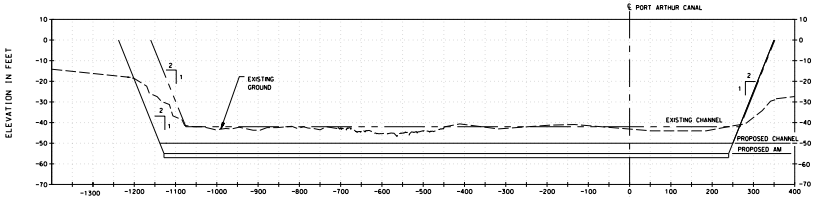
SABINE NECHES CANAL
CROSS SECTIONS

Drawing No.:
C-16

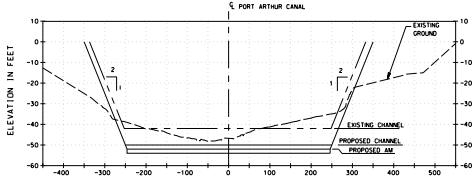
5/14/2008 12:23:58 PM w:\cadd\projects\sn\snww feas\plates\ea pl\c16 83 snc.dgn




PAC STA. 325+83.73




PAC STA. 310+00




PAC STA. 130+00

US Army Corps of Engineers Galveston District

| No. | Description | Date | By |
|---|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

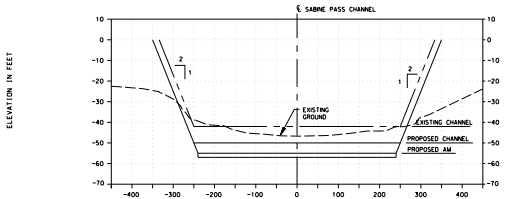
PREPARED UNDER THE DIRECTION OF
RANDALL CHRESTMAN, P.E.
DISTRICT COMMANDER

Drawn by: MCL
Checked by: MJ
Checked by: MS
Date: 4/2/2008
Level 4 Review
Approved by: Mark Sanders, P.E.
Maintenance Dredging Section Leader
Chief, Engineering and Construction Division

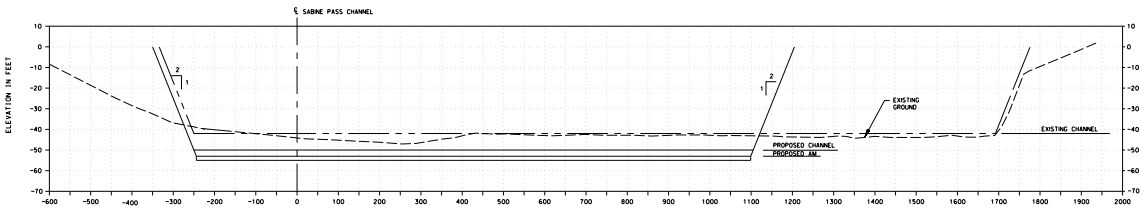
Rev. —

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
AND
PORT ARTHUR CANAL
CROSS SECTIONS

Drawing No.:
C-17R




SPC STA. 270+00

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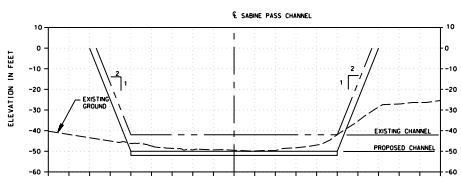



SPC STA. 10+00

US Army Corps of Engineers Galveston District

| No. | Description | Date | By |
|---|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID A. CHESTER, P.E.
DISTRICT COMMANDER

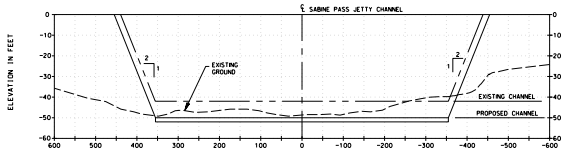
Design by: MCL
Checked by: MCL
Date: 10/2000
Rev.
Scale: AS SHOWN

Level II Review
Approved by: Jerry L. Rainey, P.E.
Chief, Engineering Division
Approved by: Jerry L. Rainey, P.E.
Chief, Engineering and Construction Division

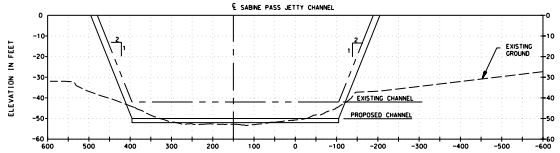
SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY

SABINE PASS CHANNEL
CROSS SECTIONS

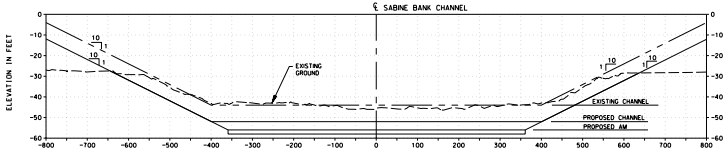
Drawing No.:
C-18R



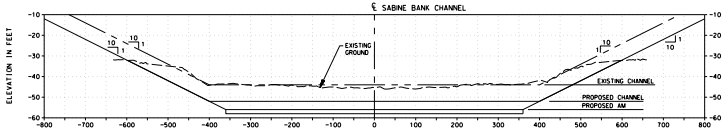

SPJ STA. -214+00




SPJ STA. -0+50




SABINE OUTER BAR STA. 3+000




SABINE OUTER BAR STA. 18+000

US Army Corps of Engineers Galveston District

| No. | Revision | Date | By |
|---|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

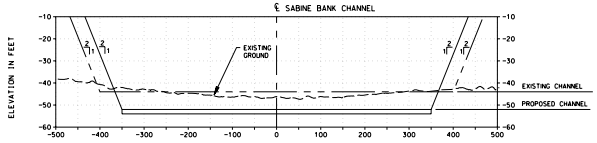
PREPARED UNDER THE DIRECTION OF
THE DISTRICT ENGINEER
DISTRICT COMMANDER

Design by: NCL
Drawn by: M.A. Ward
Checked by: NCL
Date: 15 1998
Approved by: Lead Engineer, P.E.
Approved by: Branch Chief, Engineering & Planning
Chief, Engineering and Construction Division

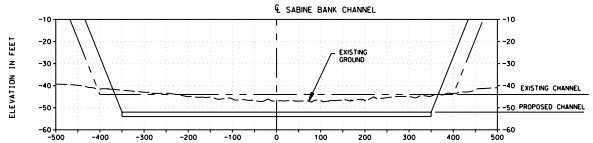
Scale: NONE
Rev. —

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
SABINE PASS
SABINE PASS JETTY & SABINE PASS OUTER BAR CHANNELS & CROSS SECTIONS

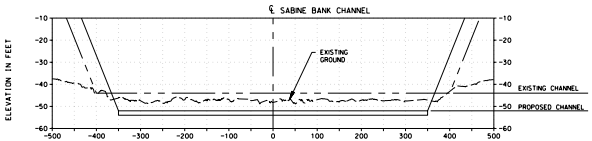
Drawing No.:
C-19R



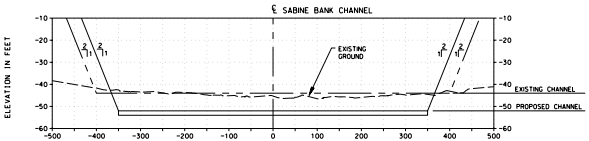

SBC STA. 30+000



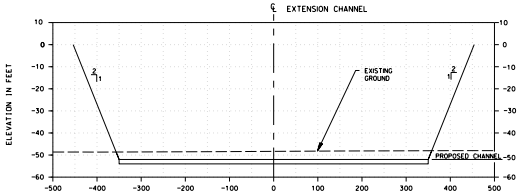

SBC STA. 50+000



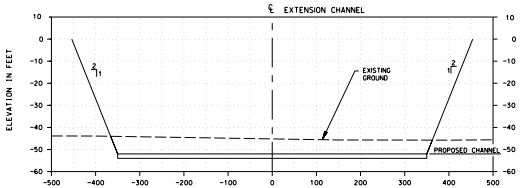

SBC STA. 70+000




SBC STA. 87+000




SNWW EXT STA. 163+000




SNWW EXT STA. 100+000

US Army Corps of Engineers
Galveston District

| Rev. | Date | Description | By |
|---|---|---|---|

Drawn by: J.D.W.C.
Date: 3-6-07
Checked by: W.
Approved by: Lynn Ayres
Date: 4-18-08
Approved by: Lynn Ayres
Chief, Engineering & Planning Div.
Scale: AS SHOWN
Rev.
Date
Chief, Engineering & Construction Division
PETE C. PARKS, P.E.

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID L. ROSENBAUM, P.E.
DISTRICT COMMANDER

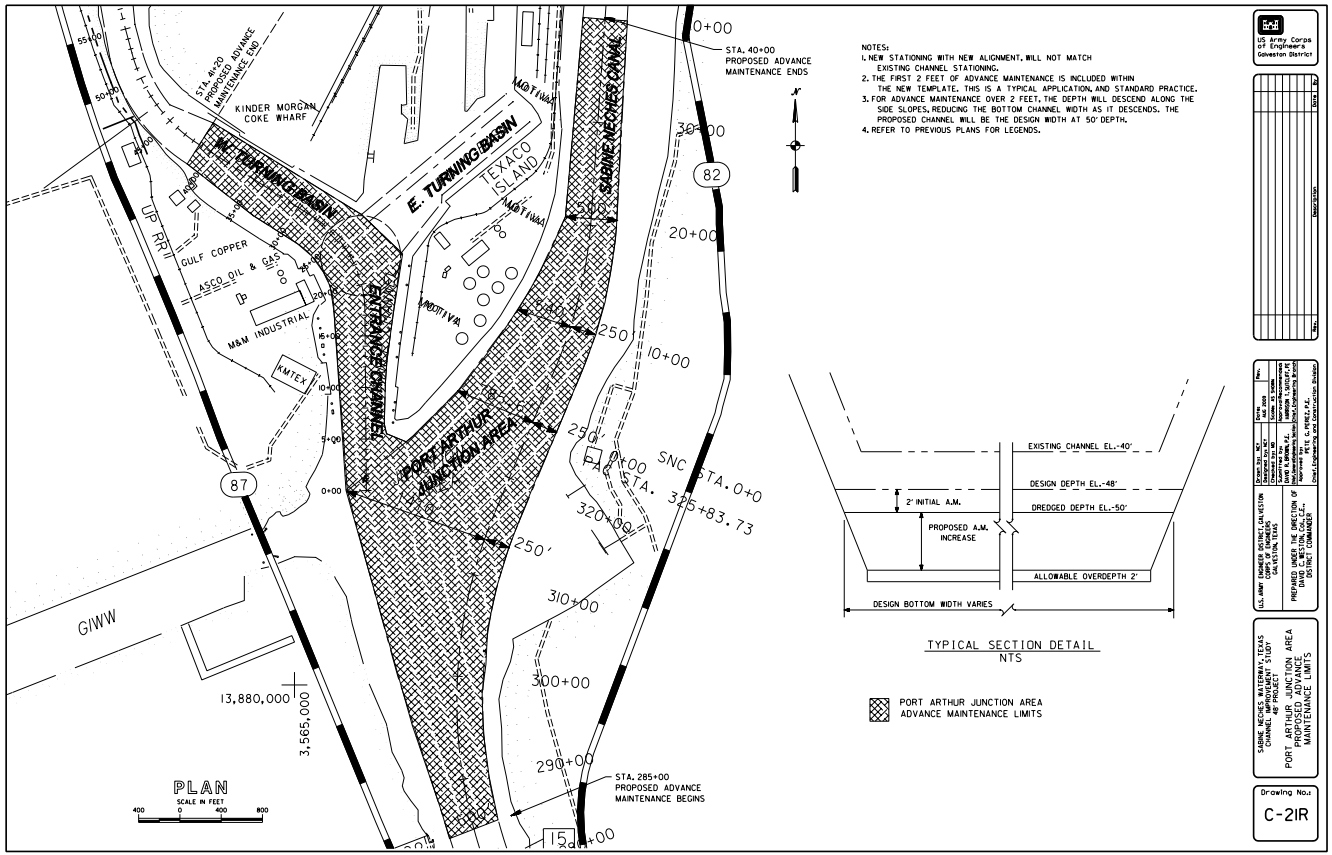
SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
AND PROJECT

SABINE BANK
& EXTENSION CHANNELS
CROSS SECTIONS

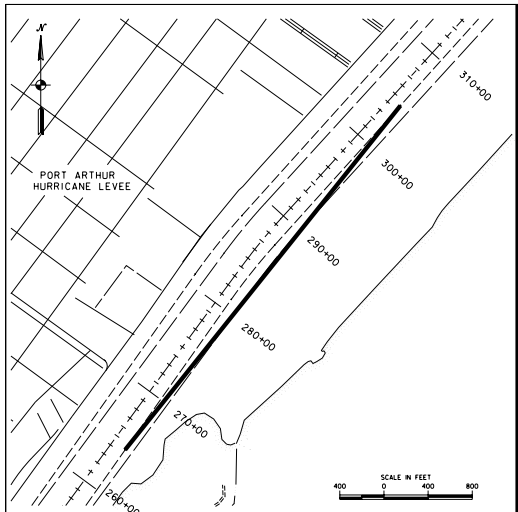
Drawing No.:
C-20



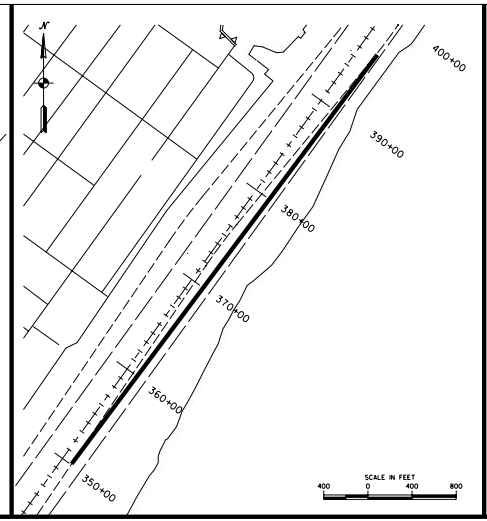
5/14/2008 12:24:09 PM w:\cadd\projects\sn\snww feas\plates\ea pl\c20 83 sb ext.dgn


STA. 40+00
PROPOSED ADVANCE
MAINTENANCE ENDS
STA. 81+20
PROPOSED ADVANCE
MAINTENANCE END
KINDER MORGAN
COKE WHARF
W. TURNING BASIN
E. TURNING BASIN
TEXACO
ISLAND
MOTIVA
SABINE NECHES CANAL
ENTRANCE CHANNEL
PORT ARTHUR
JUNCTION AREA
UP RR
GULF COPPER
ASCO OIL & GAS
M&M INDUSTRIAL
KMTEX
GIWW
13,880,000
3,565,000
PLAN
SCALE IN FEET
400 0 400 800
STA. 285+00
PROPOSED ADVANCE
MAINTENANCE BEGINS
SNC STA. 0+0
PA STA. 325+83.73
NOTES:
1. NEW STATIONING WITH NEW ALIGNMENT, WILL NOT MATCH
EXISTING CHANNEL STATIONING.
2. THE FIRST 2 FEET OF ADVANCE MAINTENANCE IS INCLUDED WITHIN
THE NEW TEMPLATE. THIS IS A TYPICAL APPLICATION, AND STANDARD PRACTICE.
3. FOR ADVANCE MAINTENANCE OVER 2 FEET, THE DEPTH WILL DESCEND ALONG THE
SIDE SLOPES, REDUCING THE BOTTOM CHANNEL WIDTH AS IT DESCENDS. THE
PROPOSED CHANNEL WILL BE THE DESIGN WIDTH AT 50' DEPTH.
4. REFER TO PREVIOUS PLANS FOR LEGENDS.
EXISTING CHANNEL EL.-40'
DESIGN DEPTH EL.-48'
2' INITIAL A.M.
DREDGED DEPTH EL.-50'
PROPOSED A.M.
INCREASE
ALLOWABLE OVERDEPTH 2'
DESIGN BOTTOM WIDTH VARIES
TYPICAL SECTION DETAIL
NTS
PORT ARTHUR JUNCTION AREA
ADVANCE MAINTENANCE LIMITS
US Army Corps
of Engineers
Galveston District
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF
DAVID A. WEST, P.E.
DISTRICT COMMANDER
SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
JEFFERSON COUNTY, TEXAS
PORT ARTHUR JUNCTION AREA
PROPOSED ADVANCE
MAINTENANCE LIMITS
Drawing No.:
C-21R

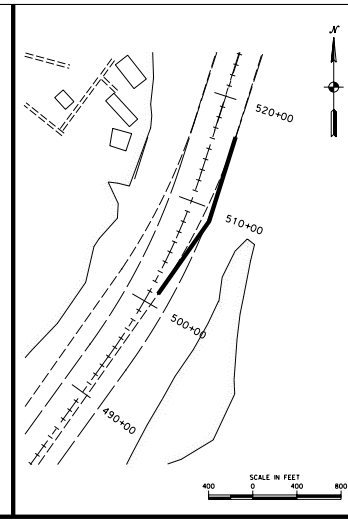
US Army Corps of Engineers Galveston District
Date
By
Description
Date
By
U.S. ARMY DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF
DAVID C. MESSINA, COL., C.E.
DISTRICT COMMANDER
Drawn by: MCT
Designed by: MCT
Checked by: JDB
Submitted by:
Approved by:
Date: 6 APRIL 2.
Scale: AS SHOWN
Date: AUG 2009
Approved for Construction:
Chief, Engineering Div.
Chief, Engineering and Construction Division
SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
48' PROJECT
BEND EASING
PORT ARTHUR &
SABINE NECHES CANALS
Drawing No.:
C-22R
N
D
MOTIVA
TEXACO ISLAND
MOTIVA
MOTIVA
TEXACO ISLAND
SABINE NECHES CANAL
400'
500'
540'
250'
785.6'
250'
1410'
PORT ARTHUR JUNCTION AREA
PORT ARTHUR CANAL
82
50+00
40+00
30+00
20+00
10+00
0+00
15+00
10+00
5+00
0+00
SNC STA. 0+00
PAC STA. 345+83.73
320+00
310+00
300+00
290+0
3,570,000
13,880,000
PLAN
SCALE IN FEET
300
0
300
600
NOTES:
1. FOR LEGEND REFER TO DWG C-01.




**SABINE NECHES CANAL**
**BEND EASING**
**STA. 260+00 TO STA. 350+00**

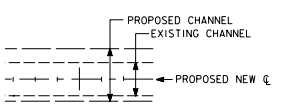



**SABINE NECHES CANAL**
**BEND EASING**
**STA. 350+00 TO STA. 396+00**




**SABINE NECHES CANAL**
**BEND EASING**
**STA. 501+00 TO STA. 515+00**

## LEGEND




NOTE:
1. BEND EASING LIMITS RECOMMENDED BY ERDC. REFER TO SHIP SIMULATION REPORT.

US Army Corps of Engineers
Galveston District

| Mark | Date | Description | By |
|---|---|---|---|

Drawn By: SDCMC
Designed By: WC
Checked By: WC
Date: Mar. 2008
Scale: AS SHOWN
Reviewed By: Mark Dennis, Senior Project Engineering Manager
Date: D. BROWN, P.E.
HARRISON S. SCHOLAR, P.E.
Reviewed By: Mark Dennis, Senior Project Engineering Manager
Chief, Engineering and Construction Division

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

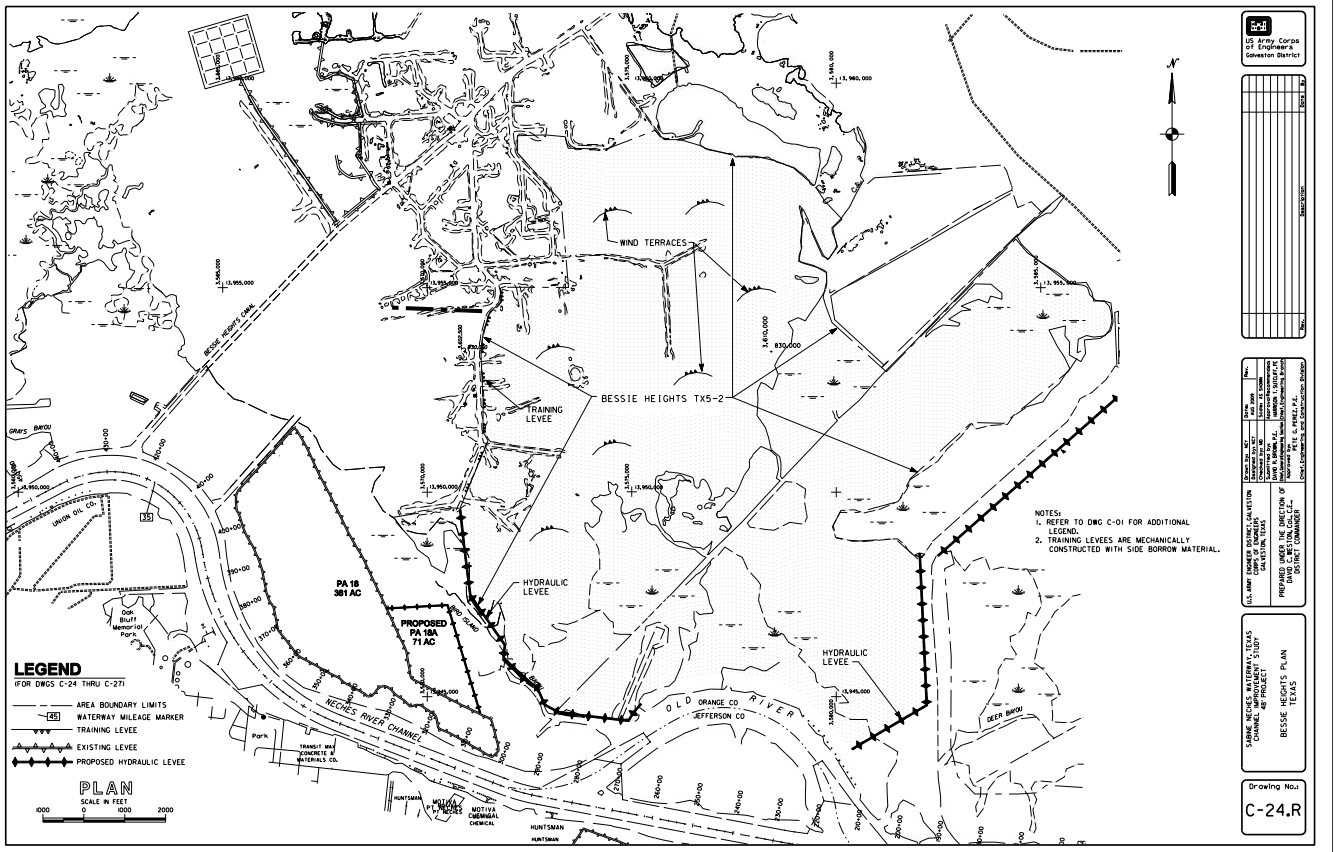
PREPARED UNDER THE DIRECTION OF
DAVID J. ROBINSON, P.E.
DISTRICT COMMANDER

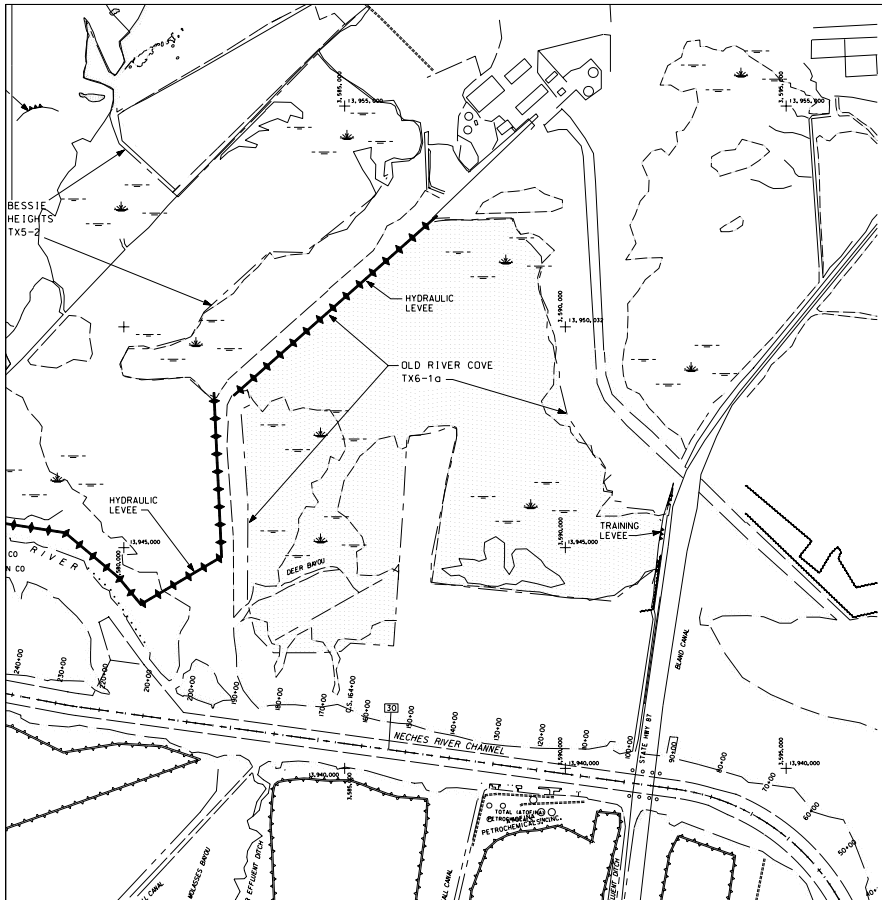
SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
JEFFERSON COUNTY

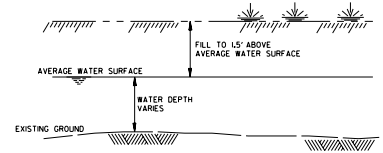
SABINE NECHES CANAL
BEND EASINGS

Drawing No.:
C-23

5/14/2008 12:24:25 PM w:\cadd\projects\sn\snww feas\plates\ea pl\c23 83 bend easz.dgn


US Army Corps of Engineers Galveston District
WIND TERRACES
BESSIE HEIGHTS TX5-2
TRAINING LEVEE
HYDRAULIC LEVEE
HYDRAULIC LEVEE
PA 18 361 AC
PROPOSED PA 18A 71 AC
BESSIE HEIGHTS CANAL
GRAYS BAYOU
UNION OIL CO.
Oak Bluff Memorial Park
NECHES RIVER CHANNEL
OLD RIVER
ORANGE CO
JEFFERSON CO
DEER BAYOU
TRANSIT MIX CONCRETE & MATERIALS CO.
HUNTSMAN
MOTIVA CHEMICAL
LEGEND
(FOR DWGS C-24 THRU C-27)
AREA BOUNDARY LIMITS
WATERWAY MILEAGE MARKER
TRAINING LEVEE
EXISTING LEVEE
PROPOSED HYDRAULIC LEVEE
PLAN
SCALE IN FEET
NOTES:
1. REFER TO DWG C-01 FOR ADDITIONAL LEGEND.
2. TRAINING LEVEES ARE MECHANICALLY CONSTRUCTED WITH SIDE BORROW MATERIAL.
SABINE NECHES WATERWAY, TEXAS CHANNEL IMPROVEMENT STUDY
BESSIE HEIGHTS PLAN
TEXAS
U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF THE DISTRICT COMMANDER
Drawing No.:
C-24.R




TYPICAL MARSH RESTORATION SECTION

NOT TO SCALE

PLAN

SCALE IN FEET

1000 0 1000 2000

US Army Corps of Engineers Galveston District

| Rev. | Date | By | Description |
|---|---|---|---|

Drawn By: J. Sikkel
Date: Mar. 2008
Designed By: W.
Scale: AS SHOWN
Checked By: W.
Rev.
Date
Approved By: Mark Dennis, Senior Project Engineering Branch
Date: D. BROWN, P.E.
MARCUS S. SCHLUP, P.E.
Approved By: Mark Dennis, Senior Project Engineering Branch
Date: D. BROWN, P.E.
Chief, Engineering and Construction Division

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CIVIL SYSTEMS ENGINEERS
CAPT. ROY E. DUNCAN
DISTRICT COMMANDER

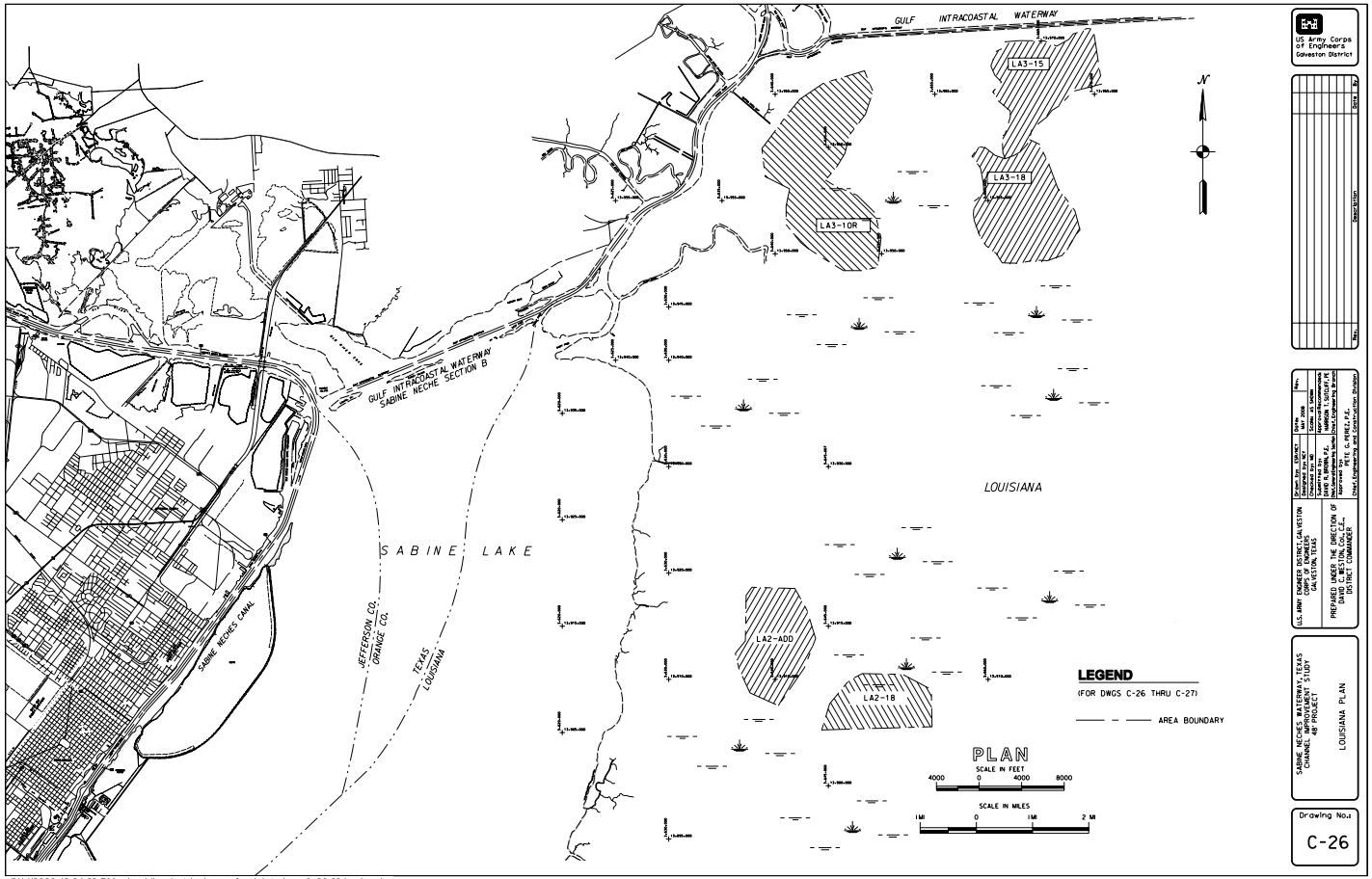
PREPARED UNDER THE DIRECTION OF
DAVID J. SOUTHERLAND, P.E.
CHIEF, PLANNING DIVISION

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
NECHES RIVER

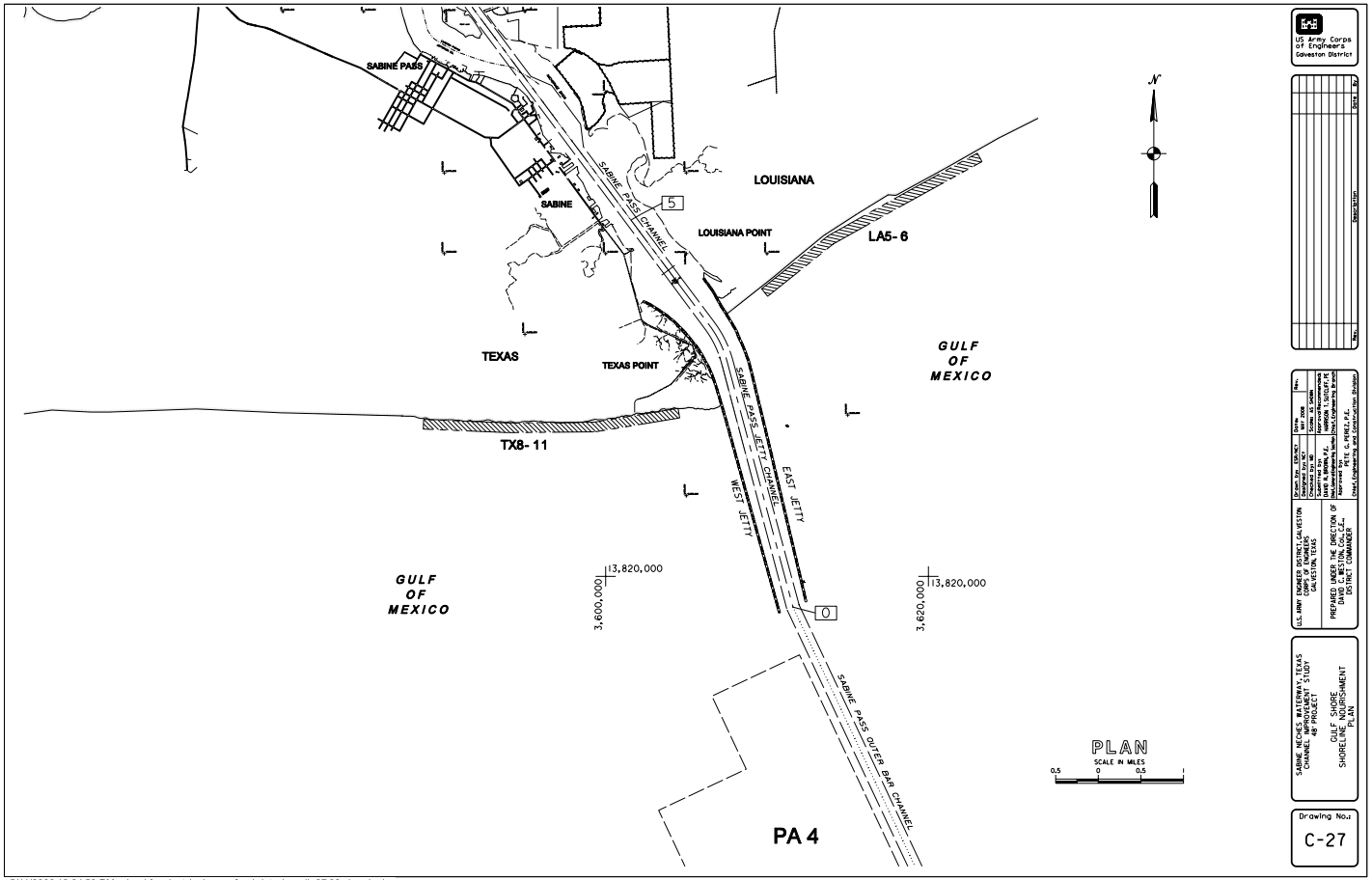
OLD RIVER COVE PLAN
TEXAS

Drawing No.:
C-25

5/14/2008 12:24:36 PM w:\cadd\projects\sn\snww feas\plates\ea pl\c25 83 bh plan.dgn




5/14/2008 12:24:39 PM w:\cadd\projects\sn\snww feas\plates\ea pl\c26 83 la plan.dgn

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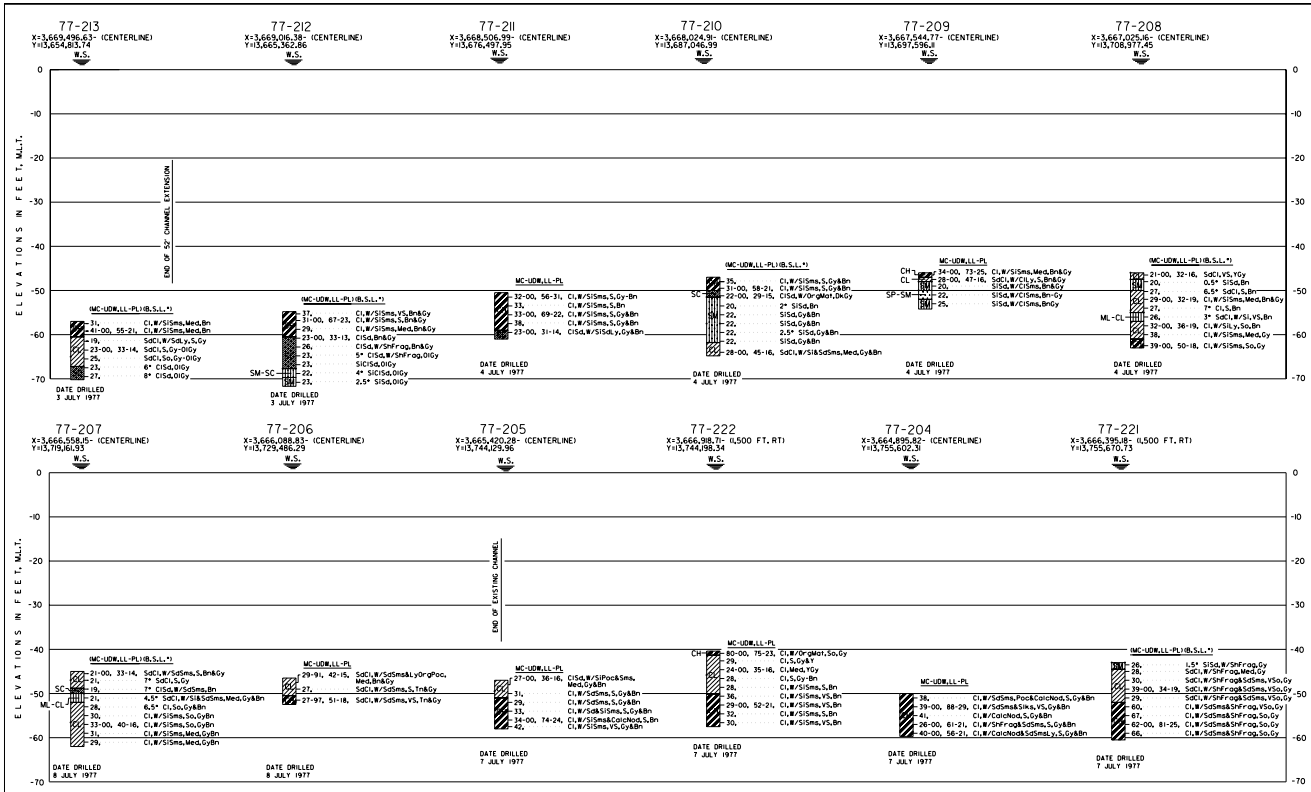


NOTES: TO BORINGS

1. DIRECTIONS LEFT AND RIGHT OF CENTERLINE ARE AS VIEWED LOOKING UPSTREAM (TOWARD INCREASING STATION)
2. SEE DRAWING C-11 AND C-12 FOR BORING LOCATIONS.
3. SEE DRAWING F-6 FOR BORING NOTES AND LEGEND.

US Army Corps of Engineers
Galveston District

| No. | Description | Date | By |
|---|---|---|---|

Date: April 2008
Scale: AS SHOWN
Rev.
Drawn By: J. Hernandez
Designed By: J. Hernandez
Checked By: J. Hernandez
Approved By: Lori L. Hamann, P.E.
Approved By: Mark Ellis, P.E.
Chief, Engineering Branch
Chief, Engineering and Construction Division

U.S. ARMY ENGINEER DISTRICT-GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID L. WESTON, COL, C.E.
DISTRICT COMMANDER

SABINE-NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
4B PROJECT

LOGS OF BORINGS
77-204 TO 77-222

Drawing No.:
F-1



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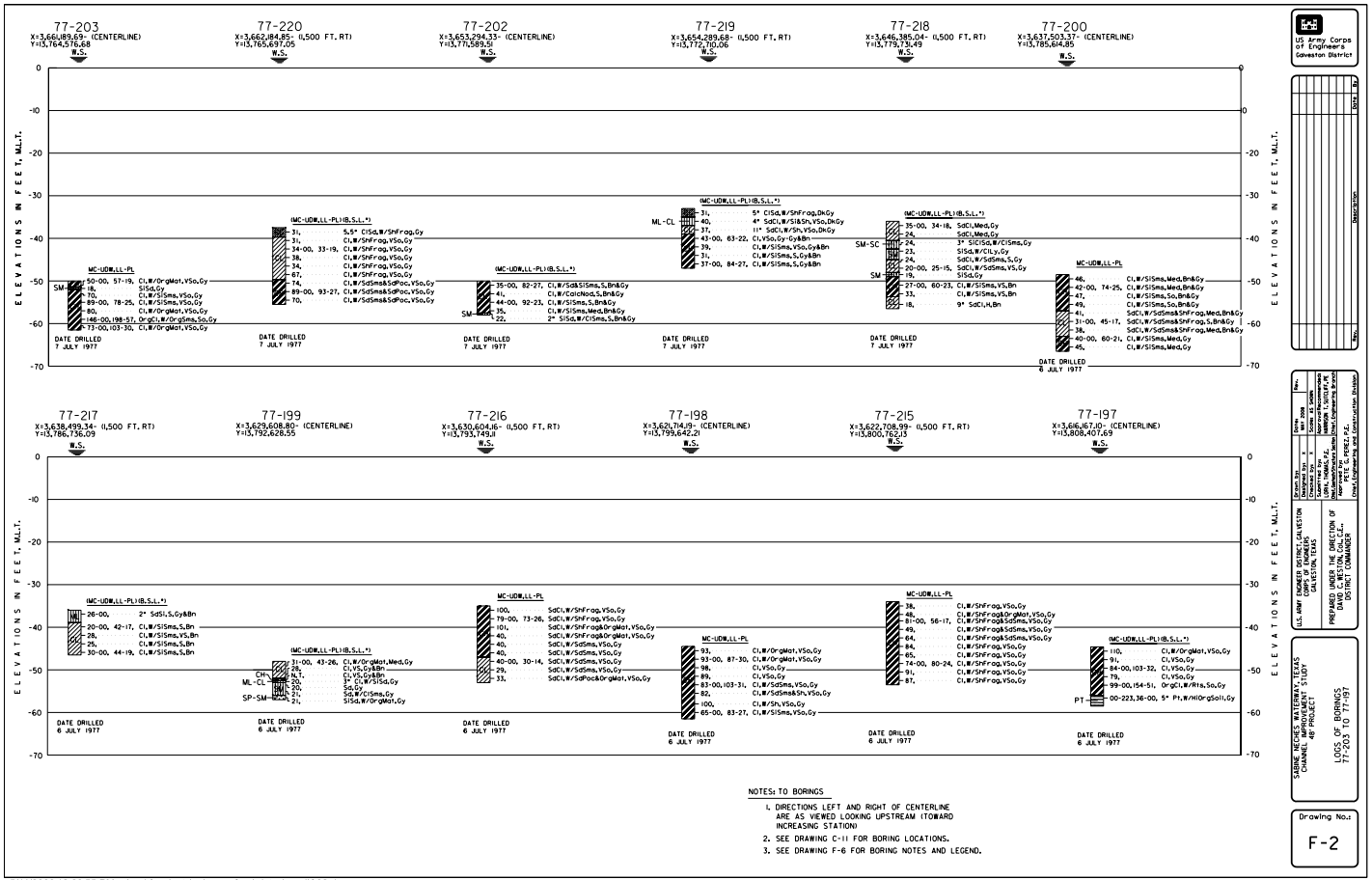



NOTES: TO BORINGS

1. DIRECTIONS LEFT AND RIGHT OF CENTERLINE ARE AS VIEWED LOOKING UPSTREAM (TOWARD INCREASING STATION)
2. SEE DRAWING C-11 FOR BORING LOCATIONS.
3. SEE DRAWING F-6 FOR BORING NOTES AND LEGEND.

US Army Corps of Engineers
Galveston District

| No. | Date | Description | By |
|---|---|---|---|
| | | | |

Date 2008
Scale 1" = 10'
Designed by
Drawn by
Checked by
Approved by
Approved for
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

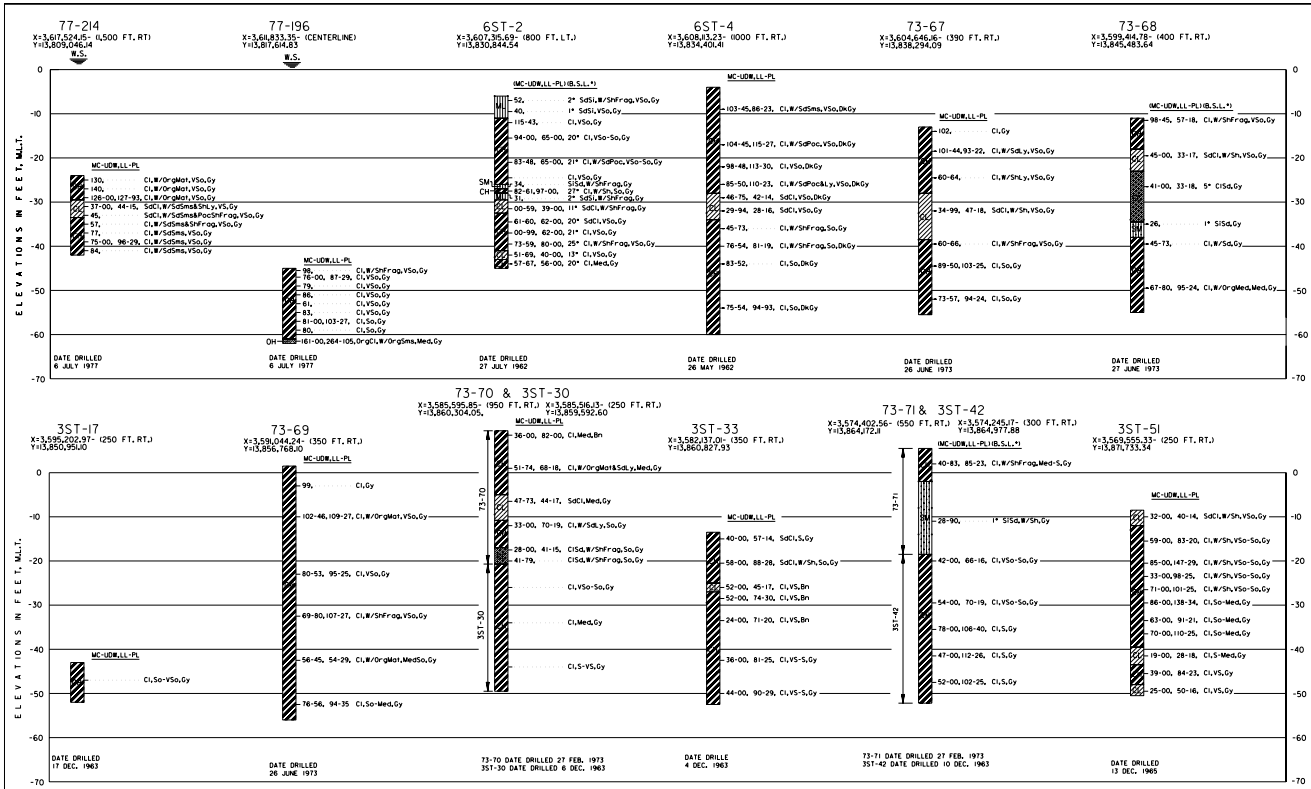
PREPARED UNDER THE DIRECTION OF
DAVID C. WESTON, COL, C.E.
DISTRICT COMMANDER

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENTS STUDY
48 PROJECT

LOCS OF BORINGS
77-203 TO 77-197

Drawing No.:
F-2

5/14/2008 12:29:55 PM w:\cadd\projects\sn\snww feas\plates\ea pl\f-02.dgn




NOTES: TO BORINGS

1. DIRECTIONS LEFT AND RIGHT OF CENTERLINE ARE AS VIEWED LOOKING UPSTREAM (TOWARD INCREASING STATION)
2. SEE DRAWINGS C-08, C-09, C-10 AND C-11 FOR BORING LOCATIONS.
3. SEE DRAWING F-6 FOR BORING NOTES AND LEGEND.

US Army Corps of Engineers
Galveston District

| No. | Description | Date | By |
|---|---|---|---|

(U.S. ARMY ENGINEER DISTRICT-GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS)

PREPARED UNDER THE DIRECTION OF
DAVID L. WESTON, COL, C.E.
DISTRICT COMMANDER

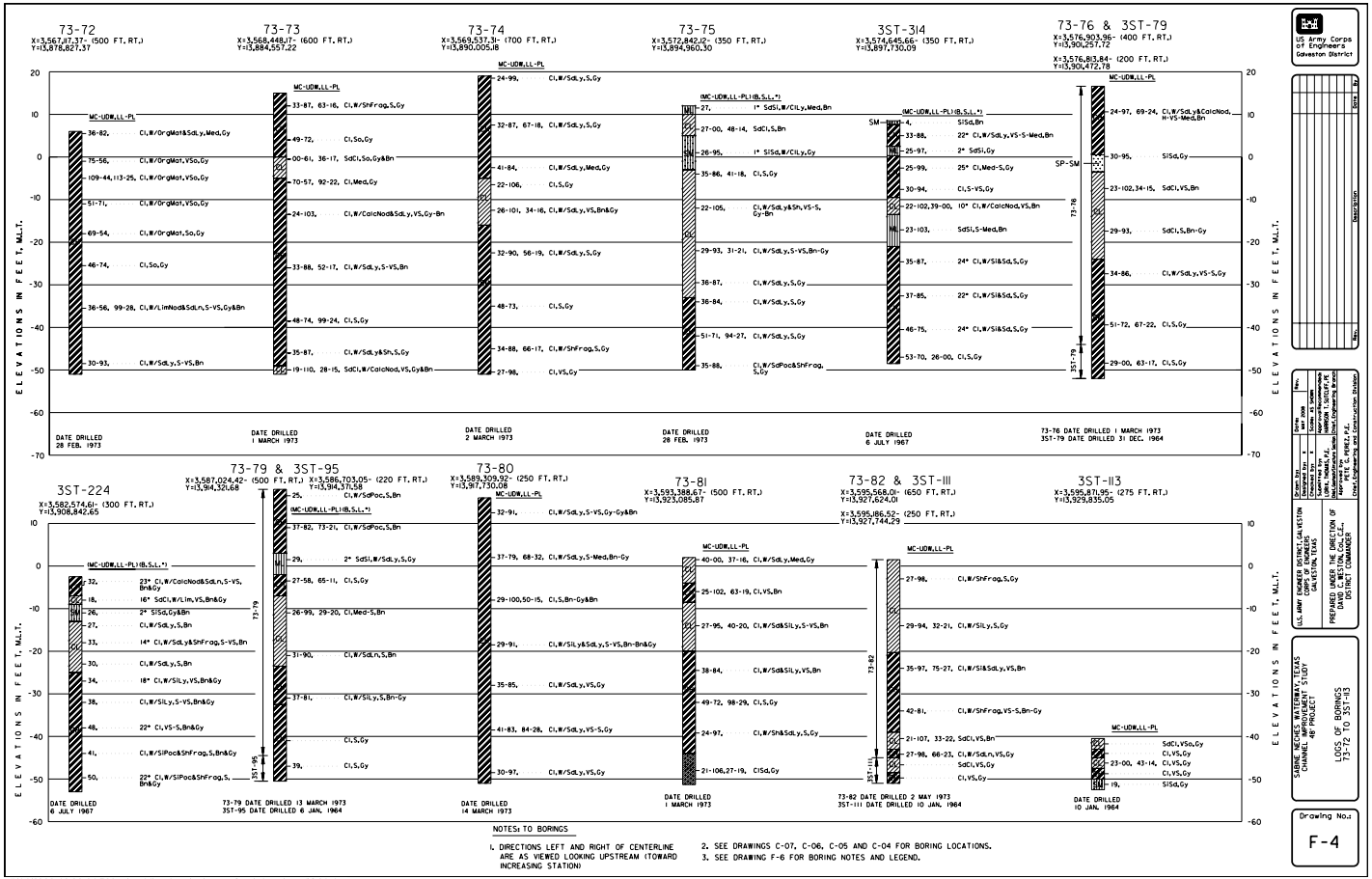
Drawn by: [illegible]
Checked by: [illegible]
Checked by: [illegible]
Date: April 2008
Scale: AS SHOWN
Submitted by: [illegible]
LORI L. HOGAN, P.E.
Approved by: [illegible]
HARRION L. SCHLAPK
Chief, Engineering Division
Chief, Engineering and Construction Division

SABINE-NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
4B PROJECT

LOGS OF BORINGS
77-214 TO 3ST-51

Drawing No.:
F-3

5/14/2008 12:29:58 PM w:\cadd\projects\sn\snww feas\plates\ea pl\f-03.dgn




NOTES: TO BORINGS

1. DIRECTIONS LEFT AND RIGHT OF CENTERLINE ARE AS VIEWED LOOKING UPSTREAM (TOWARD INCREASING STATION)
2. SEE DRAWINGS C-07, C-06, C-05 AND C-04 FOR BORING LOCATIONS.
3. SEE DRAWING F-6 FOR BORING NOTES AND LEGEND.

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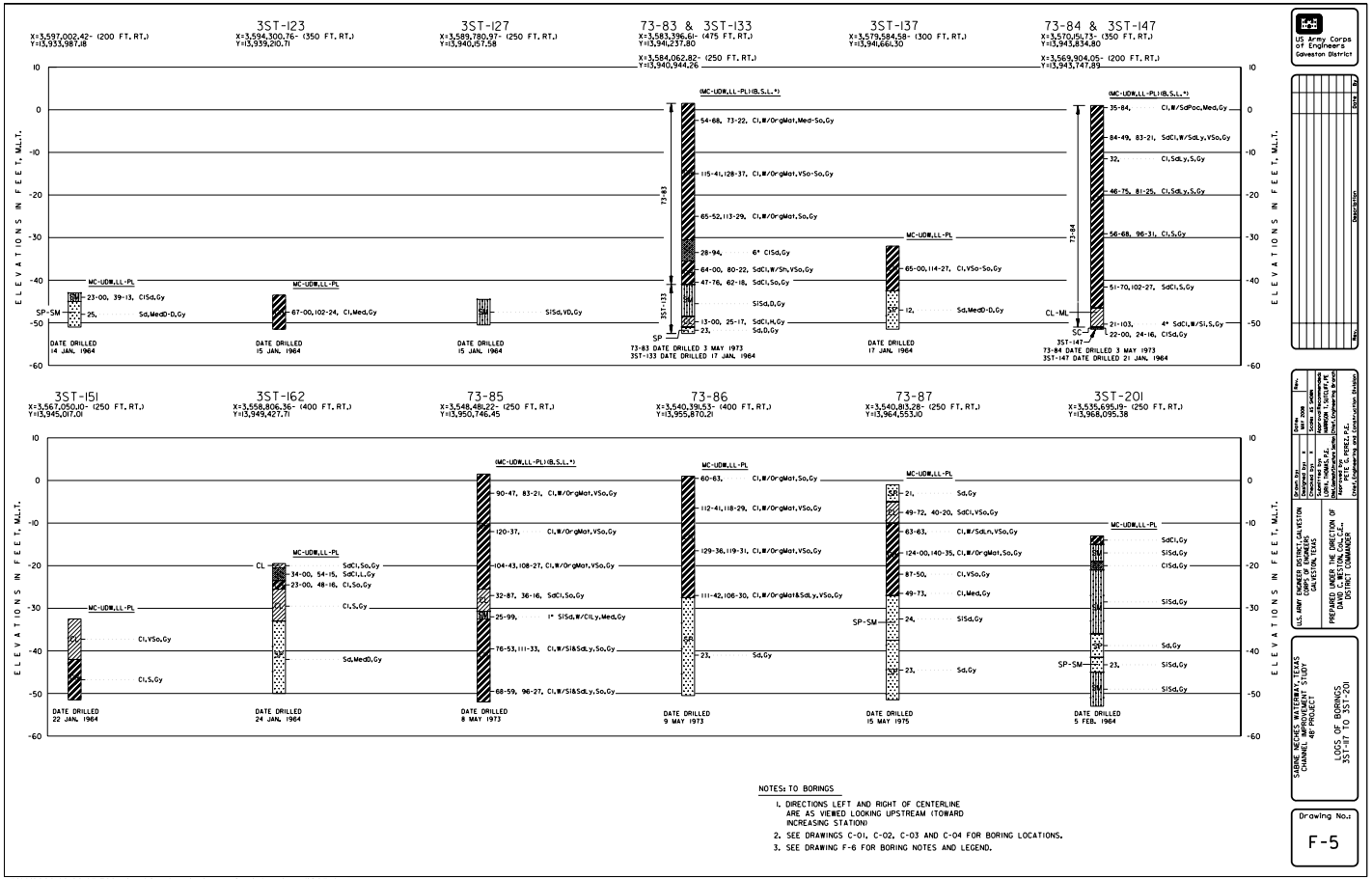



NOTES: TO BORINGS

1. DIRECTIONS LEFT AND RIGHT OF CENTERLINE ARE AS VIEWED LOOKING UPSTREAM (TOWARD INCREASING STATION)
2. SEE DRAWINGS C-01, C-02, C-03 AND C-04 FOR BORING LOCATIONS.
3. SEE DRAWING F-6 FOR BORING NOTES AND LEGEND.

US Army Corps of Engineers
Galveston District

| No. | Description | Date | By |
|---|---|---|---|

Drawn By: | Date: 1 Apr 2008
Designed By: | Scale: AS SHOWN
Checked By: | Reviewed By: HARRISON L. SCHILAF, PE
Approved By: | Approved By: LORI L. FOGARTY, PE
Approved By: | Approved By: Chief, Engineering Branch
Chief, Engineering and Construction Division

Rev.

U.S. ARMY ENGINEER DISTRICT-GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID L. WESTON, CWO, C.E.
DISTRICT COMMANDER

SABINE-NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
4B PROJECT

LOGS OF BORINGS
3ST-87 TO 3ST-201

Drawing No.:
F-5

5/14/2008 12:30:15 PM w:\cadd\projects\sn\snww feas\plates\ea pl\f-05.dgn

## LABORATORY CLASSIFICATION

CH INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.

CL INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, LEAN CLAYS.
CL-ML CLAY-SILT OF LOW PLASTICITY.

ML INORGANIC SILTS AND VERY FINE SANDS, WITH SLIGHT PLASTICITY.

SC CLAYEY SANDS, SAND-CLAY MIXTURES.

SM SILTY SANDS, SAND-SILT MIXTURES.

SP POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES.
SP-SM POORLY-GRADED SAND W/SILT.

OH ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.

PT PEAT AND OTHER HIGHLY ORGANIC SOILS.

## NOTES;

1. SOILS HAVE BEEN CLASSIFIED IN ACCORDANCE WITH ASTM D-2487-93 "CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (UNIFIED SOIL CLASSIFICATION SYSTEM) "." CONSISTENCY OF SOILS SUCH AS SOFT, MEDIUM, HARD, LOOSE, DENSE, ETC., ARE RELATIVE TERMS BASED ON ESTIMATED UNDISTURBED SHEAR STRENGTH OF THE MATERIAL AS DETERMINED BY VISUAL CLASSIFICATION POCKET PENETROMETER TESTS AND PENETRATION RESISTANCE DURING SAMPLING.
2. FIGURES TO THE RIGHT OF BORING LOGS ARE WATER CONTENTS IN IN PERCENT OF THE DRY WEIGHT, DRY DENSITY, LIQUID LIMIT, PLASTIC LIMIT AND BAR LINER SHRINKAGE. (MC-UDW,LL-PL) (B.L.S.*). FIGURES TO THE LEFT OF BORING LOGS ARE BLOWS PER FOOT PENETRATION FROM STANDARD PENETRATION TESTING.
3. BORINGS WERE DRILLED USING WET ROTARY DRILLING TECHNIQUES AND UNDISTURBED SAMPLES WHERE RECOVERED WITH A 3-INCH DIAMETER THIN WALL SAMPLER WHERE COHESIVE MATERIALS WERE ENCOUNTERED. WHERE COHESIONLESS MATERIALS WERE ENCOUNTERED, DISTURBED SAMPLES WERE TAKEN WITH A SPLIT SPOON SAMPLER DURING PERFORMANCE OF STANDARD PENETRATION TESTING.

## VISUAL CLASSIFICATIONS

| | | |
|---|---|---|
| Bn Brown(ish) | Ly Layer(s) | Si Silty |
| Calc Calcareous | Mat Material | Slks Slicken Sides |
| Cl Clay(ey) | Med Medium | Sms Seams |
| D Dense | Nod Nodules | So Soft |
| Dk Dark | N.T. No Test | Soil Soils |
| Frag Fragment(s) | Ol Olive | S Stiff |
| Gy Gray(ish) | Org Organic | Tn Tan(nish) |
| H Hard | Prt Parting(s) | V Very |
| Hi Highly | PT Peat | W.S. Water Surface |
| Lim Limonites | Rts Root(s) | W With |
| L Loose | Sd Sand(y) | Y Yellow(ish) |
| Ln Lense(s) | Sh Shell(y) | |

NOTES: TO BORINGS

1. DIRECTIONS LEFT AND RIGHT OF CENTERLINE ARE AS VIEWED LOOKING UPSTREAM (TOWARD INCREASING STATION)
2. SEE DRAWING C-01 FOR BORING LOCATIONS.
3. SEE DRAWING F-6 FOR BORING NOTES AND LEGEND.

US Army Corps of Engineers Galveston District

| Rev. | Description | Date | By |
|---|---|---|---|

| | |
|---|---|
| Drawn by: | Date: |
| Designed by: x | MAY 2008 |
| Checked by: x | Scale: AS SHOWN |
| Submitted by: LORI K. THOMAS, P.E. Chief, Geotech/Structure Section | Approval/Recommended: HARRISON T. SUTCLIFF, PE Chief, Engineering Branch |
| Approved by: PETE G. PEREZ, P.E. Chief, Engineering and Construction Division | Rev. |

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

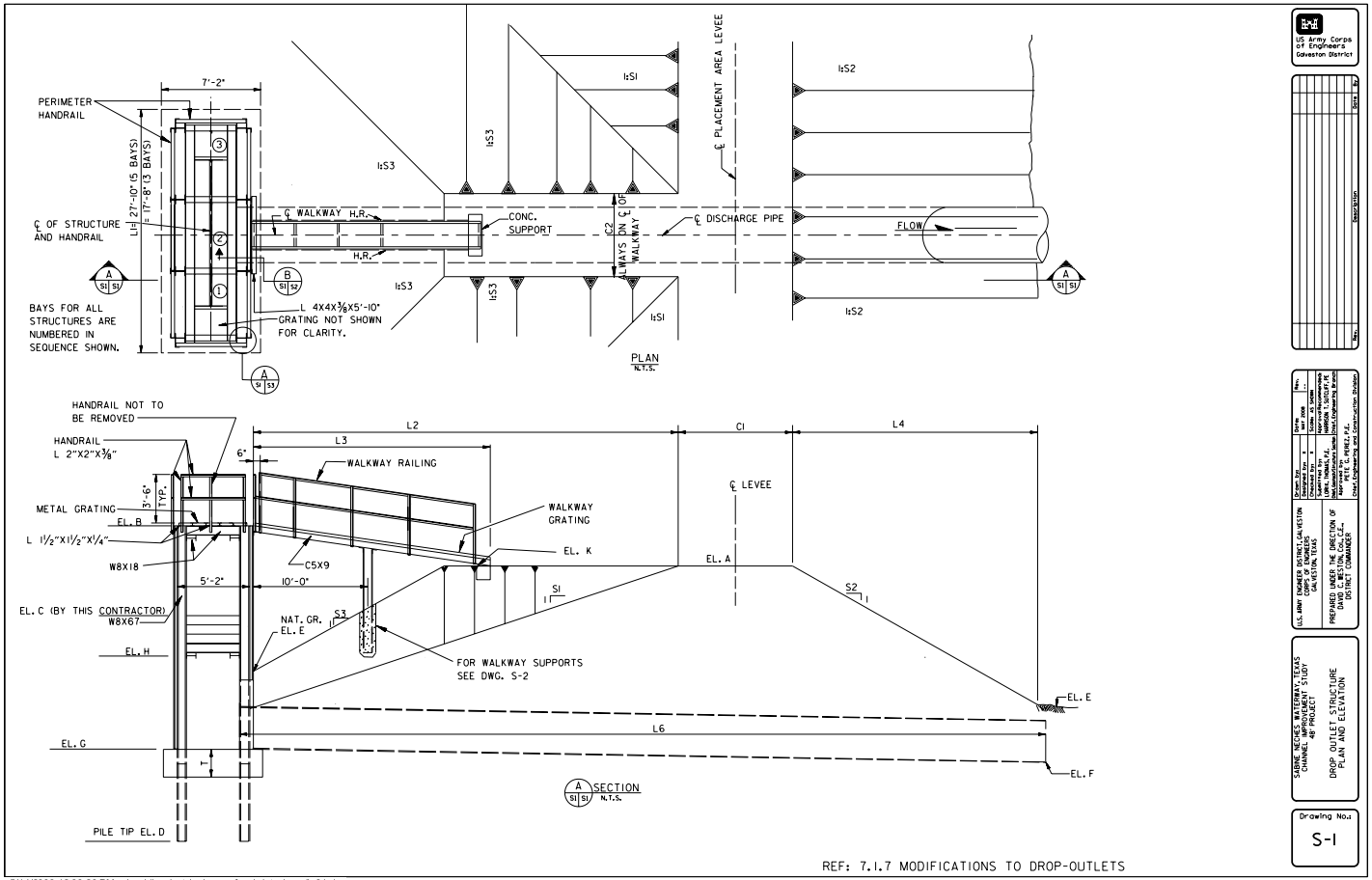
PREPARED UNDER THE DIRECTION OF
DAVID C. WESTON, Col., C.E.,
DISTRICT COMMANDER

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
48' PROJECT

LOGS OF BORINGS
3ST-207 TO 3ST-211

Drawing No.: F-6

5/14/2008 12:30:18 PM w:\cadd\projects\sn\snww feas\plates\ea pl\f-06.dgn




REF: 7.1.7 MODIFICATIONS TO DROP-OUTLETS

US Army Corps of Engineers Galveston District

| Rev. | Date | Description | By |
|---|---|---|---|

Drawn by: [illegible] Date: [illegible]
Designed by: [illegible] Rev. date: [illegible]
Checked by: [illegible] Scale: AS SHOWN
Approved by: [illegible] Horizontal datum: NAD83 (Feet)
Vertical datum: NGVD29 (Feet)
Coordinates: [illegible]
Sub-division: Water Dept./Engineering Branch
Chief: PETE E. PAPELLA P.E.
Chief: CONSTRUCTION DIVISION

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID A. ESTES, COL., EN
DISTRICT COMMANDER

SABINE-NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
4B PROJECT

DROP OUTLET STRUCTURE
PLAN AND ELEVATION

Drawing No.:
S-1

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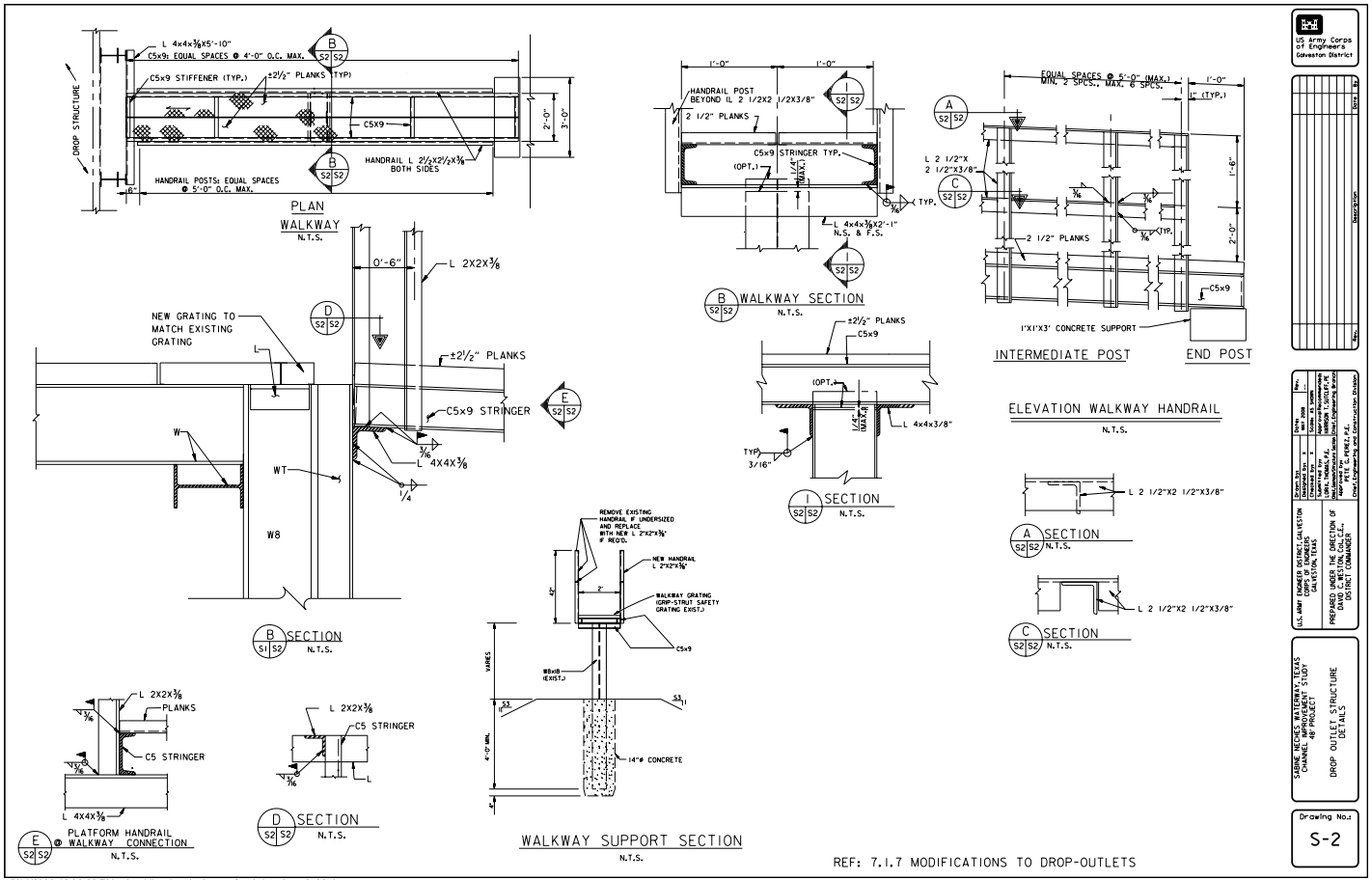


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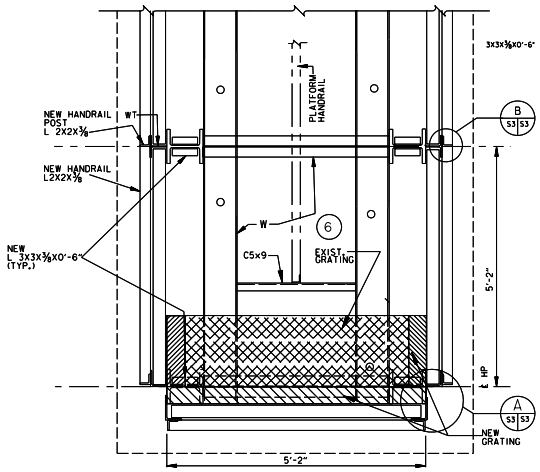
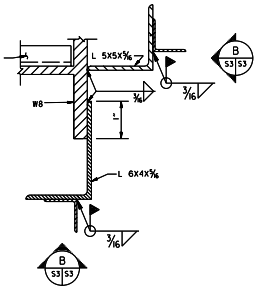


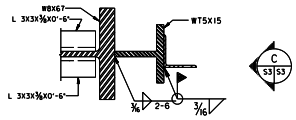

PARTIAL PLAN

N.T.S.

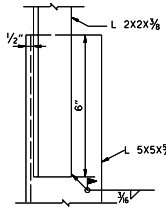
(WALKWAY NOT SHOWN)



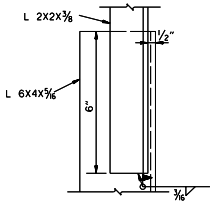

A S3 S1 DETAIL N.T.S.



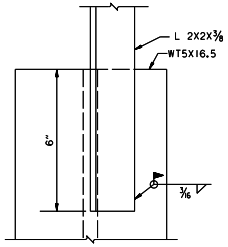

B S3 S3 DETAIL N.T.S.




VIEW A S3 S3 N.T.S.




VIEW B S3 S3 N.T.S.




VIEW C S3 S3 N.T.S.

REF: 7.1.7 MODIFICATIONS TO DROP-OUTLETS

US Army Corps of Engineers
Galveston District

| Rev. | Date | Description | By |
|---|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
PREPARED UNDER THE DIRECTION OF
DAVID O. BELSTON, LOUIS, C.E.
DISTRICT COMMANDER

Drafted By: J. Rodriguez
Designed By: J. Rodriguez
Checked By: J.
Date: Mar 2008
Scale: AS SHOWN
Recommended By: LUBIN, THOMAS, P.E.
Supervisory Engineer: HARRISON, T. SCHOLPP, P.E.
Chief, Design Branch
Chief, PETER G. PAPELA, P.E.
Chief, Engineering Division
Chief, Construction Division

SABINE NECHES WATERWAY, TEXAS
CHANNEL IMPROVEMENT STUDY
4B PROJECT

DROP OUTLET STRUCTURES
DETAILS

Drawing No.:
S-3

## TABLE I EXISTING/NEW STRUCTURES

| REF. DWG. NOS. | C-09 | | | C-07 C-08 | C-07 | C-06 | C-04 | | C-04 | | C-04 | | C-03 | | | C-02 | | C-01 | | | C-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESCRIPTION | EXIST. 5N | EXIST. 5S | EXIST. 5C | EXIST. 8 | EXIST. 9, 9A | EXIST. 11 | EXIST. 12 | EXIST. 13 | EXIST. 14 | EXIST. 14A | EXIST. 16, 16A | | EXIST. 18A | EXIST. 21 | EXIST. 22 | EXIST. 23A | EXIST. 24 | EXIST. 25A | NEW 16A | NEW 24 | NEW 24A | NEW 27D |
| NO. OF BAYS | | | | 5 | | | | 5 | | | | | | | | | | | | | | |
| WALKWAY ℄ BAY | | | | 4 | | | | 3 | | | | | | | | | | | | | | |
| WALKWAY BETWEEN BAYS | | | | | | | | | | | | | | | | | | | | | | |
| HEIGHT OF STRUCTURE | | | | 19' | | | | 11' | | | | | | | | | | | | | | |
| PIPE(S) IN BAY NO(S) | | | | 2&3 | | | | 2&4 | | | | | | | | | | | | | | |
| PIPE(S): NO./DIA. | | | | 2-48 | | | | 2-36 | | | | | | | | | | | | | | |
| ELEVATIONS: | | | | | | | | | | | | | | | | | | | | | | |
| A | | | | 18.0 | | | | 15.0 | | | | | | | | | | | | | | |
| B | | | | 23.0 | | | | 18.0 | | | | | | | | | | | | | | |
| C | | | | | | | | | | | | | | | | | | | | | | |
| D | | | | | | | | R | | | | | | | | | | | | | | |
| E | | | | | | | | | | | | | | | | | | | | | | |
| F | | | | | | | | | | | | | | | | | | | | | | |
| G | | | | 4.0 | | | | 7.0 | | | | | | | | | | | | | | |
| H | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| K | | | | | | | | | | | | | | | | | | | | | | |
| LENGTHS: | | | | | | | | | | | | | | | | | | | | | | |
| L 1 | | | | 28.5' | | | | 28.5' | | | | | | | | | | | | | | |
| L 2 | | | | | | | | | | | | | | | | | | | | | | |
| L 3 | | | | 40' | | | | 20' | | | | | | | | | | | | | | |
| L 4 | | | | | | | | | | | | | | | | | | | | | | |
| L 5 | | | | | | | | | | | | | | | | | | | | | | |
| L 6 | | | | | | | | | | | | | | | | | | | | | | |
| C 1 | | | | | | | | | | | | | | | | | | | | | | |
| C 2 | | | | | | | | | | | | | | | | | | | | | | |
| T | | | | | | | | | | | | | | | | | | | | | | |
| SLOPES: | | | | | | | | | | | | | | | | | | | | | | |
| S 1 | | | | | | | | | | | | | | | | | | | | | | |
| S 2 | | | | | | | | | | | | | | | | | | | | | | |
| S 3 | | | | | | | | | | | | | | | | | | | | | | |
| COLUMNS | | | | W8X58 | | | | W8X58 | | | | | | | | | | | | | | |
| STRUTS | | | | W8X18 | | | | W8X18 | | | | | | | | | | | | | | |
| SUPPORTS | | | | W8X58 | | | | W8X18 | | | | | | | | | | | | | | |
| WT SIZE | | | | 4X9 | | | | 4X12 | | | | | | | | | | | | | | |
| TIMBER SIZE | | | | 3" | | | | 3" | | | | | | | | | | | | | | |

REF: 7.1.7 MODIFICATIONS TO DROP-OUTLETS

US Army Corps of Engineers
Galveston District

| Mark | Description | Date | By |
|---|---|---|---|

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CHANNEL & WATERWAY STUDY
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF
DAVID C. WESTON, COL, C.E.
DISTRICT COMMANDER

Drawn By: Date: June 2008
Designed By: Scale: AS SHOWN
Checked By: Sabine-Neches Waterway
Approved By: LONG, THOMAS, R. HARRISON, S. SUTCLIFF, M.
Corps of Engineers, Galveston Dist. Engineering Division
Civil Engineering and Construction Division

SABINE NECHES WATERWAY, TEXAS
CHANNEL & WATERWAY STUDY
4B PROJECT

DROP OUTLET STRUCTURE
TABLE I

Drawing No.:
S-4



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# Appendix 2

# Economic Appendix

# APPENDIX 2
# ECONOMIC APPENDIX
# SABINE-NECHES WATERWAY
# CHANNEL IMPROVEMENT PROJECT
# SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

June 2010

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## List of Acronyms

| | |
|---|---|
| AEO | *Annual Energy Outlook* |
| AIS | Automatic Identification System |
| API | American Petroleum Institute |
| Bcf | billion cubic feet |
| Bcf/d | billion cubic feet per day |
| BCR | benefit to cost ratio |
| BOOT | Beaumont Offshore Oil Terminal |
| BOOTS | Bulk Oil Offshore Transfer System |
| BPD | barrel-per-day |
| DWT | dead weight tons |
| EGM | Economic Guidance Memorandum |
| EIA | U.S. Energy Information Administration |
| ERDC | Engineering Research and Development Center |
| FAO | Food and Agriculture Organization |
| FERC | Federal Energy Regulatory Commission |
| FY | fiscal year |
| GICA | Gulf Intracoastal Canal Association |
| GIWW | Gulf Intracoastal Waterway |
| IWR | Institute of Water Resources |
| LNG | Liquefied natural gas |
| LoLo | load-on/load off |
| LOOP | Louisiana Offshore Oil Port |
| LRS | Lloyd's Register-Fairplay of Ships |
| $m^3$ | cubic meters |
| MSA | metropolitan statistical area |
| MSO | Marine Safety Office |
| MTBE | methyl tertiary-butyl ether |
| NDC | Navigation Data Center |
| PADD | Petroleum Administration Defense District |
| SB | Sabine Bar or the Sea Buoy |
| SETWAC | Southeast Texas Waterways Advisory Council |
| SNWW | Sabine-Neches Waterway |
| SPA | Sabine Pilots Association |
| SPR | Strategic Petroleum Reserve |
| Tcf | trillion cubic feet |
| TOPS | Texas Offshore Oil Port System |
| ULCC | Ultra Large Crude Carriers |
| USACE | U.S. Army Corps of Engineers |
| USCG | U.S. Coast Guard |
| USDA | U.S. Department of Agriculture |

| | |
|---|---|
| USDOE | U.S. Department of Energy |
| VLCCs | very large crude carriers |
| VTM | Vessel Traffic Management |
| VTS | vessel traffic service |
| WCSC | Waterborne Commerce Statistics Center |

# APPENDIX 2

# ECONOMIC APPENDIX

## 1.0 GENERAL

This appendix presents the economic analysis for proposed modifications to the Sabine-Neches Waterway (SNWW). The SNWW project area and the general boundaries of its channel reaches are shown on Figure 1. The existing project is defined by a 40-foot project depth from the Gulf of Mexico offshore entrance channel to Port Arthur and Beaumont and a 30-foot project depth to the Port of Orange. Project alternatives were evaluated based on reductions in transportation costs generated from more-efficient vessel loading and from reductions in vessel delays due to channel deepening and widening. The benefits were calculated for a 2019–2069 period of analysis using Fiscal Year (FY) 2009 Federal Discount rate of 4.375 percent and the deep-draft vessel operating costs contained in the unpublished update to Economic Guidance Memorandum (EGM 08-04). The deepening benefits were calculated using a Microsoft Excel spreadsheet model. The widening benefits were calculated using the HarborSym model. The analyses and computations presented in this appendix are based on data and statistics obtained from personal interviews with industry officials and from analyses of historical data and published trends.

The appendix contains of nine sections. This first section presents general information on channel use and the results of the initial screening, and an overview of the historical traffic base. Section 2 presents evaluation of the major commodity groups. Section 3 presents existing vessel utilization trend data and a casualty assessment. Section 4 presents the commodity and fleet forecasts. Section 5 summarizes total tonnage. Section 6 presents the transportation savings benefit analysis. Section 7 presents a summary of the project benefits and the incremental analysis. Section 8 presents the sensitivity analyses. Section 9 presents an overview of regional economics.

The SNWW terminals include the public marine facilities owned by the ports of Beaumont, Port Arthur, and Orange, as well as the petroleum refineries, chemical plants, and general cargo terminals. Vessels and barges are used to transport crude oil, petroleum products, liquid and dry chemicals, and steel and dry bulk cargo. Deep-draft cargoes are transported from offshore through the Sabine Pass Channel. The Port of Port Arthur's general cargo facilities are located on the Sabine-Neches Canal near mile 32, and its crude petroleum and product terminals are in the Taylor Bayou basin. The Port of Beaumont's public and private docks are located on the Neches River Channel. The Channel to Orange intersects with the Gulf Intracoastal Waterway (GIWW) at the east end of the SNWW. Improvements to the Channel to Orange were not evaluated due to the expectation of low utilization of the existing project depth. In addition to its large volume of deep-draft traffic, the Sabine-Neches Canal serves as a through channel for the GIWW. The GIWW extends from Apalachee Bay, Florida, to Brownsville, Texas, and connects with the SNWW at approximately 3 miles below Orange and then follows the Sabine River and Sabine-Neches Canal to the head of the Port Arthur Canal where it exits the SNWW and continues westward to Galveston Bay. Distributions of SNWW's port-specific deep-draft and shallow-draft tonnage are displayed in Table 1.

Figure 1: Project Location

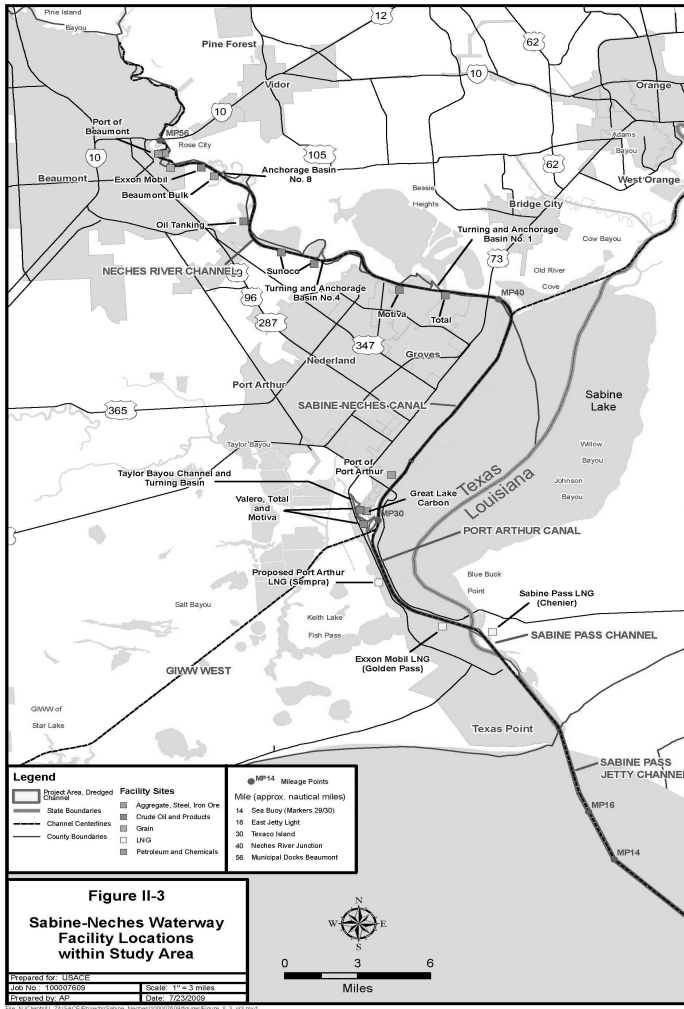


Table 1
SNWW Port Tonnage
(1,000s of Short Tons)

| | Beaumont | | Port Arthur | | Orange | | SNWW Port Totals a/ | |
|---|---|---|---|---|---|---|---|---|
| Year | Deep-Draft | Shallow-Draft | Deep-Draft | Shallow-Draft | Deep-Draft | Shallow-Draft | Deep-Draft | Shallow-Draft |
| 1999 | 69,655 | 12,997 | 13,730 | 7,657 | 0 | 681 | 83,385 | 21,335 |
| 2001 | 64,777 | 14,354 | 16,173 | 6,629 | 0 | 798 | 80,950 | 21,781 |
| 2002 | 70,441 | 15,470 | 16,640 | 6,036 | 5 | 759 | 87,086 | 22,265 |
| 2003 | 71,519 | 16,022 | 21,044 | 6,126 | 10 | 815 | 92,573 | 22,963 |
| 2004 | 74,065 | 17,632 | 20,758 | 6,812 | 3 | 606 | 94,826 | 25,050 |
| 2005 | 63,069 | 15,547 | 19,856 | 7,714 | 0 | 627 | 82,925 | 23,888 |
| 2006 | 60,431 | 18,784 | 20,990 | 7,413 | 3 | 718 | 81,424 | 26,915 |
| 2007 | 60,305 | 21,079 | 20,977 | 8,285 | 10 | 815 | 81,292 | 30,179 |

Source: U.S. Army Corps of Engineers (USACE), *Waterborne Commerce of the U.S., Part 2*, 1999–2007.
a/ Includes intraport movements.

An initial array of project alternatives was identified during the screening analysis. The screening results were presented at the May 2001 Feasibility Scoping Meeting. For the screening, channel-deepening benefits were calculated for 43, 45, 47, 48, 50, 52, and 55 feet. The results showed that the 50-foot channel depth produced the highest net excess benefits. The results also showed that the net excess benefits for 50 feet were only slightly higher than for 48 feet. Incorporation of later traffic data and improved cost estimates continued to indicate that the maximum net excess benefits were in the 48- to 50-foot range. Channel deepening was proposed by industry as a means to allow the existing fleet to be loaded more fully, reduce per ton transportation costs for vessels using the waterway, and allow for reductions in the number of annual vessel trips.

Identification of the channel-widening alternatives was driven by physical structures along the Neches River and Sabine-Neches Canal and the Port Arthur Hurricane Protection Levee in the Sabine-Neches Canal reach. Delays prompted by transit restrictions are a major concern under existing conditions and will continue to be a concern under the without-project future. As part of plan formulation, the Neches River anchorage basins were introduced as an alternative to widening of the Neches River Channel. The anchorages would be used to facilitate vessel passing. During the initial screening, extensive and intermittent widening was evaluated for the channel reaches from Sabine Pass Channel inland through the Neches River Channel. Widening of the Neches River was eliminated from consideration based on comparison of anticipated reductions in vessel delay costs and initial project construction cost estimates, and from the outputs of the Engineer Research and Development Center (ERDC) ship simulation modeling. Widening of the Neches River reach was found not be a cost-effective alternative due to the costs associated with dock relocations and extensive dredging. Additionally, intermittent widening of the Neches River Channel did not perform well during ERDC ship simulation modeling. In comparison, the Neches River anchorages and Sabine Pass Channel and Port Arthur Canal widening features performed

favorably. The results of the ERDC modeling showed that a minimum width of 700 feet through the Sabine Pass Channel and Port Arthur Canal would be necessary for the Suezmax and Aframax vessels presently using the waterway to meet smaller vessels in the Sabine Pass Channel and Port Arthur Canal. Aframax tankers characteristically range from 90,000 to 120,000 dead weight tons (DWT), and Suezmax tankers characteristically range from 135,000 to 175,000 DWT. The project design vessel is an 899-foot-long, 164-foot-wide 158,000 DWT Suezmax crude petroleum tanker. ERDC testing of a 600-foot channel width alternative showed that neither a loaded or ballast design vessel was successful in meeting a comparably sized vessel, nor could the design vessel and a smaller 110,000 DWT Aframax tanker meet. In 2007, there were over 2,000 piloted vessels. The largest sized vessels using the channel to Port Arthur are Aframax tankers. The largest sized vessels using the Neches River Channel to Beaumont are Suezmax tankers. Sixty percent of piloted vessels shipped or received cargo from docks on the Neches River. Of the remaining 40 percent, 39 percent were associated with Port Arthur and the remaining 1 percent with the Channel to Orange.

Table 2 shows the existing channel dimensions. Channel width inside of the Sabine Pass Jetty Channel ranges from 400 to 500 feet except for reaches containing turning basins. The without-project future will continue to be defined by the channel dimensions shown in Table 2.

Table 2
Existing SNWW Channel Dimensions

| Channel Reach | Authorized Depth (feet) | Bottom Width (feet) | Length (miles) |
|---|---|---|---|
| Sabine Bank Channel | 42 | 800 | 14.7 |
| Sabine Pass Outer Bar Channel | 42 | 800 | 3.4 |
| Sabine Pass Jetty Channel | 40 | 800–500 | 4.0 |
| Sabine Pass Channel | 40 | 500–1,133* | 5.6 |
| Port Arthur Canal | 40 | 500–1,788* | 6.2 |
| Sabine-Neches Canal | 40 | 400–1,060* | 11.3 |
| Neches River Channel | 40 | 400 | 18.6 |
| Channel to Orange | 30 | 200 | 14.1 |

* This reach contains an existing turning basin.

The SNWW is currently subject to navigation constraints, including one-way and daylight-only sailing rules. The pilot rules are summarized in Table 3. The transit rules and associated restrictions are agreed upon by the shipping industry, supported by the U.S. Coast Guard (USCG) Captain of the Port Orders under the Ports and Waterways Safety Act of 1978, as amended, and administered by the Sabine Pilots Association (SPA). These voluntary rules were agreed upon by the Sabine shipping industries and the SPA, and supported by USCG Captain of the Port Orders under the Ports and Waterways Safety Act of 1978, as amended. The agreement, dated January 12, 1981, will remain in force until the Sabine shipping industries, SPA, and USCG agree to its revision or modification. Liquefied natural gas (LNG) vessels are subject to additional rules. LNG vessels using the SNWW would be subject to strict USCG regulations and to local pilot rules and, therefore, will not have the opportunity to meet other vessels or barges. The USCG regulations require that a safety zone is in place 2 miles ahead of a loaded LNG vessel and 1 mile astern of the vessel while transiting. LNG vessels using the SNWW would be subject to this rule. Even in the absence of the safety concerns inherent to LNG, the beams of LNG tankers would result in vessel-meeting restrictions; however, all LNG vessel movements will be subject to one-way traffic. Operation of the LNG terminals is part of the without-project future.

Table 3
SNWW Pilots Rules

General: Vessels 85,000 DWT or over, or greater than 875 feet in length and 125 feet in beam width will move during daylight hours only above the Texas Island intersection with the GIWW West. In the event that meeting situations are applicable but circumstances will not permit the utilization of turning basins, the following criteria will prevail:

1. Vessels with combined beam widths that equal or exceed one-half of the channel width will not meet day or night.
2. Vessels ≥85,000 DWT will not meet vessels of either ≥30,000 DWT or ≥2-foot draft above the Texas Island intersection.
3. Vessels ≥85,000 DWT will not meet vessels of either ≥30,000 DWT or ≥30-foot draft above buoys 29 and 30.
4. Vessels 48,000 metric DWT or more with a draft of 30 feet or more will not meet above buoys 29 and 30.
5. Vessels with a combined draft of 70 feet or more will not meet between the Neches River intersection and Day Beacon #40 (Smith Bluff) at night. Vessels with a combined draft of 65 feet or more will not meet above Day Beacon #40 at night.

Source: SPA (2008) http://www.sabinepilots.com/guidelines.htm.

Non-LNG vessels utilizing the waterway are wider than those using the channel even 5–10 years ago. Due to wider beams and the difficulty associated with handling an increasing number of larger vessels, the Sabine Pilots would not consider relaxing the transit rules without structural modifications of the channel. Widening the channel up to the Taylor Bayou junction will result in a relaxation of the pilot rules as vessels will have an additional 200 feet of channel (i.e., the existing channel width is 500 feet and the with-project width for the Sabine Pass Channel and Port Arthur Canal, which leads up to Taylor Bayou, will be 700 feet). The expectation for the with- and without-project future is that pilot rules will continue to limit the possibility of vessel-to-vessel and vessel-to-tow meetings in the Sabine-Neches Canal reach and that both vessel and shallow-draft tow movements will be scheduled through both vessel traffic service (VTS) and communication between vessel pilots.

An anticipated effect of the alternative that includes widening the Sabine Pass Channel and Port Arthur Canal to 700 feet would be to allow a higher percentage of vessels presently affected by the 50 percent combined beam rule in the 500-foot reach to meet in the proposed 700-foot reach. The pilots are uncertain as to the effect that widening will have on the other rules and are reluctant to speculate on how these rules might be relaxed if the channel was deepened and widened. For a "widening only alternative," rules 2 and 3 would be relaxed (see Table 3). For purposes of analysis, the only rule that would change if the channel were deepened and widened is the combined beam rule. The effect of relaxing the remaining two rules is expected if the channel was widened but not deepened. An increase in channel width to 700 feet would allow a higher percentage of vessels to meet in the proposed 700-foot reach. The effect of channel widening on Rule 1 would be that a larger number of wider beam vessels would be able to meet in the Sabine Pass Channel and Port Arthur Canal reaches. Rule 2 would not change meeting and passing restrictions in the Sabine-Neches Canal. The Sabine-Neches Canal is common to the GIWW. Safety concerns associated with the Sabine-Neches Canal reach provided the impetus for Port Arthur's selection as one of 28 ports selected for participation in the 1999 Vessel Traffic Management (VTM) workshops and the subsequent implementation of the VTM service in the early 2000s.

The screening analysis included assessment of nonstructural alternatives. Nonstructural alternatives include the existing Louisiana Offshore Oil Port (LOOP); reactivation of the Beaumont Offshore Oil Terminal (BOOT) permit; and participation in the August 2008 Texas Offshore Oil Port System (TOPS) initiative. The SNWW ports presently receive approximately 1 percent of daily refinery input through LOOP. Extensive pipeline expansions to LOOP would be necessary to accommodate a higher percentage of SNWW's crude petroleum throughput requirements, as SNWW's capacity is close to LOOP's capacity. Expansion is not under consideration by the LOOP stakeholders. While LOOP expansion was not considered for the SNWW without-project future base, the effect of a without-project future that includes utilization of offshore terminals was evaluated in the sensitivity section of this appendix (Section 8). The BOOTS project, which would be offshore from Beaumont, was announced in 2002. The BOOTS regulatory permit application is presently inactive, and the USCG has not received an update to the proposal since 2002. The TOPS initiative was announced in 2008. TOPS would be located offshore from Freeport (Texas) and would serve Port Arthur, Texas City, and Houston. Freeport is located on the Texas Coast southwest of the SNWW. As with BOOTS, TOPS would require construction of a pipeline from

offshore. The existing Seaway pipeline from Freeport to Texas City would be used as part of TOPS. The connection to Port Arthur from Texas City would necessitate a new pipeline extending approximately 95 miles. A March 2009 press release revealed that the Port Arthur participant, Motiva, put its participation on hold based on uncertainty associated with future crude petroleum import volumes and trade routes. The large fixed cost of offshore terminal construction requires high volumes of very large crude carriers (VLCCs) utilization in order to achieve a return on the investment. If constructed, industry indications are that TOPS and BOOTS would not serve as the exclusive supplies, just as LOOP is not the exclusive supplier for the Louisiana markets. The SNWW without-project future is based on the assumption that offshore port alternatives are not constructed. Current expectations are that regional crude oil imports will increase at lower rates in comparison to those experienced through the 1990s and into the early 2000s. The effect of a without-project future that includes utilization of offshore terminals is evaluated in the sensitivity section of this appendix.

An additional alternative is construction of a crude oil terminal in Port Arthur below Texas Island on the Sabine-Neches Canal, northeast of its junction with the GIWW. Port Arthur's existing petroleum terminals are located in the Taylor Bayou basin. The Taylor Bayou basin is immediately northwest of Texas Island. Construction of a new terminal in Port Arthur would divert crude petroleum import tonnage from the Neches River Channel to Beaumont. A new landside terminal on the Port Arthur Canal and the offshore alternatives remain uncertain; therefore, the effects of these alternatives on the 2019–2069 tonnage forecast was evaluated in the sensitivity section of this appendix.

The large volume of tow-barges using the Sabine-Neches Canal reach, along with a high flow of deep-draft traffic, compound congestion and prompted interest early in the study process of evaluation of a barge shelf through the canal reach between the east and west junction with the GIWW. Initial responses to the barge shelf alternative revealed large variance in expectations about its potential effects, with some tow operators questioning the usefulness of the proposed project feature. In 2005, the Gulf Intracoastal Canal Association (GICA) withdrew support for the barge shelf. While mixed concerns about the functionality of the proposed feature contributed to GICA's decision, the decision was primarily based on anticipated and continued success of the VTM as a nonstructural alternative. Additionally, and as part of the VTM initiatives, improved deep-draft and barge vessel communication initiated by the USCG and user safety board activities were noted by the USCG to have resulted in improved safety. Ongoing improvements to the VTM system are expected to result in accelerated safety and communication improvements. These nonstructural initiatives made by the USCG, Sabine Pilots Association, and GICA represent nonstructural alternatives to the barge shelf. The expectation for the with- and without-project future is that pilot rules will continue to limit the possibility of vessel-to-vessel and vessel-to-tow meetings in the Sabine-Neches Canal reach and that both vessel and shallow-draft tow movements in this reach will be scheduled through both VTM and communication between vessel pilots.

## 1.1 COMMODITY OVERVIEW

The SNWW tonnage experienced strong overall growth from the middle 1990s through 2007, with total tonnage increasing from an average of 108 million short tons for 1995–1997 to 138 million for 2005–2007. In 2007, tonnage totaled nearly 141 million short tons, and the waterway ranked 4th in the U.S. in terms of total tonnage and first in the Nation in crude oil imports. As individual ports, Beaumont ranked 5th in the nation with 81.4 million short tons. Port Arthur's 2007 tonnage totaled 29.3 million short tons with a national ranking of 28th. Channel to Orange tonnage totaled 682 thousand short tons in 2007. Tonnage for the three ports totaled approximately 111 million short tons. The remaining 30 million short tons of the 141-million-short-ton total consist of shallow-draft barge cargo. Table 4 presents SNWW 1970–2007 total tonnage and principal deep-draft movements. Approximately 60 percent of the SNWW tonnage consists of deep-draft movements. The remaining 40 percent consists of shallow-draft GIWW-related traffic. Table 5 displays Sabine-Neches Canal 1970–2007 shallow-draft GIWW tonnage section and the relative percentage of shallow-draft to total tonnage. In 2007, nearly 30 million short tons of the 59.7 million short tons of shallow-draft barge tonnage using the waterway were transported through SNWW port facilities. Beaumont's shallow-draft barge tonnage totaled 21.2 million short tons, Port Arthur's 8.3 million short tons, Orange's 0.7 million short tons, and Sabine Pass 0.9 million short tons. The remaining 30.3 million short tons of 2007 shallow-draft barge traffic consisted of "through movements" between ports such as those on the Lower Mississippi River, Houston, and the GIWW west of Houston. In reviewing trends for commodities presently or anticipated to be constrained, the initial focus was on the commodity groups displayed in Table 4.

Distributions of Port Arthur and Beaumont's 1999–2007 tonnages are displayed in tables 6 and 7. Port specific data for years prior to 1999 are not included in these tables due to U.S.Army Corps of Engineers (USACE) Navigation Data Center (NDC) reporting problems which resulted in a portion of Beaumont's tonnage being attributed to Port Arthur. Crude petroleum imports and petroleum and chemical product imports and exports comprised 80 percent of Port Arthur's 2007 total oceangoing tonnage. The 1999–2007 average was 83 percent. Port Arthur crude petroleum imports remained relatively flat since 2001 but steady. Port Arthur refinery capacity in 2009 is nearly 13 percent higher than in 2004, with additional expansions scheduled. Motiva announced plans for a 325,000 barrel-per-day (BPD) refinery expansion in Port Arthur in December 2007. Construction on the refinery expansion is presently taking place.

As shown in Table 6, Port Arthur's highest and most significant growth rates were for petroleum product exports and domestic coastwise, with overall tonnage growing at relatively steady rates. Analysis of the commodity-specific data showed that 81 percent of Port Arthur's 2005–2007 petroleum product exports were comprised of petroleum coke. Port Arthur's petroleum coke exports constitute 11 percent of the U.S. total, up from 3 percent for the early 1990s. Port Arthur's 2005–2007 chemical exports also experienced significant increases. Port Arthur's chemical export growth is attributable to significant gains in metallic salts and hydrocarbons exports. Twenty percent of U.S. 2005–2007 metallic salts exports were shipped from Port Arthur. Metallic salts and organic compounds are used in the production of paints and solvents, paper and wood products, cleaning products, and various chemical products, and more recently in the

production of nylon in Latin America and China. Increases in Port Arthur's metallic salt exports since 2004 are associated with the completion of a 266,000 metric-ton-per-year cyclohexane facility in the Taylor Bayou section of Port Arthur in early 2004.

Table 4
SNWW Total Tonnage and Major Commodity Tonnage
(1,000s of Short Tons)

| | | | Principal Deep-Draft Commodities | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Crude Petroleum | | Petroleum Products | | Chemical Products | | |
| Year | Total Tonnage | Total Deep-Draft Tonnage a/ | Imports | Coastwise | Imports | Exports | Imports | Exports | Bulk Grain Exports |
| 1970 | 79,291 | 35,696 | 9 | 9,217 | 280 | 827 | 72 | 336 | 1,786 |
| 1975 | 79,296 | 41,134 | 13,820 | 3,102 | 177 | 256 | 42 | 310 | 2,926 |
| 1980 | 108,124 | 52,560 | 28,640 | 3,082 | 715 | 2,359 | 648 | 634 | 1,843 |
| 1985 | 70,239 | 39,169 | 22,627 | 1,835 | 2,516 | 1,514 | 267 | 707 | 1,642 |
| 1990 | 90,819 | 36,175 | 20,348 | 2,921 | 2,198 | 1,635 | 34 | 546 | 2,090 |
| 1993 | 95,418 | 46,990 | 32,639 | 81 | 2,656 | 3,260 | 25 | 537 | 3,471 |
| 1994 | 99,675 | 49,775 | 37,226 | 225 | 1,859 | 3,092 | 49 | 577 | 2,303 |
| 1995 | 103,254 | 52,959 | 38,743 | 187 | 1,304 | 4,258 | 33 | 725 | 1,712 |
| 1996 | 103,262 | 54,863 | 40,930 | 971 | 1,473 | 3,930 | 48 | 777 | 1,038 |
| 1997 | 116,012 | 67,553 | 51,142 | 81 | 2,470 | 4,595 | 33 | 1,101 | 1,370 |
| 1998 | 115,935 | 70,351 | 53,877 | 38 | 3,491 | 4,329 | 140 | 966 | 910 |
| 1999 | 114,393 | 69,259 | 53,834 | 86 | 3,627 | 3,307 | 449 | 753 | 936 |
| 2000 | 126,285 | 83,385 | 67,187 | 149 | 3,051 | 4,043 | 619 | 1,469 | 894 |
| 2001 | 128,944 | 80,950 | 64,226 | 127 | 2,734 | 5,120 | 754 | 1,296 | 858 |
| 2002 | 135,088 | 87,081 | 66,383 | 133 | 5,028 | 5,635 | 683 | 1,587 | 835 |
| 2003 | 143,923 | 92,563 | 70,158 | 195 | 5,187 | 6,573 | 434 | 1,555 | 1,125 |
| 2004 | 150,297 | 94,823 | 69,875 | 134 | 6,002 | 7,152 | 656 | 2,104 | 1,329 |
| 2005 | 134,695 | 82,925 | 59,691 | 165 | 5,349 | 6,354 | 1,084 | 1,891 | 1,081 |
| 2006 | 138,065 | 81,640 | 57,616 | 139 | 3,819 | 6,823 | 1,244 | 2,904 | 1,214 |
| 2007 | 140,967 | 81,282 | 56,088 | 217 | 3,744 | 6,608 | 955 | 3,169 | 1,632 |

Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1970–2007.
a/ Includes commodities in addition to what is shown.

Table 5
SNWW Shallow-Draft Port and GIWW Through Tonnage, Deep-Draft Total Tonnage, and Shallow-Draft Percentage of Total Tonnage (1,000s of Short Tons) a/

| Year | Shallow-Draft Port Tonnage and GIWW Through Tonnage | Deep-Draft Tonnage | SNWW Total | Shallow-Draft Percent of Total Tonnage |
|---|---|---|---|---|
| 1970 | 43,595 | 35,696 | 79,291 | 55 |
| 1975 | 38,162 | 41,134 | 79,296 | 48 |
| 1980 | 55,564 | 52,560 | 108,124 | 51 |
| 1985 | 31,070 | 39,169 | 70,239 | 44 |
| 1990 | 54,644 | 36,175 | 90,819 | 60 |
| 1995 | 50,295 | 52,959 | 103,254 | 49 |
| 1996 | 48,399 | 54,863 | 103,262 | 47 |
| 1997 | 48,459 | 67,553 | 116,012 | 42 |
| 1998 | 45,584 | 70,351 | 115,935 | 39 |
| 1999 | 45,134 | 69,259 | 114,393 | 39 |
| 2000 | 42,900 | 83,385 | 126,285 | 34 |
| 2001 | 47,902 | 81,998 | 128,944 | 37 |
| 2002 | 48,007 | 87,081 | 135,088 | 36 |
| 2003 | 51,360 | 92,563 | 143,923 | 36 |
| 2004 | 55,474 | 94,823 | 150,297 | 37 |
| 2005 | 51,770 | 82,925 | 134,695 | 38 |
| 2006 | 56,646 | 81,421 | 138,067 | 41 |
| 2007 | 59,685 | 81,282 | 140,967 | 42 |

Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1970–2007.
a/ Includes intra-port movements.

As shown in Table 6, Port Arthur's commodity movements other than petroleum and chemicals include crude materials, which consist of 513,000 short tons of limestone, sand, and gravel. For 1999–2007, crude material volumes averaged nearly 500,000 short tons annually. Port Arthur's crude material facilities are located on the Sabine-Neches Canal near mile 32, and its crude petroleum and product terminals are in the Taylor Bayou basin.

Port Arthur's steady volume of coastwise tonnage shown in Table 6 is associated with continuing shipments of gasoline, distillate fuel oil, and petroleum coke between Port Arthur and other deep-draft U.S. ports. Approximately 39 percent of tonnage is shipped to Florida's Atlantic Coast, 34 percent to Florida's Gulf Coast, 9 percent to Baton Rouge, 6 percent to Houston, 3 percent to Lake Charles, and 2 percent to Corpus Christi. The remaining 7 percent of destinations include Puerto Rico, the U.S. West Coast, and the Northeast.

Table 6
Port Arthur Total Tonnage and Major Commodity Tonnage
(1,000s of short tons)

| Year | Total Tonnage | Total Deep-Draft | Total Coastwise | Crude Petroleum | Petroleum Products | | Chemical Products | | Crude Materials, Except Fuels | | Primary Manufactured Goods | | Major Group | % of Deep- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Imports | Imports | Exports | Imports | Exports | Imports | Exports | Imports | Exports | Total | Draft |
| 1999 | 18,308 | 12,073 | 659 | 7,977 | 604 | 1,136 | 5 | 349 | 566 | 21 | 617 | 107 | 12,041 | 100 |
| 2000 | 21,387 | 13,730 | 817 | 8,862 | 1,121 | 1,502 | – | 307 | 206 | 7 | 743 | 107 | 13,672 | 100 |
| 2001 | 22,802 | 16,173 | 1,043 | 11,064 | 641 | 2,327 | 25 | 136 | 131 | – | 665 | 101 | 16,133 | 100 |
| 2002 | 22,676 | 16,640 | 1,422 | 9,013 | 997 | 3,143 | 89 | 176 | 919 | 2 | 641 | 194 | 16,596 | 100 |
| 2003 | 27,170 | 21,044 | 2,577 | 11,987 | 1,152 | 3,734 | 60 | 210 | 481 | 20 | 557 | 128 | 20,906 | 99 |
| 2004 | 27,570 | 20,758 | 1,804 | 10,015 | 2,150 | 4,255 | 225 | 889 | 531 | 41 | 564 | 106 | 20,580 | 99 |
| 2005 | 26,385 | 19,856 | 1,803 | 9,320 | 2,205 | 3,858 | 194 | 998 | 558 | 14 | 710 | 84 | 19,744 | 99 |
| 2006 | 28,403 | 21,209 | 2,323 | 10,627 | 1,144 | 4,391 | 111 | 1,330 | 566 | 54 | 542 | 46 | 21,134 | 100 |
| 2007 | 29,067 | 20,977 | 3,330 | 10,334 | 792 | 3,978 | 97 | 1,525 | 513 | 64 | 122 | 35 | 20,790 | 99 |
| | Average Annual Growth Rate (1999-2007) | | | | | | | | | | | | | |
| | 5.9% | 7.1% | 22.4% | 3.3% | 3.4% | 17.0% | 44.9% | 20.2% | −1.2% | 14.9% | −18.3% | −13.0% | 7.1% | −0.1% |

Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1999–2007.

Table 7
Beaumont Total Tonnage and Major Commodity Tonnage
(1,000s of short tons)

| Year | Total Tonnage | Total Deep-Draft | Total Coastwise | Crude Petroleum Imports | Petroleum Products Imports | Petroleum Products Exports | Chemical Products Imports | Chemical Products Exports | Crude Materials, Except Fuels Imports | Crude Materials, Except Fuels Exports | Primary Manufactured Goods Imports | Primary Manufactured Goods Exports | Grain Exports | Major Group Total | % of Deep Draft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 69,406 | 57,186 | 3,330 | 45,857 | 3,023 | 2,170 | 444 | 404 | 115 | 446 | 281 | 8 | 936 | 57,014 | 100 |
| 2000 | 76,894 | 69,655 | 3,046 | 58,325 | 1,930 | 2,541 | 619 | 1,162 | 413 | 410 | 133 | 1 | 894 | 69,474 | 100 |
| 2001 | 79,131 | 64,777 | 2,793 | 53,162 | 2,093 | 2,793 | 729 | 1,160 | 622 | 165 | 103 | 6 | 858 | 64,484 | 100 |
| 2002 | 85,911 | 70,441 | 2,712 | 57,370 | 4,031 | 2,492 | 594 | 1,411 | 394 | 14 | 204 | 14 | 835 | 70,071 | 99 |
| 2003 | 87,541 | 71,519 | 2,732 | 58,171 | 4,035 | 2,839 | 374 | 1,345 | 583 | 73 | 115 | 36 | 1,125 | 71,428 | 100 |
| 2004 | 91,968 | 74,065 | 3,191 | 59,860 | 3,852 | 2,897 | 431 | 1,215 | 559 | 104 | 420 | 1 | 1,329 | 73,859 | 100 |
| 2005 | 78,887 | 63,069 | 2,967 | 50,371 | 3,144 | 2,496 | 890 | 893 | 624 | 106 | 471 | 12 | 1,082 | 63,056 | 100 |
| 2006 | 79,486 | 60,431 | 3,115 | 46,988 | 2,676 | 2,432 | 1,133 | 1,574 | 550 | 243 | 364 | 8 | 1,214 | 60,296 | 100 |
| 2007 | 80,062 | 60,305 | 3,261 | 45,776 | 2,952 | 2,713 | 858 | 1,644 | 617 | 421 | 173 | 86 | 1,632 | 60,133 | 100 |
| | Average Annual Growth Rate (1999-2007) | | | | | | | | | | | | | | |
| | 1.8% | 0.7% | –0.3% | 0.0% | –0.3% | 2.8% | 8.6%% | 19.2% | 23.4% | –0.7% | –5.9% | 34.5% | 7.2% | 0.7% | 0.0% |

Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1999–2007.

Examination of Beaumont's tonnage (see Table 7) showed that crude petroleum imports and petrochemical imports and exports composed 89 percent of Beaumont's 2007 total oceangoing tonnage. Four percent of 2005–2007 U.S. fertilizer and fertilizer mixes were exported from Beaumont. For 2005–2007, the Beaumont share of potassic fertilizer exports increased to 12.5 percent of the U.S. fertilizer export total, up from 1 percent prior to 2001. Beaumont's other commodity movements include grain exports, coastwise shipments of gasoline and liquid sulphur, and imports and exports of crude materials and manufactured goods. The latter groups comprise approximately 7 percent of Beaumont's deep-draft tonnage. Beaumont's crude material imports, which include limestone, sand, and gravel, comprised 1 percent of the 2005–2007 average U.S. total. Beaumont's imports of manufactured goods for 2005–2007 consisted of 336,000 short tons of iron and steel products, representing 1 percent of the U.S. total. Coastwise shipments for 2005–2007 averaged 2.4 million short tons and included 1.3 million short tons of gasoline and 720,000 short tons of chemicals. Liquid sulphur composed 85 percent of coastwise chemical shipments. For the period 1998–2007, sulphur shipments ranged from a low of 506,000 short tons in 2004 to a high of 679,000 in 2001. In 2007, Beaumont's sulphur shipments totaled 553,000 short tons.

While the initial screening focused on crude petroleum imports, interest in channel deepening alternatives was found to include aggregate, bulk grain, chemicals, and LNG. During the early 2000s, LNG permits were approved for the Cheniere Sabine Pass, Golden Pass (Exxon Mobil), and Sempra terminals. Cheniere opened its terminal in April 2008. Receipt of "commissioning cargo," which is used to chill the tanks and keep the natural gas in its liquefied state, occurred in 2008. Since opening, throughput has been low due to increased demand in other parts of the world. The effect of competing demand drove up LNG prices on the world market, with other countries willing to pay more than we are for LNG, little is being shipped to the U.S.[1] Japan imported much higher than anticipated volumes of LNG to fuel peaking plants after the summer of 2008 earthquake shut down most of the country's nuclear power generation. Tentatively there are short-term plans to export LNG from the Sabine Pass LNG import terminal in Louisiana. In a July 2009 press release, the U.S. Energy Information Administration (EIA) noted that expectations in 2010–2012 are for prices to stabilize and shipments to the U.S. to increase. Cheniere presently has three storage tanks built and another two under construction. Construction of the Exxon Golden Pass LNG terminal is scheduled for completion in 2011. Its schedule was delayed due to ongoing Hurricane Ike cleanup activities along with the unexpected surge in Japanese demand for LNG. Construction of the third permitted facility, Sempra, is anticipated after 2012. The three LNG sites are located in the Sabine Pass Channel and Port Arthur Canal reaches; these reaches are presently 500 feet wide and will remain so under the without-project future

As indicated, the EIA raised its projections for liquefied natural gas imports in July 2009, citing falling long-term demand elsewhere as new global production comes online. The EIA noted that U.S. LNG imports are expected to increase from 350 billion cubic feet (Bcf) in 2008 to about 480 Bcf in 2009 and 650 Bcf in 2010.[2] It was also noted that the U.S. tends to be the LNG market of last resort as producers send LNG to the higher-paying Asian and European markets first, adding that global LNG demand and prices have began to decline 2009, potentially leaving more LNG for the U.S. whose extensive storage

[1] *Beaumont Enterprise*, "Sabine LNG Filing Tanks Up," June 28, 2009.
[2] USDOE, Short-Term Energy Outlook, EIA, June 9, 2009.

and pipeline network means it can absorb LNG even at times of low demand. Added effects expected to result in increases in U.S. LNG imports are new production projects coming online in Russia and Qatar late in 2009. Expectations through 2011 are for completion of projects in Yemen and Indonesia. The LNG projection is subject to considerable uncertainty, while noting that initial production from new liquefaction capacity has been slowed or delayed for extended periods.

The remainder of this section presents additional detail on breakbulk foreign imports and exports and coastwise commodities. SNWW's breakbulk commodities of wood products, iron ore, limestone, and rock fall within the classification of manufactured goods. Figure 2 displays SNWW's established base of import and export tonnage by major commodity group.[3] Petroleum and chemical product imports and exports, breakbulk imports and exports, and bulk grain exports are shown. Tonnage increased for all groups except grain. In spite of declines, grain exports have increased marginally since the middle 1990s, and Beaumont's 2005–2007 wheat exports represent 5 percent of total U.S. wheat exports. The U.S. Department of Agriculture (USDA) shows 909 million bushels of wheat exports for the 2006–2007 crop-year, and 1,150 million bushels for 2007–2008. The USDA forecasted a constant export level of 950 million bushels for 2008–2009 through 2017–2018.[4]

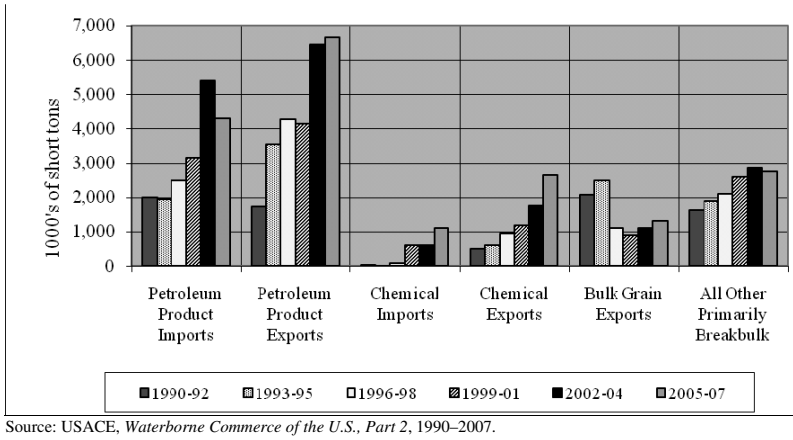
Figure 3 provides a detailed display of SNWW's major breakbulk tonnage. With the exception of wood and related product exports, which decreased at an average annual rate 9.5 percent, overall breakbulk volumes increased from 1990 to 1992 through 2005 to 2007. Iron and steel imports grew at an average annual rate of 8.8 percent. Limestone and rock imports increased at a rate of 6.3 percent. Wood product imports increased at an annual rate of 31.7 percent.[5] While 2005–2007 breakbulk volumes are up from the early nineties, 2007 tonnage was down. Approximately 60 percent of 2005–2007 combined imports and exports of breakbulk are transported through Port Arthur, and the remainder through Beaumont. Imports of iron and steel products and limestone and rock materials compose the majority of current breakbulk tonnage.

[3] Data for the years prior to 1999 are not presented for the individual ports. The Bureau of Census data contained in the *Waterborne Commerce of the United States* does not reflect correct allocation of Port Arthur and Beaumont traffic between the ports. Some of Beaumont's traffic was recorded under Port Arthur due to a Bureau of Census error. Total tonnage values were found to be correct for the SNWW, but the individual counts for years prior to 1999 were found to be unreliable.

[4] USDA, *USDA Agricultural Projections to 2017,* Long-term Projections Report OCE-2008-1, February 2008, p. 40.

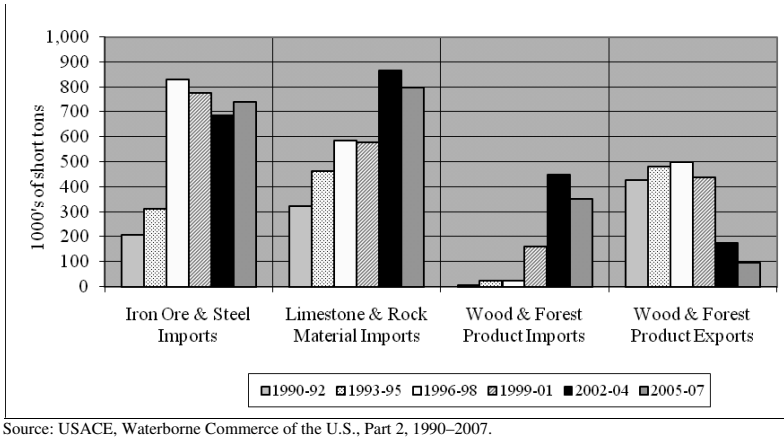
[5] The average annual growth rates for period such as 1990/1992 to 2005/2007 was calculated based on 15 years. The 1990/1992 to 2005/2007 averages were used as inputs.

Figure 2
SNWW Foreign Imports and Exports by Major Commodity Group
(Excluding Crude Petroleum)




Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1990–2007.

Figure 3
SNWW Breakbulk Imports and Exports
1989/1991 to 2004/2006 Distribution



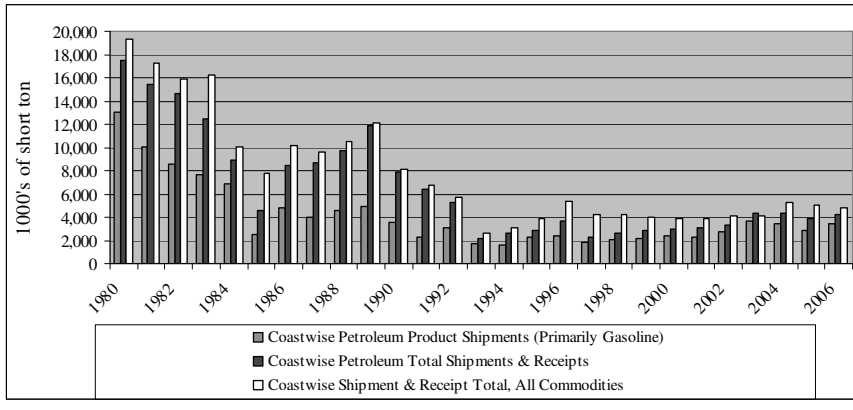

Source: USACE, Waterborne Commerce of the U.S., Part 2, 1990–2007.

Iron ore and rock materials increased dramatically from the early 1990s. Approximately 55 percent of 1999–2007 limestone and rock imports were shipped to Beaumont and the remainder to Port Arthur. SNWW aggregate tonnage primarily consists of imports of limestone, rock, and other raw building materials. For the period 2002–2007, 3.2 percent of U.S. limestone and rock imports were transported through the SNWW ports.

Approximately 62 percent of 1999–2007 iron and steel product imports were transported through Port Arthur and the remainder to Beaumont. While down in 2007, an average of 2.5 percent of 2002–2006 U.S. iron ore and steel slab imports were transported through the SNWW ports. For the period 2002–2007, imports ranged from a low of 240,000 short tons in 2007 and a high of 1.1 million short tons in 2005. SNWW wood and product imports primarily consist of pulp and waste paper, with the waterway importing 14 percent of 2005–2007 U.S. pulp and waste paper products.

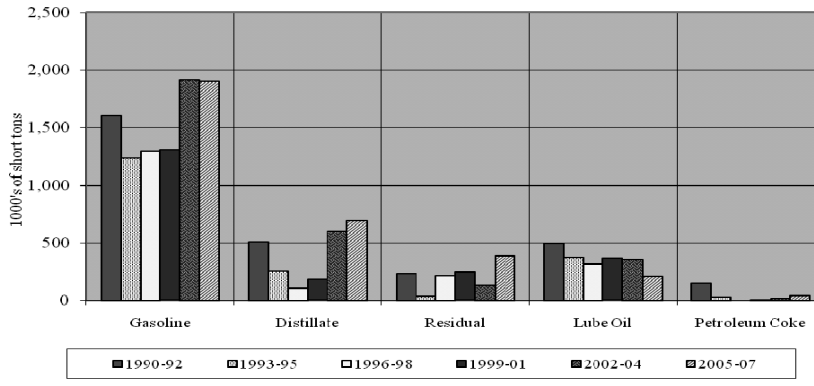
Coastwise tonnage consists almost exclusively of petroleum and chemical commodities. Figure 4 shows SNWW's 1980–2007 coastwise tonnage. The dramatic declines in coastwise product shipments experienced in the 1980s resulted from the transition from domestic production of crude petroleum to imports.

Figure 4
SNWW Coastwise Shipments and Receipts




Since the mid-1999s coastwise tonnage has been relatively steady, with some modest increases in recent years. Petroleum product shipments represented 67 percent of 2005–2007 tonnage, petroleum product receipts 22 percent, and the remaining 11 percent represented chemical shipments. Figure 5 displays SNWW's 1990–2007 coastwise petroleum product shipment averages by major commodity classification.

Figure 5
SNWW Coastwise Shipments and Receipts
by Major Commodity Group




Shipments consist of gasoline, distillate fuel oil, residual fuel oil, lube oil, and petroleum coke. Gasoline and products are shipped to the U.S. East Coast, specifically eastern Florida. Figure 6 displays Beaumont's and Port Arthur's petroleum product port shares for 1999–2007. As noted, 11 percent of SNWW coastwise tonnage consists of chemical shipments. Analysis of total chemical shipments showed that Beaumont shipped 95 percent of 1999–2007 chemical coastwise tonnage and Port Arthur the remaining 5 percent. Liquid sulphur constituted 75 percent of outbound shipments and contributed to a 95 percent increase in SNWW chemical shipments since the early 1990s. All of SNWW sulphur is shipped from Beaumont, with nearly all movements going to Florida. Figure 7 displays Beaumont's and Port Arthur's port shares for 1999–2007 chemical products.

Figure 6
Port Arthur and Beaumont
Outbound Coastwise Gasoline Shipments

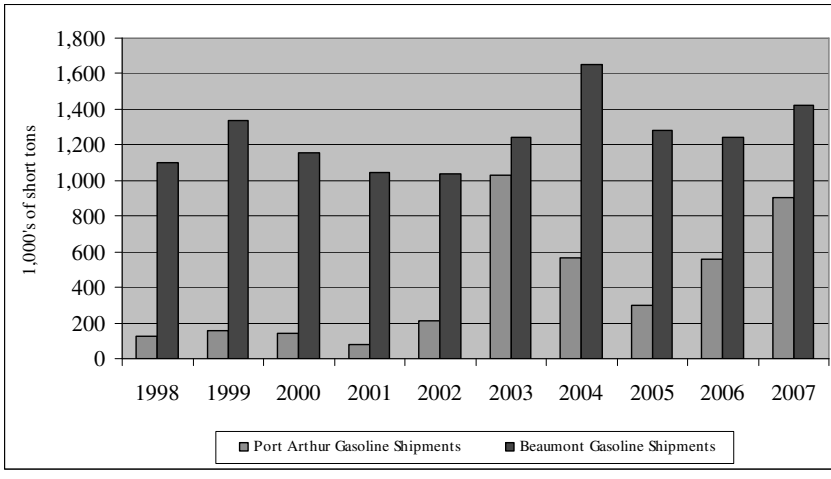
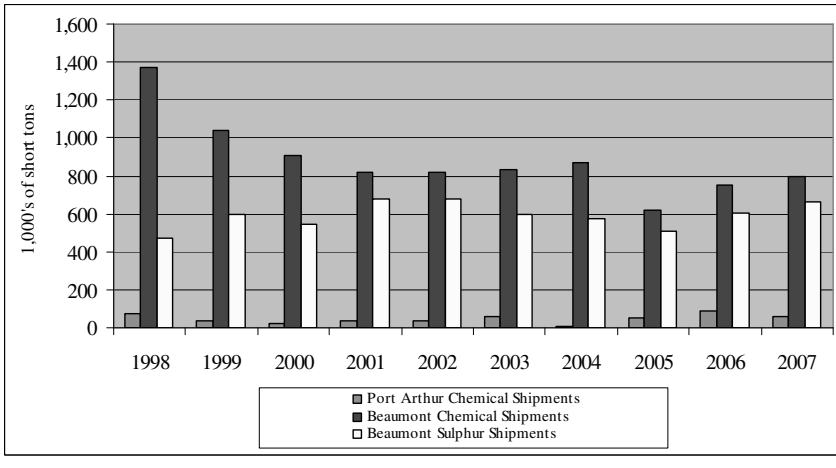



Figure 7
Port Arthur and Beaumont
Outbound Chemical Shipments



## 2.0 DETAILED COMMODITY ANALYSIS

This section presents detailed analyses of the major commodity groups currently or anticipated to be transported in larger vessels. Data obtained from vessel operators and ongoing analyses of SNWW trends and commodity-specific world and regional fleet data indicated that a portion of these commodities are limited by the constraints of the existing and the without-project future channel dimensions. The analyses address crude petroleum, petroleum products, chemical products, grain, aggregate, and LNG, with crude petroleum representing the most significant group.

### 2.1 CRUDE PETROLEUM

There are 20 waterfront facilities in Port Arthur and 27 in Beaumont that receive and/or ship crude petroleum or petroleum products. The SNWW refineries supply crude oil to the U.S. Department of Energy's (USDOE) "Big Hill Site" in Texas and the "Hackberry Site" in Louisiana Strategic Petroleum Reserve (SPR). The SNWW is the primary means of delivery for crude oil to four refineries in Beaumont and Port Arthur. Beaumont and Port Arthur each have two oil refineries, and the four refineries serve four terminals on the Neches River. Two of the Neches River terminals are connected by pipelines to the USDOE Strategic Petroleum Reserve underground storage units. The Motiva and Valero refineries are in Port Arthur in the Taylor Bayou basin. Motiva has a vessel terminal in the Taylor Bayou basin and another terminal on the Neches River. The Total Petrochemicals and ExxonMobil refineries are on the Neches River. Additional crude oil terminals located on the Neches River include BASF-Fina, Sun Oil, and Chevron-Phillips. The Neches River crude petroleum tankers accommodate Suezmax tankers.

The SNWW is contained in the U.S. Gulf Coast Petroleum Administration Defense District (PADD III). PADD III includes the states of Texas, Louisiana, Arkansas, Mississippi, Alabama, and New Mexico. SNWW's 2002–2006 crude petroleum waterborne imports composed 12 percent of U.S. and 18 percent of PADD III imports. Table 8 displays SNWW crude petroleum imports and the waterway's share of the national and regional totals for 1990–2007, and Table 9 displays the port-specific shares for 1998–2007.[6] Figure 8 shows the U.S. PADD boundaries. SNWW's crude petroleum imports represent 4 percent of the U.S. total and 7 percent of the U.S. Gulf Coast PADD III region. Figure 9 shows the regional SPR sites served by the SNWW terminals.

[6] Data for the years prior to 1998 are not presented for the individual ports. The Bureau of Census data contained in the *Waterborne Commerce of the United States* does not reflect correct allocation of Port Arthur and Beaumont traffic between the ports. Some of Beaumont's traffic was recorded under Port Arthur due to a Bureau of Census error. Total tonnage values were found to be correct for the SNWW, but the individual counts for years prior to 1999 were found to be unreliable.

SNWW's capacity represents six percent of the U.S. total. Specific capacity is 572,000 BPD for Port Arthur and 577,000 BPD for Beaumont. SNWW capacity levels for 2009 are presently 12 percent higher than in 2004 and 31 percent higher than in 1994. The Motiva expansion is presently under construction and will increase the refinery's crude oil throughput capacity to approximately 600,000 BPD, making it the largest refinery in the U.S. and one of the largest in the world. The ExxonMobil Beaumont refinery is presently the third largest refinery in the world. As a result of these additions, SNWW's combined capacity will represent the largest concentration in the State of Texas.

Table 8
Comparison of SNWW and Regional and National Totals
Crude Petroleum Imports (1000s of short tons)

| Year | SNWW Imports | PADD III Imports | U.S. Total Imports |
|---|---|---|---|
| 1990 | 20,348 | 178,052 | 322,433 |
| 1991 | 19,245 | 174,852 | 316,310 |
| 1992 | 23,613 | 184,871 | 333,666 |
| 1993 | 32,639 | 204,356 | 371,267 |
| 1994 | 37,226 | 221,020 | 386,381 |
| 1995 | 38,743 | 222,164 | 395,484 |
| 1996 | 40,930 | 237,708 | 411,824 |
| 1997 | 51,142 | 252,270 | 449,961 |
| 1998 | 53,877 | 267,175 | 476,231 |
| 1999 | 53,834 | 270,491 | 477,592 |
| 2000 | 67,187 | 281,170 | 497,547 |
| 2001 | 64,226 | 292,859 | 510,298 |
| 2002 | 66,383 | 282,226 | 499,999 |
| 2003 | 70,158 | 300,325 | 528,703 |
| 2004 | 69,875 | 316,402 | 553,337 |
| 2005 | 59,691 | 310,493 | 553,923 |
| 2006 | 57,615 | 309,399 | 553,489 |
| 2007 | 56,078 | 305,732 | 548,742 |
| 1990/1992 Average | 21,069 | 179,258 | 324,136 |
| 2005/2007 Average | 57,795 | 308,541 | 552,051 |
| 1990/1992 to 2005/2007 Compound Annual Growth (AAG) Rates | | | |
| | 7.0% | 3.7% | 3.6% |

Source: USACE and EIA, 1990–2007.

Table 9
Beaumont and Port Arthur Crude Petroleum Imports
(1,000s of Sort Tons)

| Year | Beaumont | % of SNWW Total | Port Arthur | % of SNWW Total | SNWW Total | PADD III Total | SNWW % of PADD | U.S. Total | SNWW % of U.S. |
|---|---|---|---|---|---|---|---|---|---|
| 1998 | 44,179 | 86.0 | 8,620 | 14.0 | 53,877 | 267,175 | 20.2 | 476,231 | 11.3 |
| 1999 | 45,857 | 85.2 | 7,977 | 14.8 | 53,834 | 270,491 | 19.9 | 477,592 | 11.3 |
| 2000 | 58,325 | 86.8 | 8,862 | 13.2 | 67,187 | 281,170 | 23.9 | 497,547 | 13.5 |
| 2001 | 53,162 | 82.8 | 11,064 | 17.2 | 64,226 | 292,859 | 21.9 | 510,298 | 12.6 |
| 2002 | 57,370 | 86.4 | 9,013 | 13.6 | 66,383 | 282,226 | 23.5 | 499,999 | 13.3 |
| 2003 | 58,171 | 82.9 | 11,987 | 17.1 | 70,158 | 300,325 | 23.4 | 528,703 | 13.3 |
| 2004 | 59,860 | 85.7 | 10,015 | 14.3 | 69,875 | 316,402 | 22.1 | 553,337 | 12.6 |
| 2005 | 50,371 | 84.4 | 9,320 | 15.6 | 59,691 | 310,493 | 19.2 | 553,923 | 10.8 |
| 2006 | 46,989 | 81.6 | 10,627 | 18.4 | 57,616 | 309,399 | 18.6 | 553,489 | 10.4 |
| 2007 | 45,766 | 81.6 | 10,312 | 18.4 | 56,078 | 305,732 | 18.3 | 548,742 | 10.2 |

Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1998–2007.

Figure 8
U.S. Petroleum Administration Defense Districts

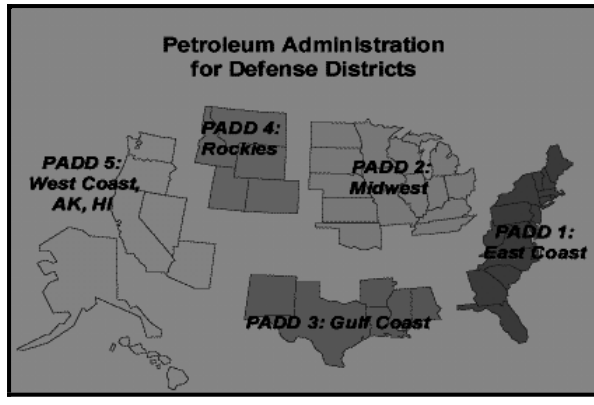
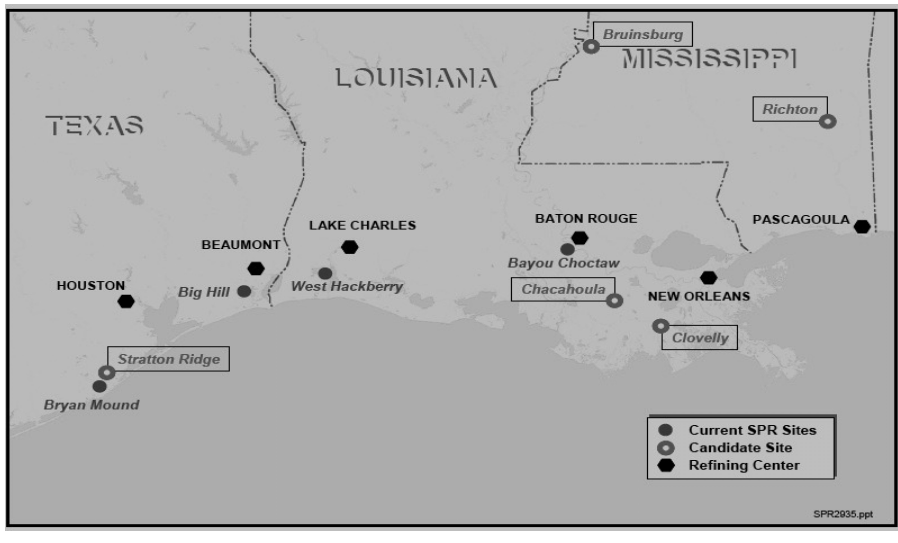



Figure 9
U.S. Strategic Petroleum Reserves Gulf Coast Sites



The amount of crude petroleum imported into the SNWW is largely dependent upon the area's capacity to refine crude and/or deliver pipeline by to other refining complexes. Table 10 displays regional crude petroleum refinery capacity data. In addition to supplying oil to two the USDOE SPR sites, the SNWW system delivers crude to refineries in Texas, Louisiana, Oklahoma, Ohio, Arkansas, and Kentucky. Examination of the refinery capacity data presented in Table 10 shows that the SNWW's 2002–2007 crude petroleum import volumes do not exceed crude petroleum refining capacity. Recent refinery expansions and anticipated new refinery construction prior to 2020 indicates that added capacity will be sufficient to meet anticipate crude petroleum import volumes.

Table 10
SNWW Atmospheric Crude Oil Distillation Capacity
(1,000s of Barrels Per Calendar Day)

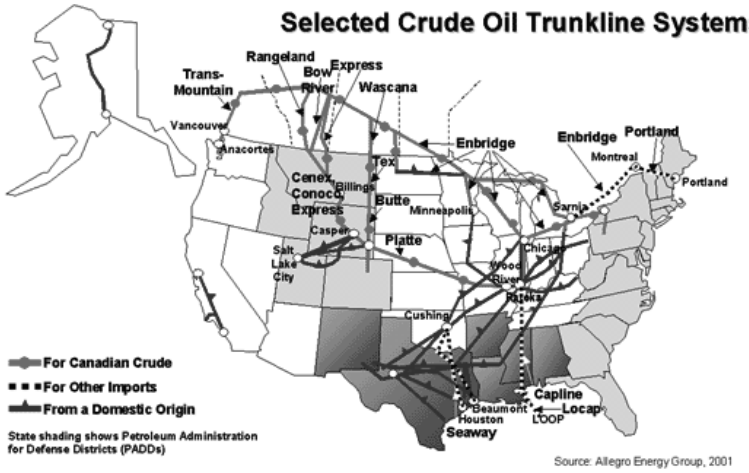
| Period | Beaumont | Port Arthur | Percent of Texas | Percent of U.S. | U.S. Total |
|---|---|---|---|---|---|
| 1994 | 420.5 | 454.0 | 19.6 | 5.8 | 15,034 |
| 1999 | 438.5 | 513.5 | 22.7 | 5.9 | 16,261 |
| 2000 | 450.0 | 523.0 | 23.0 | 5.9 | 16,512 |
| 2001 | 500.0 | 521.0 | 23.8 | 6.2 | 16,595 |
| 2002 | 500.0 | 527.0 | 22.9 | 6.1 | 16,785 |
| 2003 | 510.0 | 523.6 | 23.8 | 6.1 | 16,757 |
| 2004 | 505.0 | 523.6 | 22.9 | 6.1 | 16,974 |
| 2005 | 540.0 | 582.0 | 24.2 | 6.5 | 17,196 |
| 2006 | 545.0 | 580.5 | 24.0 | 6.5 | 17,383 |
| 2007 | 545.0 | 590.5 | 24.0 | 6.5 | 17,436 |
| 2008 | 574.0 | 576.5 | 24.0 | 6.5 | 17,436 |
| 2009 | 572.0 | 576.5 | 24.0 | 6.5 | 17,436 |

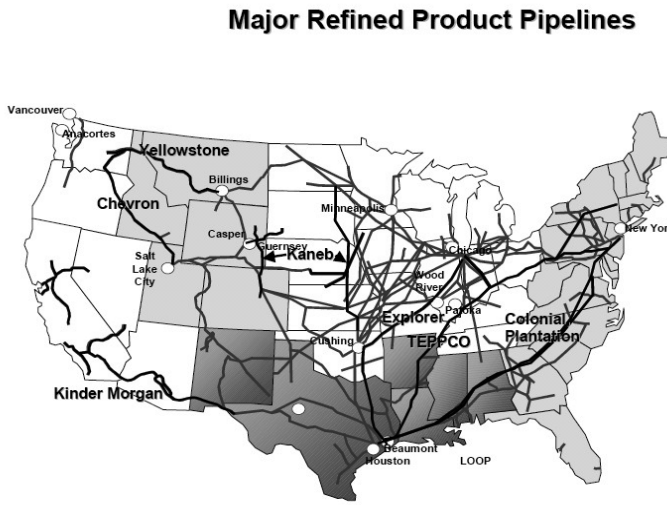
Source: U.S. Department of Energy (USDOE), EIA, 1994–2009.
* Variations occur in annual volumes due to temporary shutdowns and routine maintenance.

The Port Arthur and Beaumont terminals transport 400,000 barrels per day of waterborne crude oil via pipelines to inland refineries including refineries in Texas, Louisiana, Oklahoma, Ohio, Arkansas, and Kentucky.[7] Colonial Product Pipeline delivers over 2 million BPD of refined products via pipeline serving Louisiana, Alabama, Mississippi, Georgia, Tennessee, South Carolina, North Carolina, Virginia, Maryland, Delaware, and New Jersey. Explorer Product Pipeline delivers 650,000 BPD of refined products via pipeline serving Texas, Oklahoma, Missouri, Illinois, and Indiana. Products, such as gasoline, heating oil, diesel, and jet fuel, are transported from the Gulf Coast to the East Coast and the Midwest through existing pipeline networks. Product traffic also moves between U.S. ports by coastwise tankers and inland waterway barges. The SNWW refineries supply 15 percent of the product on Colonial's system and 13 percent of the product on Explorer's system. The pipeline maps shown on Figure 10 illustrate the distribution that includes the SNWW ports.

[7] Martin Associates. 2006. Economic Impacts of the Sabine-Neches Waterway and Economic benefits of Maintenance Dredging of the Waterway. Martin Associates, Lancaster, Pennsylvania.

Figure 10
Major U.S. Crude Petroleum and Product Pipelines



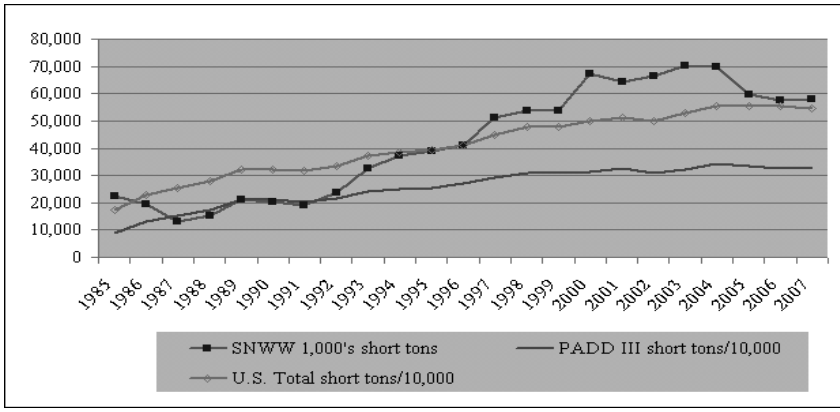

Source: Allegro Energy Group: How Pipelines Make the Oil Market Work, Their Networks, Operations, and Regulation, A Memorandum Prepared for the Association of Oil Pipelines and the American Petroleum Institute's Committee, December 2001.

Since the 1970s, overall SNWW and U.S. crude petroleum import volumes rose as U.S. crude production fell and was replaced by foreign imports of crude. The U.S. Gulf Coast leads the Nation in refinery capacity, with 41 percent of the Nation's crude oil distillation capacity, and one-half of the Gulf Coast refinery capacity is in Texas and the remainder is in Louisiana. The Gulf Coast is also the Nation's leading supplier in refined products. Figure 11 displays SNWW's 1985–2007 crude petroleum imports and SNWW's share of the national and regional totals. Although SNWW tonnage exhibits more variance than the region and the Nation, long-term expectations are that SNWW imports will grow at rates comparable to or higher than regional and national trends. These expectations are based on analysis of long-term historical trends and the study area's established infrastructure of regional and national pipeline distribution links. Declines in 2005–2007 imports are largely attributable to supply disruptions associated with Hurricane Rita, which devastated the SNWW region in September 2005.[8] The hurricane surge resulting from Rita resulted in sand bars at the offshore Entrance Channel and silting of the Neches River Channel to Beaumont. Silting of the Neches River Channel severely limited transit of the upper reaches for several months and resulted in tonnage diversions to other ports due to loaded-draft limitations. Aside from pipeline movements and events such as hurricanes, analysis of SNWW's crude petroleum and product tonnages and discussions with industry revealed that the effect of planned maintenance contributes to annual variances. U.S. imports declined marginally in 2006–2007.

While SNWW's 2005–2007 import volumes are down, Figure 11 shows that SNWW imports from 1992 through 2004 grew at higher rates than the region or the Nation. In comparison to other Texas Gulf Coast ports, SNWW 2000–2004 crude petroleum imports volumes exceeded other ports by nearly 35 percent. Additionally, recent increases in SNWW refinery capacity indicate the region will regain an increasing share of U.S. and PADD III totals. As noted, the Motiva expansion is presently under construction and will increase the refinery's crude oil throughput capacity to approximately 600,000 BPD, making it the largest refinery in the U.S. and one of the largest in the world, and the ExxonMobil Beaumont refinery is presently the third largest refinery in the world. The effect of Motiva expansion will result in SNWW's capacity representing the largest concentration in the State of Texas.

[8] Personal communication, ExxonMobil, Beaumont Office.

Figure 11
U.S. and Sabine-Neches Crude Oil Imports, 1985–2007




## 2.2 PETROLEUM PRODUCT IMPORTS

Table 11 presents SNWW and the U.S. 1990–2007 petroleum product imports. SNWW imports consist primarily of gasoline, distillate fuel oil, residual fuel oil, and naphtha. Figure 12 displays a comparison of the SNWW and U.S. trendlines. Comparison of the SNWW and U.S. totals indicates a strong level of correlation between the study area and the Nation; however, product types show significant variability. Variability in product volumes is noted to be a function of the demand and the supply of the relative types of crude oil supplied. The SNWW refineries have the capability to refine both high-sulfur and low-sulfur crude oil. The EIA notes that the average sulfur content of U.S. crude oil imports increased from 0.9 percent in 1985 to 1.4 percent in 2005. Future expectations are for increasing volumes of high-sulfur crude. Import of a range of crude oil types and spot-market sales result in dynamic market conditions and annual fluctuation in the product imports. For SNWW, high variability is noted for SNWW naphtha and distillate fuel oil. Naphtha is produced as an intermediate project from the distillation of crude oil and is primarily used as feedstock for producing high-octane gasoline. It is also used by the chemical industry for producing olefins in steam crackers. Distillate fuel oil is also a by-product of the refining process, but like naphtha, it is also imported. Variability is also reflected in the distribution of the U.S. products types, which is also characterized by annual fluctuations prompted by conditions where outputs fall short or are preempted by other market drivers.

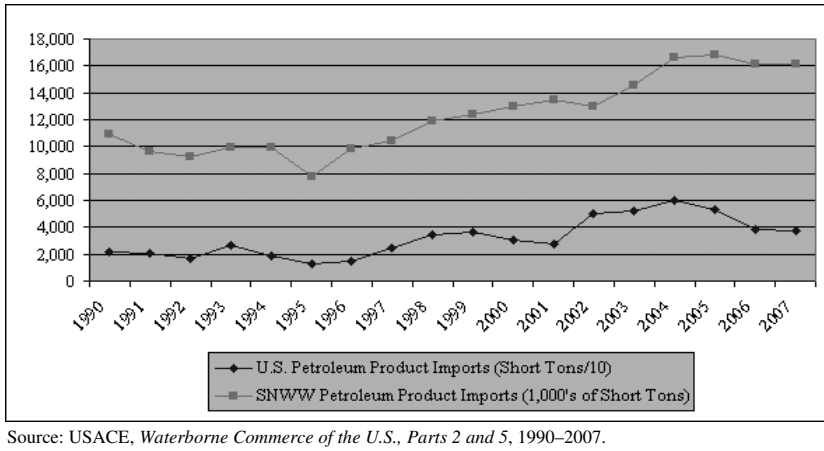
Table 11
SNWW and U.S. Petroleum Product Imports by Commodity Classification
1,000s of Short Tons

| | SNWW Petroleum Product Imports (1,000s of Short Tons) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | – | – | – | | – | – | 37 | 32 | 62 | 551 | 1,613 | 1,800 | 1,678 | 1,096 |
| Distillate Fuel Oil | 74 | 12 | 126 | 210 | 102 | 230 | 1,047 | 572 | 566 | 1,337 | 2,008 | 1,728 | 1,268 | 1,872 |
| Residual Fuel Oil | 1,035 | 72 | 137 | 115 | 57 | 49 | 319 | 25 | 541 | 56 | 728 | 804 | 351 | 355 |
| Lube Oil | 8 | 690 | 597 | 1,262 | 2,140 | 2,009 | 52 | 700 | 1,039 | 1,301 | 619 | 50 | 71 | 2 |
| Naphtha | 813 | 155 | 267 | 450 | 808 | 900 | 1,326 | 1,138 | 2,074 | 1,650 | 780 | 595 | 367 | 139 |
| Petroleum Coke | 12 | 241 | 185 | 245 | 250 | 308 | 270 | 266 | 746 | 290 | 256 | 365 | 84 | 276 |
| Other | 254 | 134 | 160 | 188 | 134 | 70 | – | 1 | – | 2 | – | 7 | – | 4 |
| SNWW Total Imports | 2,196 | 1,304 | 1,472 | 2,470 | 3,491 | 3,626 | 3,051 | 2,734 | 5,028 | 5,187 | 6,003 | 5,349 | 3,819 | 3,744 |
| % of U.S. Total | 2.0 | 1.7 | 1.5 | 2.4 | 2.9 | 2.9 | 2.3 | 2.0 | 3.9 | 3.6 | 3.6 | 3.3 | 2.4 | 2.3 |

| | U.S. Petroleum Product Imports (1,000s of Short Tons) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 18,054 | 10,789 | 19,561 | 19,374 | 17,381 | 18,404 | 24,157 | 27,732 | 29,282 | 32,294 | 50,746 | 63,022 | 64,261 | 58,574 |
| Distillate Fuel Oil | 13,644 | 12,915 | 16,155 | 16,619 | 13,592 | 15,278 | 21,111 | 20,589 | 19,936 | 29,115 | 53,876 | 52,679 | 53,670 | 55,627 |
| Residual Fuel Oil | 41,502 | 25,914 | 28,121 | 29,198 | 23,291 | 25,781 | 40,361 | 40,891 | 35,411 | 31,330 | 13,955 | 13,757 | 9,723 | 10,771 |
| Lube Oil | 12,533 | 9,558 | 8,869 | 11,144 | 35,327 | 35,229 | 9,040 | 10,353 | 8,606 | 10,653 | 10,148 | 515 | 666 | 383 |
| Naphtha | 13,277 | 9,916 | 14,085 | 13,825 | 12,736 | 10,901 | 17,844 | 15,718 | 16,227 | 17,405 | 7,994 | 8,634 | 7,109 | 7,146 |
| Petroleum Coke | 297 | 1,930 | 2,651 | 4,020 | 4,163 | 4,244 | 2,926 | 3,180 | 7,354 | 4,608 | 5,170 | 5,262 | 4,950 | 3,961 |
| Liquid Natural Gas | 5,321 | 3,027 | 4,292 | 4,303 | 5,306 | 6,312 | 6,694 | 8,364 | 7,671 | 15,556 | 22,192 | 16,566 | 18,618 | 21,238 |
| Other | 4,842 | 4,117 | 670 | 707 | 6,870 | 7,900 | 7,899 | 7,480 | 5,483 | 4,831 | 2,169 | 2,044 | 2,413 | 3,460 |
| Total | 107,470 | 78,166 | 98,316 | 104,167 | 118,666 | 124,049 | 130,032 | 134,307 | 129.970 | 145,792 | 166,250 | 162,479 | 161,410 | 161,160 |

Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1990–2007.

Figure 12
SNWW and U.S. Total Petroleum Product Imports
1990–2007

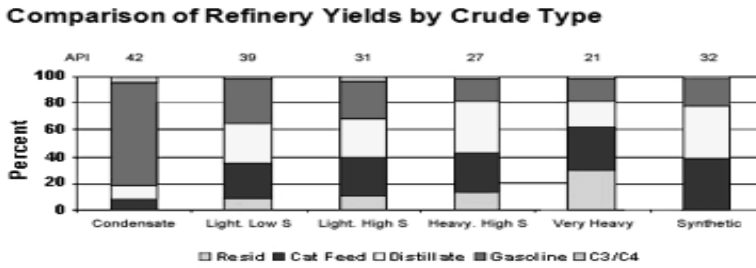



Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1990–2007.

Figure 13 displays the product yield for six typical types of crude oil. The figure shows both light and heavy crudes as well as sweet and sour crude oils and the associated American Petroleum Institute (API) gravity. The chart provides a comparison of the different output when each crude type is processed in a simple distillation refinery. The chart includes five main product groups: gasoline; propane and butane (C3/C4); Cat feed (a partially processed material that requires further refining to make usable products); distillate (which includes diesel oil and furnace oil); and residual fuel (the heaviest and lowest-valued part of the product output, used to make heavy fuel oil and asphalt).

Table 12 displays Port Arthur and Beaumont petroleum products by major commodity group. Distillate fuel oil represents 50 percent of Port Arthur's 2005–2007 imports, up by approximately 250 percent from the early 2000s. Residual fuel presently represents 23 percent of Port Arthur's product total, with overall imports increasing but to a smaller degree than distillate. The remainder of 2005–2007 imports consists of naphtha (4 percent), gasoline (7 percent), and petroleum coke (10 percent). Port Arthur's product imports dropped in 2006 and again in 2007. These downturns are partially attributable to hurricane-induced channel damages and refinery expansion.

Figure 13




Source: Natural Resources Canada, "Refinery Economics," January 1, 2009.

Table 12
Petroleum Product Imports by Port and Commodity Classification

| | Port Arthur Petroleum Product Imports (1,000s of Short Tons) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 0 | 0 | 0 | 17 | 0 | 28 | 91 | 181 | 101 | 36 |
| Distillate Fuel Oil | 9 | 1 | 522 | 177 | 127 | 643 | 1,096 | 1,019 | 658 | 414 |
| Residual Fuel Oil | 57 | 0 | 97 | 25 | 340 | 0 | 659 | 631 | 300 | 24 |
| Lube Oil | 56 | 0 | 0 | 49 | 168 | 52 | 0 | 0 | 0 | 2 |
| Naphtha | 337 | 216 | 232 | 106 | 37 | 140 | 90 | 109 | 0 | 0 |
| Petroleum Coke | 250 | 308 | 270 | 266 | 325 | 290 | 214 | 265 | 84 | 40 |
| Other | 18 | 78 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Port Arthur Imports | 727 | 603 | 1,121 | 640 | 997 | 1,153 | 2,150 | 2,205 | 1,144 | 792 |
| % of U.S. Total | 0.6 | 0.5 | 0.9 | 0.5 | 0.8 | 0.8 | 1.3 | 1.4 | 0.7 | 0.5 |
| | Beaumont Petroleum Product Imports (1,000s of Short Tons) | | | | | | | | | |
| Commodity | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 0 | 0 | 37 | 15 | 62 | 525 | 1,520 | 1,619 | 1,577 | 1,060 |
| Distillate Fuel Oil | 93 | 229 | 526 | 395 | 439 | 694 | 912 | 709 | 610 | 1,458 |
| Residual Fuel Oil | 0 | 49 | 222 | 0 | 201 | 56 | 69 | 173 | 51 | 331 |
| Lube Oil | 2,084 | 2,009 | 52 | 651 | 871 | 1,250 | 619 | 50 | 71 | 0 |
| Naphtha | 470 | 684 | 1,094 | 1,032 | 2,037 | 1,510 | 690 | 486 | 367 | 99 |
| Petroleum Coke | 0 | 0 | 0 | 0 | 421 | 0 | 42 | 100 | 0 | 0 |
| Other | 118 | 52 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 4 |
| Beaumont Imports | 2,765 | 3,023 | 1,931 | 2,093 | 4,031 | 4,035 | 3,852 | 3,144 | 2,676 | 2,630 |
| % of U.S. Total | 2.3 | 2.4 | 1.5 | 1.6 | 3.1 | 2.8 | 2.3 | 1.9 | 1.7 | 1.8 |

Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1998–2007.

Beaumont's product imports are dominated by gasoline. Gasoline represents 43 percent of Beaumont's 2005–2007 total product import total. Imports totaled nearly 1.1 million short tons in 2007, up from zero in the late 1990s. Beaumont's remaining imports consisted primarily of distillate fuel oil and naphtha. Beaumont's other imports consist of lube oil, residual, and naphtha, with annual volumes exhibiting relatively high degrees of variation.

## 2.3 PETROLEUM PRODUCT EXPORTS

Table 13 displays SNWW 1990–2007 petroleum product exports. SNWW petroleum product exports primarily consist of petroleum coke, gasoline, and distillate fuel oil. Overall exports increased since the 1990s at a generally steady rate, with exports exceeding 6 million short tons since 2003. Petroleum coke exports dominate total exports and represented 63 percent of 2005–2007 and 14.1 percent of U.S. total petroleum coke exports. Gasoline represented 11 percent of the SNWW total and 16.7 percent of U.S. gasoline exports. Distillate fuel oil represented 5 percent of SNWW total exports and 1.6 percent of U.S. distillate exports. The remaining 21 percent of SNWW exports consisted of lube oil, naphtha, residual fuel oil, and general products. Analysis of the SNWW and national totals indicated a strong level of correlation between the study area and the Nation, with regional growth generally exhibiting higher annual growth rates. Figure 14 provides a comparison of the SNWW and U.S. trendlines, and Figure 15 provides a comparison of regional and national petroleum coke exports.

Table 14 presents Port Arthur and Beaumont product exports by major commodity group. Port Arthur's product imports averaged 4.1 million short tons in 2005–2007. Petroleum coke represented 81 percent of Port Arthur's 2005–2007 exports, with its 2007 share nearly 90 percent. Gasoline represented 11 percent of Port Arthur's 2005–2007 product exports, and distillate 7 percent. The remaining 9 percent consisted of relatively small amounts of lube oil, naphtha, residual fuel oil, and general products. Port Arthur's relative shares of gasoline and distillate fuel oil exports increased over the last 8 years. Port Arthur's 2005–2007 petroleum coke export volumes represented 11 percent of the U.S. petroleum coke total. Overall demand for petroleum coke has been noted to be increasing due to growing use of heavy crude oil. It was noted that the cumulative effect of increasing product demand, tightening crude oil supplies, heavier and coarser crude oil, and constrained refinery capacity has contributed to the need for additional coking capacity.[9]

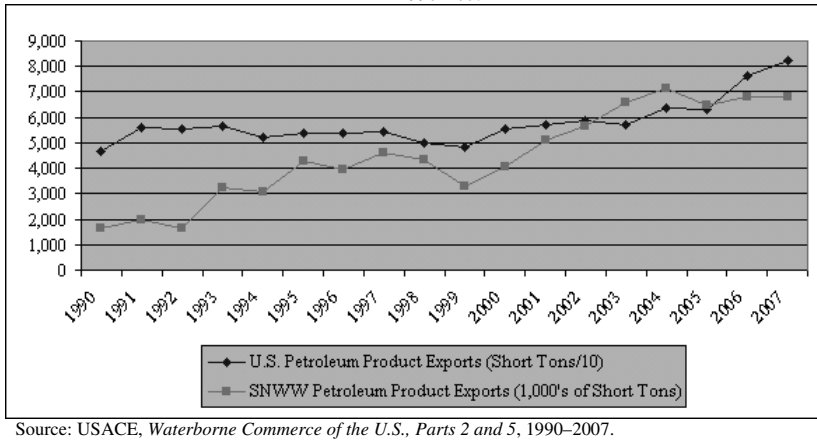
[9] Barnes and Clark, "Refining Perspectives," November 2005.

Table 13
SNWW and U.S. Total Petroleum Product Exports by Commodity Classification
1,000s of Short Tons

| | SNWW Petroleum Product Exports (1,000s of Short Tons) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 39 | 518 | 676 | 1,412 | 1,376 | 826 | 1,474 | 1,258 | 1,344 | 1,578 | 1,950 | 1,755 | 1,777 | 1,970 |
| Distillate Fuel Oil | 192 | 8 | 263 | 604 | 620 | 333 | 9 | 179 | 228 | 401 | 449 | 546 | 371 | 345 |
| Residual Fuel Oil | 417 | 160 | 228 | 136 | 206 | 125 | 42 | 9 | 17 | - | - | - | 68 | - |
| Lube Oil | 113 | 46 | 76 | 24 | 41 | 20 | 115 | 55 | 37 | 70 | 39 | 33 | 117 | 99 |
| Naphtha | 29 | 23 | 23 | - | - | 23 | 0 | 46 | 14 | 14 | 8 | 39 | 94 | 58 |
| Petroleum Coke | 724 | 3,435 | 2,578 | 2,185 | 1,622 | 1,473 | 2,235 | 3,447 | 3,777 | 4,426 | 4,689 | 3,903 | 4,362 | 4,210 |
| Other | 121 | 68 | 85 | 234 | 464 | 507 | 168 | 128 | 219 | 84 | 17 | 78 | 34 | 215 |
| SNWW Total Exports | 1,635 | 4,258 | 3,929 | 4,258 | 4,329 | 3,307 | 4043 | 5,122 | 218 | 6,573 | 7,152 | 6,354 | 6,823 | 6,607 |
| SNWW % of U.S. | 3.5 | 7.9 | 7.3 | 8.4 | 8.7 | 6.9 | 7.3 | 9.0 | 9.6 | 11.5 | 11.2 | 10.1 | 8.9 | 8.9 |
| | U.S. Petroleum Product Exports (1,000s of Short Tons) | | | | | | | | | | | | | |
| Commodity | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 2,405 | 3,849 | 4,265 | 5,786 | 4,828 | 4,140 | 6,434 | 6,906 | 6,726 | 6,630 | 11,053 | 9,564 | 10,661 | 12,704 |
| Kerosene | 2,408 | 1,307 | 2,338 | 1,642 | 893 | 994 | 1,497 | 1,078 | 1,075 | 767 | 55 | 615 | 546 | 434 |
| Distillate Fuel Oil | 5,349 | 6,625 | 6,227 | 5,879 | 4,591 | 4,148 | 4,953 | 4,982 | 5,861 | 7,046 | 16,202 | 15,642 | 26,249 | 27,068 |
| Residual Fuel Oil | 13,191 | 10,141 | 9,062 | 8,519 | 9,282 | 10,030 | 12,693 | 14,032 | 12,129 | 9,420 | 1,269 | 3,501 | 2,538 | 5,426 |
| Lube Oil | 2,555 | 1,803 | 2,028 | 1,662 | 1,410 | 1,583 | 1,595 | 1,191 | 1,302 | 1,240 | 263 | 287 | 829 | 881 |
| Naphtha | 2,079 | 3,712 | 3,636 | 3,473 | 3,877 | 4,263 | 1,896 | 2,598 | 2,180 | 2,146 | 1,577 | 2,426 | 2,285 | 2,683 |
| Asphalt, Tar and Pitch | 1,232 | 3,364 | 3,565 | 3,960 | 3,340 | 2,693 | 58 | 32 | 81 | 365 | 291 | 279 | 474 | 555 |
| Petroleum Coke | 15,798 | 20,199 | 20,581 | 21,239 | 19,298 | 17,926 | 23,508 | 23,859 | 26,520 | 26,904 | 30,588 | 28,676 | 30,202 | 30,290 |
| Liquid Natural Gas | 1,421 | 2,257 | 2,172 | 2,170 | 2,144 | 2,197 | 2,842 | 2,150 | 2,757 | 2,327 | 2,251 | 1,889 | 2,441 | 2,104 |
| Other | 515 | 684 | 119 | 115 | 77 | 78 | 157 | 120 | 90 | 106 | 115 | 80 | 113 | 172 |
| U.S. Total Exports | 46,953 | 53,941 | 53,993 | 54,445 | 49,740 | 48,052 | 55,633 | 56,948 | 58,721 | 56,951 | 63,664 | 62,959 | 76,338 | 82,317 |

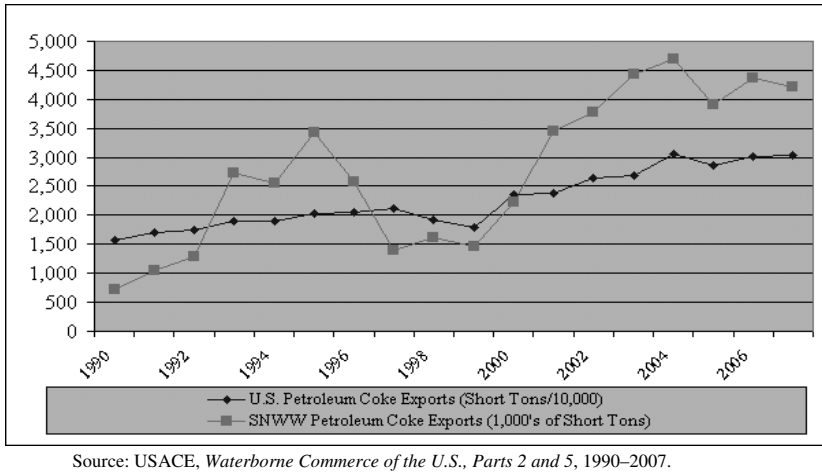
Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1990–2007.

Figure 14
U.S. and SNWW Total Petroleum Product Exports
1990–2007




Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1990–2007.

Figure 15
U.S. and SNWW Total Petroleum Coke Exports
1990–2007




Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1990–2007.

Table 14
Petroleum Product Exports by Port and Commodity Classification

| | Port Arthur Petroleum Product Exports (1,000 of Short Tons) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 105 | 2 | 123 | 51 | 0 | 158 | 290 | 558 | 492 | 324 |
| Distillate Fuel Oil | 82 | 66 | 0 | 96 | 213 | 238 | 389 | 444 | 262 | 117 |
| Residual Fuel Oil | 131 | – | – | – | – | – | – | – | – | – |
| Naphtha | – | 23 | 0 | 46 | 14 | 14 | 8 | 39 | 58 | – |
| Petroleum Coke | 1,112 | 1,038 | 1,274 | 2,125 | 2,754 | 3,319 | 3,550 | 2,812 | 3,545 | 3,530 |
| Other | 55 | 6 | 105 | 11 | 162 | 5 | 18 | 5 | 35 | 6 |
| Port Arthur Exports | 1,485 | 1,135 | 1,502 | 2,329 | 3,143 | 3,734 | 4,255 | 3,858 | 4,392 | 3,977 |
| % of U.S. Exports | 3.0 | 2.4 | 2.7 | 4.1 | 5.4 | 6.6 | 6.7 | 6.1 | 5.8 | 4.8 |
| | Beaumont Petroleum Product Exports (1,000s of Short Tons) | | | | | | | | | |
| Commodity | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 1,271 | 824 | 1,351 | 1,207 | 1,344 | 1,420 | 1,660 | 1,197 | 1,286 | 1,704 |
| Distillate Fuel Oil | 538 | 267 | 9 | 83 | 15 | 163 | 60 | 102 | 109 | 169 |
| Residual Fuel Oil | 75 | 125 | 42 | 9 | 17 | – | – | – | 51 | 22 |
| Lube Oil | 31 | 20 | 115 | 55 | 37 | 70 | 39 | 33 | 99 | 55 |
| Petroleum Coke | 510 | 435 | 961 | 1,322 | 1,023 | 1,107 | 1,139 | 1,091 | 817 | 679 |
| Other | 418 | 498 | 63 | 117 | 55 | 78 | – | 73 | 70 | 84 |
| Beaumont Exports | 2,843 | 2,169 | 2,541 | 2,793 | 2,491 | 2,838 | 2,898 | 2,496 | 2,432 | 2,713 |
| % of U.S. Exports | 5.7 | 4.5 | 4.6 | 4.9 | 4.2 | 5.0 | 4.6 | 4.0 | 3.2 | 3.2 |

Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1998–2007.

Large volumes of excess petroleum coke, specifically calcined coke, have historically been exported from Port Arthur existing facilities. Calcined coke is used in production of plastics, as feedstock for continuous particle thermal desulfurization, and for special low-sulfur carbon raiser in steel production.[10] Seven countries received more than 59 percent of U.S. coke exports in 2002. The major importer is Japan, which imports nearly 100 percent green coke and a trace of premium coke. The seven top importing countries use the green fuel-grade coke in their processing industries and as boiler fuel.[11] As indicated, world light sweet crude oil supplies are declining, and the refining of heavy oils is becoming a necessity. The refining of these heavy oils dramatically increases the amounts of petroleum waste product that are produced

The Port Arthur coker is used to convert heavy oil at the refinery directly to light products, in a process more typical of the refining process for conventional oils. Chief among methods of conversion is thermal coking, in which heavy oil from a vacuum distillation unit is fed to a heating unit (coker) that splits off lighter hydrocarbon chains and routes them to the traditional refinery units. The almost pure carbon remaining is a coal-like substance known as petroleum coke. The accumulated coke can be removed from

[10] Ellis, Paul J. and Christopher A. Paul, "Tutorial: Delayed Coking Fundamentals," Great Lakes Carbon Corporation, Port Arthur, Texas, March 8, 1998.
[11] *Petroleum Coke*, Pacific Mountain Energy Center I-1, September 12, 2006.

the coking vessels during an off cycle and either sold, primarily as a fuel for electricity generation, or used in gasification units to provide power, steam, and/or hydrogen for the refinery. Plans for a new 45,000 BPD "delayed coker" in Port Arthur were announced in February 2008, with construction anticipated to be complete by 2011.[12] Delayed cokers are used to convert residual oils into gasoline and diesel oil. Delayed coker feed originates from the crude oil, and the effect of new construction will be used to produce residual fuel and other products.

Beaumont product exports consist primarily of gasoline and also petroleum coke, with Beaumont gasoline exports representing 13 percent of U.S. total gasoline exports. Beaumont petroleum coke exports represented 3 percent of the U.S. total petroleum coke exports. Beaumont product exports remained relatively steady from 1998 through 2007, with growth exhibited for both gasoline and petroleum coke. Gasoline represented over 55 percent of 2005–2007 Beaumont product exports and petroleum coke approximately 34 percent. The remaining 11 percent of product exports consisted of distillate fuel oil, lube oil, residual fuel oil, and general products.

## 2.4 CHEMICAL PRODUCT IMPORTS

Table 15 displays 1990–2007 commodity-specific import totals for the SNWW. Distribution of Port Arthur's and Beaumont's 1999–2006 chemical imports by major commodity group is shown in Table 16. Examination of Port Arthur's and Beaumont's 1999–2006 chemical product shares showed that while Port Arthur's imports increased, overall tonnage remains relatively low in comparison to Beaumont's. Beaumont's 2005–2007 chemical imports averaged nearly 1 million. Increase in Beaumont's tonnage is primarily attributable to alcohols (methanol or methyl alcohol) and ammonia. For 2005–2007, imports of these two groups averaged 822,000 short tons and represented 83 percent of Beaumont chemical imports. Beaumont imported 16 percent of U.S. alcohol and 6 percent of U.S. ammonia.

[12] *Port Arthur News*, "Valero Expansion Expands Community Opportunities," February 29, 2008.

Table 15
SNWW and U.S. Chemical Imports by Commodity Classification

| | SNWW Chemical Product Imports (1,000s of Short Tons) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Acyclic and Other Hydrocarbons | 1 | 26 | 8 | 2 | 0 | 7 | 27 | 16 | 11 | 8 | 6 | 3 | – | 4 |
| Benzene and Toluene | 4 | – | 30 | 4 | 2 | – | 20 | 52 | 37 | 26 | 58 | 7 | 98 | 84 |
| Alcohols (Methyl Alcohol) | 22 | – | – | 6 | 20 | 199 | 189 | 195 | 169 | 74 | 22 | 477 | 460 | 374 |
| Sulphuric Acid | – | – | – | – | 0 | 6 | 158 | 0 | 100 | 71 | 131 | 124 | 147 | 6 |
| Ammonia | – | – | – | 21 | 100 | 234 | 174 | 361 | 221 | 173 | 401 | 469 | 425 | 684 |
| Inorganic Elements | – | – | – | – | 0 | – | – | 2 | – | – | – | – | – | – |
| Chemical Products | – | – | – | – | 0 | – | 45 | – | 129 | 74 | 17 | 4 | – | – |
| Other | 7 | 7 | 10 | – | 25 | 3 | 6 | 128 | 16 | 8 | 21 | – | 3 | 43 |
| SNWW Import Total | 34 | 33 | 48 | 33 | 147 | 449 | 619 | 754 | 683 | 434 | 656 | 1,084 | 1,133 | 955 |
| % of U.S. Total | 0.2 | 0.1 | 0.2 | 0.1 | 0.5 | 1.6 | 1.6 | 1.7 | 1.7 | 1.0 | 1.5 | 2.4 | 2.6 | 2.0 |
| | U.S. Chemical Product Imports (1,000s of Short Tons) | | | | | | | | | | | | | |
| Commodity | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Acyclic and Other Hydrocarbons | 337 | 434 | 328 | 431 | 440 | 489 | 695 | 571 | 465 | 1,112 | 882 | 639 | 927 | 1,428 |
| Benzene and Toluene | 278 | 311 | 563 | 292 | 513 | 584 | 1,603 | 1,260 | 1,224 | 1,378 | 1,883 | 1,874 | 2,473 | 2,443 |
| Alcohols (Methyl Alcohol) | 1,718 | 2,745 | 3,398 | 3,587 | 3,806 | 4,626 | 5,794 | 7,091 | 6,950 | 6,236 | 7,218 | 8,348 | 10,653 | 8,882 |
| Sulphuric Acid | 800 | 502 | 835 | 799 | 841 | 799 | 1,155 | 1,220 | 1,008 | 601 | 773 | 563 | 474 | 187 |
| Ammonia | 2,495 | 3,803 | 3,499 | 3,381 | 3,517 | 3,811 | 4,284 | 5,974 | 5,396 | 6,630 | 6,809 | 7,433 | 7,083 | 7,569 |
| Inorganic Elements | 435 | 869 | 664 | 766 | 838 | 1,051 | 2,153 | 1,305 | 3,046 | 2,288 | 2,981 | 2,134 | 2,625 | 1,404 |
| Chemical Products | 225 | 368 | 323 | 387 | 402 | 444 | 1,458 | 1,359 | 2,012 | 2,364 | 1,756 | 866 | 1,084 | 1,451 |
| Plastics | 1,120 | 1,332 | 1,411 | 1,694 | 1,776 | 2,074 | 2,227 | 2,034 | 2,282 | 2,626 | 2,954 | 3,646 | 3,850 | 3,224 |
| Organic Compounds | 351 | 3,315 | 3,640 | 4,049 | 4,733 | 4,742 | 4,882 | 4,965 | 4,300 | 3,053 | 2,438 | 1,858 | 1,087 | 487 |
| Agricultural Chemicals | 7,165 | 9,252 | 8,682 | 8,014 | 8,953 | 8,490 | 12,405 | 17,494 | 11,826 | 15,538 | 14,707 | 17,469 | 15,588 | 18,238 |
| Other | 1,017 | 1,138 | 1,254 | 1,654 | 1,624 | 1,031 | 1,821 | 560 | 1,063 | 184 | 1,409 | 687 | 2,169 | 1,568 |
| U.S. Import Total | 15,943 | 24,069 | 24,597 | 25,054 | 27,443 | 28,141 | 38,477 | 43,833 | 39,572 | 42,010 | 43,810 | 45,517 | 48,013 | 46,881 |

Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1990–2007.

Table 16
Chemical Product Imports by Port and Commodity Classification

| | Port Arthur Chemical Imports (1,000s of Short Tons) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Acrylic and Other Hydrocarbons | 2 | 3 | – | 3 | 7 | – | – | – | 0 | 4 |
| Benzene and Toluene | – | – | – | 22 | 4 | – | – | – | 27 | 73 |
| Alcohols | 13 | – | – | – | – | 8 | – | 37 | – | – |
| Sulphuric Acid | – | – | – | – | 34 | 31 | 73 | 12 | – | – |
| Ammonia | 6 | – | – | – | 38 | 21 | 152 | 146 | 35 | 18 |
| Chemical Products | | – | – | – | 5 | – | – | – | – | – |
| Other | 23 | 2 | – | – | 1 | – | – | – | 49 | 2 |
| Port Arthur Imports | 44 | 5 | – | 25 | 89 | 60 | 225 | 195 | 111 | 97 |
| | Beaumont Chemical Imports (1,000s of Short Tons) | | | | | | | | | |
| Commodity | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Acrylic and Other Hydrocarbons | – | 4 | 27 | 13 | 4 | 8 | 6 | 3 | – | 4 |
| Benzene and Toluene | – | – | 20 | 30 | 33 | 26 | 58 | 7 | 98 | 84 |
| Alcohols | 7 | 199 | 189 | 195 | 169 | 66 | 22 | 440 | 460 | 374 |
| Sulphuric Acid | – | 6 | 158 | – | 66 | 40 | 58 | 112 | 147 | 6 |
| Ammonia | 88 | 234 | 174 | 361 | 183 | 152 | 249 | 323 | 425 | 444 |
| Chemical Products | – | – | 45 | 0 | 124 | 74 | 17 | 4 | – | – |
| Other | 1 | 1 | 6 | 130 | 15 | 8 | 21 | – | 3 | 43 |
| Beaumont Imports | 96 | 444 | 619 | 729 | 594 | 374 | 431 | 889 | 1,133 | 955 |

Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1998–2007.

The USDA noted that the volatile and upward trend in U.S. natural gas prices from 2000 to 2006 has led to a 17 percent decline in the Nation's annual aggregate supply of ammonia. During the period, U.S. ammonia production declined 44 percent, while U.S. ammonia imports increased 115 percent. Also, the share of U.S.-produced ammonia in the U.S. aggregate supply of ammonia dropped from 80 to 55 percent, while the share from imports increased from 15 percent to 42 percent. Meanwhile, ammonia prices paid by farmers increased from $227 per ton in 2000 to $521 per ton in 2006, an increase of 130 percent. Natural gas is the main input used to produce ammonia. Additional increases in U.S. natural gas prices could lead to a further decline in domestic ammonia production and an even greater rise in ammonia imports.

Increases in SNWW methyl alcohol imports are also attributable to global market shifts. Methyl alcohol is used in the industrial production of many synthetic organic compounds and is a constituent of many commercially available solvents; it is noted that, when used as a gasoline additive, it lowers the carbon monoxide emissions but increases hydrocarbon emissions. Information published by SDI Consulting notes that a major shift in regional methanol capacity and production has occurred over the last two

decades.[13] Countries with large reserves of natural gas and limited domestic consumption have built world-scale methanol facilities to monetize their low-cost natural gas. The largest producing region in 2006 was Central and South America, whereas in 2011, China (northeast Asia) and the Middle East will be the largest producing regions in terms of both capacity and expected production. Overall, world demand for methanol is projected to grow at an average annual rate of just over 5.6 percent from 2006 to 2011, with lower growth expected in the industrialized areas of the world where the markets are mature. As expected, the largest consuming region for methanol in 2011 will be northeast Asia (Japan, China, Republic of Korea, and Taiwan), with 44 percent of world methanol consumption. China will consume 76 percent of northeast Asia's share. As a reflection of its growth potential, it is interesting to note that in spite of its projected methanol capacity in 2011, China will still remain a net importer.

Worldwide, formaldehyde production is the largest consumer of methanol, with 34 percent of world methanol demand in 2007. This demand is driven by the construction industry since formaldehyde is used primarily to produce adhesives for the manufacture of various construction board products. Historically, the major end product has been plywood, but in developed countries, demand is also driven by the expanding use of engineering board products such as OSB (oriented strandboard).

It was noted that the second-largest market for methanol worldwide is methyl tertiary-butyl ether (MTBE). In the U.S., consumption of MTBE increased substantially when the Clean Air Act Amendments of 1990 mandated that oxygenated compounds be added to gasoline as one aspect of a program to alleviate air pollution. In recent years, MTBE use has decreased due to groundwater contamination issues. SDI noted that California, formerly the leading consumer of MTBE, banned the use of MTBE at the end of 2003, and several states followed suit. Methanol use in U.S. MTBE production is cited to have declined since 1999 and according to the EIA will likely decline further to a steady level, supported only by export-driven demand.

Eighty-nine percent of SNWW methyl alcohol imports come from Trinidad, 8 percent come from Chile, and the remaining 3 percent from Venezuela. The Trinidad plant represents the world's largest methanol production plant and is capable of producing 5,000 tons per day. The plant located in Punta Arenas, Chile, plans to triple its methanol production capacity by the end of 2008. Additionally, new plants are planned in West Africa and the Middle East, with those locations presently serving markets other than the SNWW.

Ammonia is the main input source for all nitrogen fertilizers. Increases in ammonia imports are attributable to rising price of natural gas.[14] From 2000 to 2006, the increase in natural gas prices decreased the producers' gross return margins (the difference between the cost of natural gas to produce 1 ton of ammonia and the ammonia price [in the Gulf region] received by ammonia producers). The low average gross return margins in 2000–2003 suggest that, on average, ammonia production in these 3 years was less profitable than in 1992–1998, a period of high average gross return margins. Low profitability is

[13] SDI Consulting, Guillermo A. Saade, Abstract, July 2007.

[14] USDA, Impact of Rising Natural Gas Prices on U.S. Ammonia Supply, A Report from the Economic Research Service by Wen-yuan Huang, WRS-07-02, August 2007.

cited to have resulted in a significant number of ammonia producers ceasing production or merging with other producers. The USDA noted that U.S. net imports of ammonia maintained a relatively constant level from 1991 to 2000. Since 2001, however, with the decline of domestic ammonia production, imported ammonia has become increasingly important to the U.S. ammonia supply. From 2000 to 2006, annual U.S. imports of ammonia increased from 3.9 to 8.4 million tons, an increase of 115 percent, while ammonia exports remained constant. During that period, most SNWW ammonia imports came from Trinidad and Tobago, Canada, Russia, and Ukraine. In 2006, Trinidad and Tobago accounted for 57 percent of U.S. ammonia imports. North Dakota and Montana were the main entry ports for ammonia imports from Canada, while the Gulf States were the main entry ports for ammonia shipped from Trinidad and Tobago, Russia, and Ukraine. SNWW's points of origin for ammonia are Trinidad and Tobago, Russia, and Ukraine.

## 2.5 CHEMICAL PRODUCT EXPORTS

Table 17 shows SNWW and U.S. totals by commodity for 1990–2007. Table 18 presents Port Arthur's and Beaumont's 1998–2007 chemical exports by major commodity group. Port Arthur and Beaumont exports increased dramatically. Comparison of 1998–2000 with 2005–2007 data shows a 279 percent increase in Port Arthur's tonnage and a 107 percent increase in Beaumont's. Port Arthur's chemical exports consist primarily of metallic salts, which composed 73 percent of 2005–2007 tonnage and 91 percent of 2007 tonnage. The remainder of Port Arthur recent tonnage consists of hydrocarbons and organic compounds. For 2005–2007, 20 percent of U.S. metallic salts were exported from Port Arthur. Figure 16 shows the 1990–2007 U.S. and SNWW metallic salts trendline, and Figure 17 shows the distribution of these exports between Port Arthur and Beaumont. Approximately 60 percent of 2005–2007 metallic salt exports are shipped to the countries of Brazil, Argentina, Venezuela, Colombia, and Ecuador. The remaining 40 percent are shipped to Europe and South Africa. Metallic salts are included in the SIC classification of cyclohexane. The increase in Port Arthur's metallic salt exports experienced since 2004 is associated with the completion of a 266,000 metric-ton-per-year cyclohexane facility in Port Arthur. While most cyclohexane goes into the production of intermediates for nylon, it is also used as a solvent in chemical and industrial processes and recently has been substituted for benzene in many applications. The more general category of metallic salts and organic compounds is associated with the production of paints and solvents, paper and wood products, cleaning products, and various chemical products. It was noted in the September 2006 *Chemical Industry Newsletter* that by 2010, global demand for cyclohexane is anticipated to increase to 6 million metric tons, representing an average annual growth rate of 3 percent during 2005–2010.[15] Two percent of the 2005–2010 growth is attributed to China, with the associated demand driven mainly by nylon. As previously noted, nearly 60 percent of Port Arthur's 2005–2007 exports is shipped to South America. Of the six producers noted to account for 50 percent of world capacity for cyclohexane, five have operations on the SNWW. The six producers include ExxonMobil, Chevron Phillips, Huntsman, Deutsche BP Aktiengesellschaft, ConocoPhillips, and Idemitsu Kosan.

[15] Tefera, Ngan, Chemical Industry Newsletter, Cyclohexane (an abstract contained in Chemical Economics Handbook) p. 2, September 2006.

Table 17
SNWW and U.S. Chemical Exports by Commodity Classification

| | SNWW Chemical Exports (1,000s of Short Tons) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Nitrogenous Fertilizer | – | – | – | – | – | – | – | – | – | – | 8 | 3 | 23 | 23 |
| Potassic Fertilizer | – | – | – | – | – | – | 18 | 328 | 315 | 293 | 274 | 196 | 483 | 373 |
| Fertilizers and Mixes | – | 12 | 10 | 69 | 11 | 11 | 11 | 90 | 30 | 69 | 81 | 111 | 119 | 187 |
| Hydrocarbons | 40 | 148 | 231 | 510 | 340 | 209 | 564 | 300 | 541 | 513 | 617 | 407 | 523 | 343 |
| Alcohols | 76 | 100 | 70 | 73 | 3 | 32 | 85 | 15 | 9 | 68 | 66 | 52 | 11 | 16 |
| Organic Compounds | – | 22 | 97 | 104 | 207 | 96 | 218 | 207 | 225 | 91 | 127 | 145 | 653 | 706 |
| Metallic Salts | 386 | 430 | 338 | 294 | 368 | 335 | 376 | 257 | 347 | 379 | 812 | 909 | 1,027 | 1,412 |
| Plastics | 1 | – | 3 | – | 7 | 15 | 56 | 30 | 82 | 91 | 47 | – | – | – |
| Chemical Additives | – | 1 | 17 | 41 | 43 | 44 | 80 | 44 | 11 | 38 | 71 | 44 | 19 | 26 |
| Other | 44 | 11 | 10 | 10 | – | 11 | 61 | 25 | 27 | 13 | 1 | 24 | 42 | 83 |
| SNWW Total Exports | 547 | 724 | 776 | 1101 | 979 | 753 | 1,469 | 1,296 | 1,587 | 1,555 | 2,104 | 1,891 | 2,905 | 3,169 |
| % of U.S. Total | 1.4 | 1.5 | 1.6 | 2.2 | 1.9 | 1.4 | 2.5 | 2.4 | 2.9 | 2.9 | 3.5 | 3.4 | 4.9 | 5.3 |

| | U.S. Chemical Exports (1,000s of Short Tons) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Nitrogenous Fertilizer | 2,498 | 1,934 | 2,397 | 1,983 | 1,980 | 2,099 | 1,739 | 1,442 | 1,907 | 1,689 | 1,588 | 1,330 | 1,732 | 1,012 |
| Phosphatic Fertilizer | 901 | 776 | 741 | 757 | 689 | 749 | 744 | 750 | 627 | 580 | 397 | 286 | 120 | 5 |
| Potassic Fertilizer | 1,062 | 1,394 | 1,024 | 1,256 | 2,645 | 2,852 | 2,535 | 2,380 | 2,119 | 2,190 | 2,231 | 2,522 | 2,413 | 3,452 |
| Fertilizers and Mixes | 9,150 | 12,203 | 10,167 | 12,034 | 12,504 | 13,256 | 8,518 | 9,005 | 8,593 | 8,419 | 9,196 | 8,845 | 7,899 | 6,522 |
| Hydrocarbons | 4,046 | 5,915 | 5,916 | 5,735 | 5,601 | 6,430 | 7,533 | 5,731 | 6,090 | 7,197 | 8,251 | 6,584 | 5,947 | 6,978 |
| Alcohols | 2,085 | 2,565 | 2,337 | 2,814 | 2,143 | 2,090 | 2,649 | 2,617 | 2,604 | 2,726 | 2,763 | 2,261 | 2,828 | 2,910 |
| Organic Compounds | 891 | 1,192 | 1,405 | 1,361 | 2,019 | 1,905 | 2,226 | 2,233 | 2,454 | 2,099 | 2,342 | 2,597 | 4,182 | 4,546 |
| Metallic Salts | 3,424 | 4,643 | 4,836 | 4,908 | 4,468 | 4,221 | 5,751 | 5,389 | 5,204 | 5,195 | 5,926 | 5,431 | 5,457 | 5,842 |
| Plastics | 4,471 | 5,626 | 5,710 | 6,046 | 5,774 | 5,376 | 6,883 | 6,568 | 6,268 | 5,971 | 7,868 | 7,255 | 7,767 | 10,124 |
| Sodium Hydroxide | 2,505 | 3,242 | 3,219 | 2,950 | 3,102 | 3,219 | 4,384 | 3,379 | 3,631 | 3,422 | 3,892 | 3,795 | 3,776 | 4,265 |
| Inorganic Elements | 2,078 | 1,568 | 1,148 | 1,136 | 1,158 | 993 | 3,322 | 2,959 | 3,301 | 2,518 | 4,369 | 4,486 | 5,325 | 2,587 |
| Paint, Varnish, and Related Products | 4,918 | 6,189 | 6,260 | 6,727 | 6,431 | 6,017 | 7,456 | 7,188 | 6,871 | 6,532 | 8,596 | 7,879 | 8,636 | 10,784 |
| Other | 2,390 | 2,219 | 2,316 | 2,831 | 2,829 | 2,992 | 4,146 | 5,105 | 5,292 | 5,037 | 3,315 | 3,042 | 2,617 | 2,617 |
| U.S. Total Exports | 40,419 | 49,466 | 47,476 | 50,538 | 51,343 | 52,199 | 57,886 | 54,746 | 54,961 | 53,575 | 60,734 | 56,313 | 58,699 | 60,188 |

Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1990–2007.

Table 18
Chemical Product Exports by Port and Commodity Classification

| | Port Arthur Chemical Exports (1,000s of Short Tons) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Commodity | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Nitrogenous Fertilizer | – | – | – | – | – | – | – | – | – | – |
| Potassic Fertilizer | – | – | – | 4 | 18 | 3 | – | – | 5 | – |
| Fertilizer and Mixes | 11 | 11 | 4 | – | – | – | – | – | 3 | – |
| Hydrocarbons | 109 | 46 | 116 | 52 | 94 | 20 | 95 | 90 | 208 | 116 |
| Alcohols | 3 | – | 7 | 0 | – | 22 | 3 | 6 | – | 6 |
| Organic Compounds | 38 | – | 14 | 1 | 3 | 1 | – | – | 65 | 7 |
| Metallic Salts | 353 | 268 | 87 | 60 | 61 | 160 | 787 | 902 | 1,027 | 1,385 |
| Plastics | 0 | 0 | 4 | 17 | – | 3 | – | – | 0 | – |
| Chemical Additives and Products | 31 | 22 | 73 | 2 | – | – | – | – | 18 | – |
| Other | 1 | 2 | 2 | – | – | 1 | 4 | – | 5 | 6 |
| Port Arthur Exports | 546 | 349 | 307 | 136 | 176 | 210 | 889 | 998 | 1,331 | 1,521 |
| | Beaumont Chemical Exports (1,000s of Short Tons) | | | | | | | | | |
| Commodity | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Nitrogenous Fertilizer | – | – | – | – | – | – | 8 | 3 | 23 | 23 |
| Potassic Fertilizer | – | – | 18 | 324 | 297 | 290 | 274 | 196 | 478 | 373 |
| Fertilizer and Mixes | – | – | 7 | 90 | 30 | 69 | 81 | 111 | 115 | 177 |
| Hydrocarbons | 221 | 163 | 448 | 248 | 447 | 493 | 585 | 317 | 315 | 239 |
| Alcohols | – | 32 | 78 | 15 | 9 | 46 | 63 | 46 | 11 | 10 |
| Organic Compounds | 169 | 96 | 204 | 206 | 222 | 90 | 124 | 145 | 588 | 699 |
| Metallic Salts | 11 | 67 | 289 | 197 | 286 | 219 | 25 | 7 | – | 27 |
| Plastics | 7 | 15 | 52 | 13 | 82 | 88 | 47 | 6 | – | – |
| Chemical Additives and Products | 12 | 22 | 7 | 42 | 11 | 38 | 0 | – | 19 | 26 |
| Other | 0 | 9 | 59 | 25 | 27 | 12 | 8 | 65 | 48 | – |
| Beaumont Exports | 420 | 404 | 1,162 | 1,160 | 1,411 | 1,345 | 1,215 | 893 | 1,574 | 1,644 |

Source: USACE, *Waterborne Commerce of the U.S., Parts 2 and 5*, 1990–2007.

Beaumont's 2004–2006 chemical exports primarily consist of potassic fertilizers and mixes (33 percent), organic compounds (32 percent), and hydrocarbons (23 percent). These three groups represented 88 percent of 2004–2006 exports, up from 66 percent for 1999–2001. For 2004–2006, 10 percent of U.S. nitrogenous, potassic, and fertilizer mixes was exported from Beaumont. In 2006, the Beaumont share increased to 14.8 percent. Nearly 80 percent of 2004–2006 exports was shipped to Mexico and Central and South America. The remaining 20 percent was shipped to Japan.

Figure 16
U.S. and SNWW Metallic Salt Exports

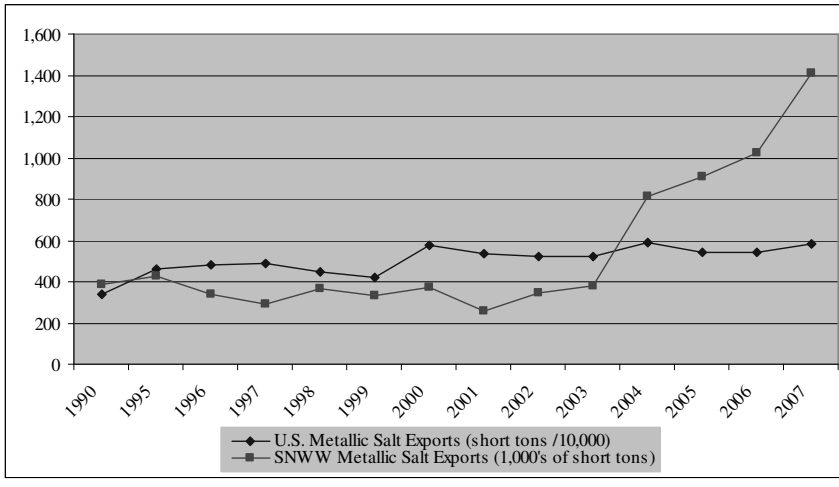
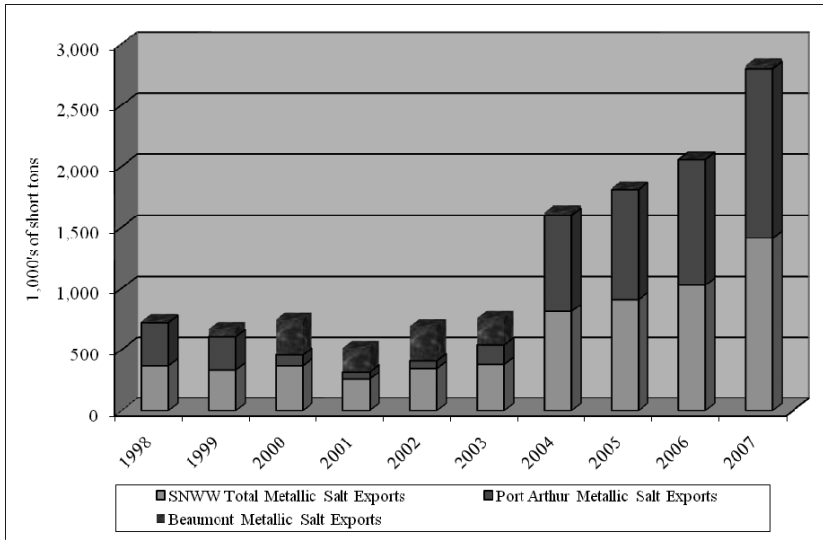



Figure 17
SNWW Total and Port Arthur Metallic Salt Exports



The Food and Agriculture Organization (FAO) of the United Nations (U.N.) notes that world fertilizer consumption is expected to increase at an annual rate of about 1.7 percent from 2007/2008 to 2011/2012, equivalent to an increment of about 15 million tons.[16] Approximately 70 percent of growth is anticipated to take place in Asia and 19 percent in America, primarily Latin America. Total fertilizer consumption in Latin America is forecast to increase at an annual rate of 2.7 percent from 2007/2008 levels. Increased demand is expected to be concentrated mainly in Brazil and Argentina where there has been a rapid response to increased crop prices partly resulting from increased sugar cane plantings for ethanol production. Future production increases are expected to come from a combination of a larger cultivated area and higher yields, which will help Latin America further increase its share of global agricultural markets.

North American consumption of nitrogen, phosphate, and potash fertilizer is forecasted to grow by 0.3 percent, 0.5 percent, and 0.7 percent, respectively. It is noted that significant gains in nitrogen use efficiency over the past 2 decades, combined with greater recycling of organic nutrient sources, are likely to mitigate increased fertilizer demand resulting from expanding bioethanol production. Asian demand is forecasted to increase by 2.1 percent annually from 2007/2008 levels through 2011/2012. The respective growth rates by fertilizer types are 1.6 percent for nitrogen, 2.4 percent for phosphate, and 3.5 percent for potash. The U.N. expects that Asia will move from a small deficit to a considerable surplus of nitrogen and will reduce its dependency on imported phosphate, but will increase the volume of its potash imports.

World demand forecast for potash fertilizers is to increase at an annual average rate of about 2.4 percent, equivalent to an increment of 3.6 million. About 68 percent of this growth will occur in Asia and 21 percent in Latin America, 5 percent in North America, 6 percent in Eastern and Central Europe, and the remainder in Western Europe. World demand for nitrogen fertilizers is expect to increase at an annual rate of 1.4 percent, with about 69 percent of growth taking place in Asia, 10 percent in Latin America, 3 percent in North America, and 7 percent in Africa, and the remainder in Eastern and Central Europe. The expected annual growth rate in world demand for phosphate fertilizers is about 2.0 percent. According to the report, about 71 percent of this growth will take place in Asia and 18 percent in America, 3 percent in North America, and the remaining 7 percent in Eastern and Central Europe.

Review of SNWW 1990–2007 (see Table 17) shows that regional potassic fertilizer exports represent 12.5 percent of U.S. total exports. SNWW fertilizer exports are nearly all associated with Beaumont (see Table 18). In general, Beaumont's chemical exports consist of a wide range of products, with fertilizer exports exhibiting notable overall increases since 2000.

## 2.6 GRAIN EXPORTS

Grain is exported from the Beaumont elevator located just below the Port of Beaumont main turning basin. Wheat presently represents 100 percent of Beaumont's grain exports for the most recent 4-year

[16] Food and Agriculture Organization of the United Nations, "Current World Fertilizer Trends and Outlook to 2011/12," FAO, Rome, 2008.

period. During earlier years, wheat represented 85 percent, sorghum 10 percent, and corn 5 percent. Table 19 displays Beaumont's 2001–2007 grain export tonnage by grain type.

Table 19
Beaumont Bulk Grain Export
Distribution of Tonnage by Grain Type

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|
| **Bulk Grain Export Totals by Year (Short Tons)** | | | | | | | |
| Beaumont Exports | 831,000 | 835,000 | 1,125,000 | 1,329,000 | 1,080,639 | 1,214,010 | 1,632,000 |
| **% by Grain Type** | | | | | | | |
| Wheat | 79.0 | 88.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Corn | 6.5 | 8.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sorghum | 14.5 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | Beaumont's Exports as a % of the U.S. Total | | | | | | |
| | 2.5 | 2.4 | 2.8 | 4.3 | 4.1 | 4.0 | 5.1 |

Source: USACE, Waterborne Commerce Database, 2001–2007.

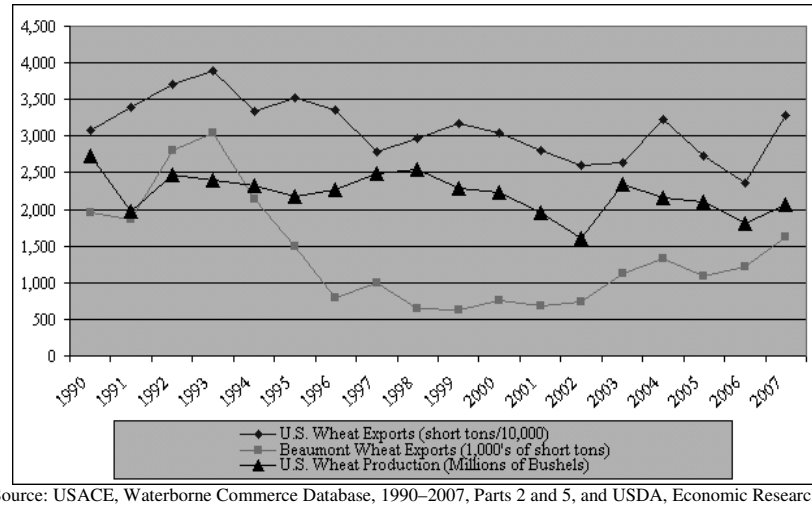
In 2007, Beaumont's wheat exports totaled 1.6 million short tons. While exports have exceeded 1 million short tons since 2003, recent volumes are less than one-half the 1993 peak volume of 3.5 million short tons. Beaumont exports are very low in comparison to the Pacific Northwest and the Lower Mississippi, but the port has maintained a 1.4 to 1.7 percent share of the U.S. waterborne bulk grain export market. Beaumont's 2006 wheat exports composed 5 percent of the U.S. wheat export total. Figure 18 displays comparison of Beaumont exports and U.S. exports and production levels for 1990–2007.

## 2.7 EXPANSION OF THE DEEP-DRAFT TRAFFIC BASE

In addition to its large existing base of crude petroleum, petroleum and chemical products, and dry bulk deep-draft cargoes, the without-project future includes operation of up to three LNG terminals. As noted, the Cheniere terminal is presently operational. Construction on the Golden Pass terminal will be complete by 2011. The LNG terminals are located below Texas Island in the portion of the waterway below the western GIWW intersection with the SNWW near Taylor Bayou.

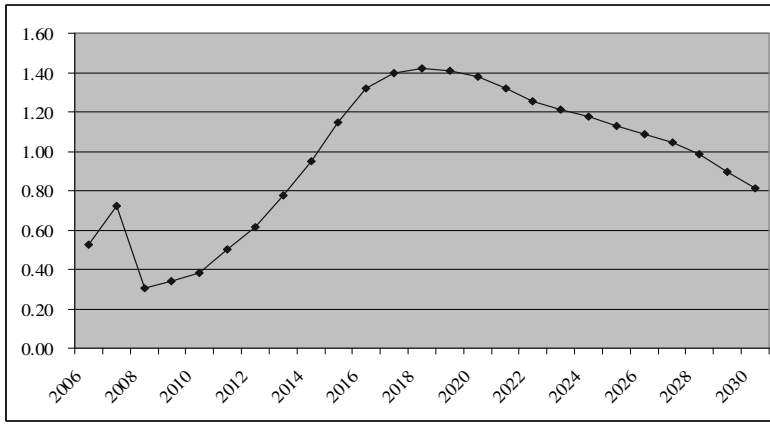
LNG is expected to play an increasingly important role in the natural gas industry and global energy markets in the next several years and in the long-term future due to the combination of higher natural gas prices, lower LNG costs, and rising gas import demand. Figure 19 shows the USDOE's 2006–2030 U.S. LNG import forecast.

Figure 18
U.S. and SNWW Bulk Grain Statistics
1990–2007




Source: USACE, Waterborne Commerce Database, 1990–2007, Parts 2 and 5, and USDA, Economic Research Service, July 2009.

Figure 19
U.S. LNG Imports 2006–2030
Trillion Cubic Feet




Source: USDOE, Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook, Table 13, SR/OIAF/2009-03.

The SNWW LNG facilities are located in the Sabine Pass Channel and Port Arthur Canal reaches; these reaches presently have an authorized channel width of 500 feet. LNG vessels using the SNWW will be subject to strict USCG regulations and to local pilot rules and, therefore, will not have the opportunity to meet other vessels or barges. The USCG regulations require that a safety zone is in place 2 miles ahead of a loaded LNG vessel and 1 mile astern of the vessel while transiting. LNG vessels using the SNWW would be subject to this rule. Even in absence of the safety concerns inherent to LNG, the beams of LNG tankers would result in vessel-meeting restrictions; however, all LNG vessel movements will be subject to one-way traffic. Operation of the LNG terminals is part of the without-project future.

# 3.0 VESSEL FLEET ANALYSIS

This section presents vessel fleet data, examines vessel utilization, outlines existing and future constraints associated with the commodity groups discussed in the previous sections, and also includes discussion of vessel casualty records and nonstructural project alternatives initiated by the USCG and industry. The outputs of the commodity and fleet analyses provided the basis for helping to identify the commodities expected to utilize vessels loaded to channel depths over 40 feet. The commodity-specific discussions include the existing commodity groups such as petroleum, chemicals, grain, and breakbulk, and the introduction of LNG. The introduction of LNG and the SNWW's already large concentration of deep-draft tankers and barge traffic highlights safety concerns. The first part of this section presents discussion of vessel safety and accident records.

## 3.1 SNWW VESSEL CASUALTIES

The large volume of deep- and shallow-draft vessels using the SNWW provided the initial basis for evaluation of waterway improvements. While the implementation of the VTM system significantly improved safety, an evaluation of safety and casualties was reevaluated in 2008 due to the opening of the Cheniere LNG Terminal and general interest in an updated assessment of navigation safety since implementation of the VTM system. As part of this evaluation, SNWW historical casualty records were updated and the circumstances associated with marine casualties were discussed with the USCG's Port Arthur Marine Safety Office (MSO), the SPA, and the GICA in 2008.

Vessel casualties are classified by three general types including vessel grounding, vessel collisions with stationary objects (called allisions), and collision of two or more moving vessels. The Port Arthur MSO noted that marine casualties are caused by a variety of reasons including strong winds, fog, pilot error, bank forecast, traffic mix, and a variety of other circumstances. Distribution of SNWW 2006 casualty rates by vessel type is shown in Table 20.

The USCG and the SPA were asked for input on the effects of the SNWW project alternatives on casualty rates. In response to this inquiry, the MSO representatives noted that factors such as reductions in deep-draft vessel traffic and channel widening would serve to reduce the probability of casualties. While recognizing that widening would reduce the probability of casualties, the MSO emphasized that casualty occurrences in the Sabine Pass Channel and Port Arthur Canal are rare and that the proposal to widening those reaches would not have a discernible effect on the net change in casualty rates.

Table 20
SNWW Casualty Incident Rates, 2006

| Transit Type a/ | Transits | Incidents | Ratio of Incidents Per Transit |
|---|---|---|---|
| Tanker Transits | 3,139 | 4 | 0.1% |
| Freighter Transits | 913 | 4 | 0.4% |
| Tow Transits | 41,793 | 42 | 0.1% |
| Other | 1,460 | 15 | 1.0% |
| Certain Dangerous Cargo Transits | 1,570 | 0 | 0.0% |
| Tanker Transits | 48,874 | 65 | 0.1% |

Source: Compiled from USCG, MSO, Port Arthur, 28 January 2007, "State of the Waterway," Southeast Texas Waterways Advisory Council (SETWAC) Presentation.
a/ Includes inbound and outbound transits.

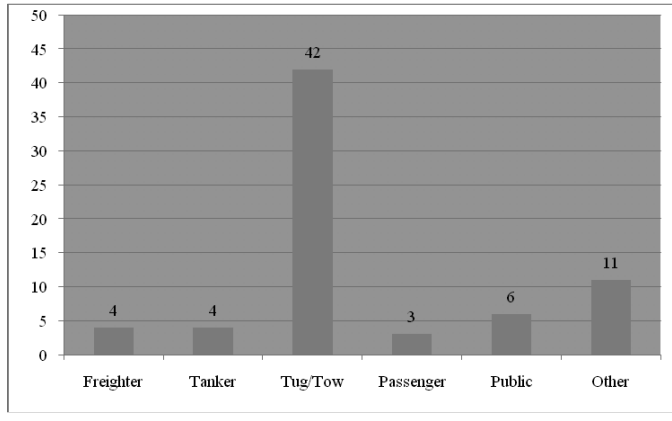
As noted, the Sabine Pass Channel and Port Arthur Canal reaches are used by oceangoing deep-draft vessels either coming in from or going out to the Gulf of Mexico. In discussing casualties with the Sabine Pilots, the pilots emphasized that the main effect of widening these reaches would be to reduce delays associated with one-way traffic restrictions.

Figure 20 contains distribution of 2006 SNWW casualties by vessel type, and Figure 21 displays the distribution of casualty incidents by nature of incident. The data indicate that 60 percent of casualties involve tows or tugs, 11 percent involve tankers and freighter, and the remaining 30 percent involve other vessel types as presented.

The MSO noted that nearly all casualties occur in the Sabine-Neches Canal reach, which, in addition to being used by all deep-draft vessels going to Port Arthur and Beaumont, serves as a through channel for the GIWW. Potential interaction between the diverse mix of vessels in this reach is presently scheduled, and scheduling will continue under the without- and with-project future conditions. As previously discussed, the large volume of tow-barges using the Sabine-Neches Canal, along with a high flow of deep-draft traffic, has the potential of compounding congestion that would increase casualty rates and probabilities and, therefore, prompted interest early in the study process for evaluation of a barge shelf through the canal reach between the east and west junctions with the GIWW. The USACE evaluation of the barge shelf coincided with the USCG efforts to evaluate the need for and plan future VTM projects, including installation and upgrades to VTS. The VTS was authorized by certain sections of the Port and Waterways Safety Act of 1972; the Oil Pollution Act of 1990 made participation mandatory in areas serviced by existing and future VTS.[17] The purpose of VTS is to provide active monitoring and navigational advice for vessels in particularly confined and busy waterways.

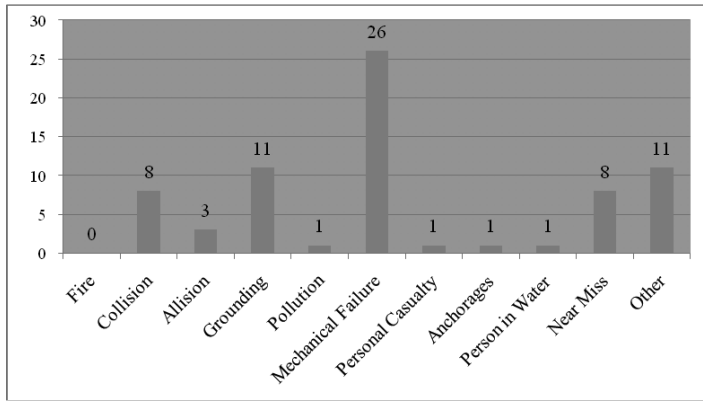
[17] USACE. 2008. Louisiana Coastal Protection and Restoration Draft Technical Report. USACE, New Orleans District.

Figure 20
SNWW Casualty Incidents (2006) by Vessel Type




Source: USCG, MSO, Port Arthur, "State of the Waterway" Presentation, January 28, 2007, USCG SETWAC Presentation, Slide 13.

Figure 21
SNWW Casualty Incidents (2006) by Casualty Type




Source: USCG, MSO, Port Arthur, "State of the Waterway" Presentation, January 28, 2007, USCG SETWAC Presentation, Slide 12.

The Port of Port Arthur and safety concerns associated with the Sabine-Neches Canal reach provided the impetus for Port Arthur's selection as one of 28 ports selected for participation in the 1999 VTM workshops. As part of the VTM study initiative, the USCG conducted a series of in-depth, user-focused workshops using their Port Risk Model to frame participant discussions and develop computer algorithms to translate expert opinions into quantified data.

For purposes of the Port Risk Model, risk is defined as a function of the probability of a casualty and its consequences. As part of the selection process, the input data used for port section included accident/incident history, the numbers and types of vessels using the port, weather conditions, waterway characteristics (e.g., configuration and complexity), and cargo types and volume. Each of those data elements was thought to bear some relationship to one or more of the risk factors included in the Port Risk Model. The model includes variables associated with both the causes and the effects of vessel casualties. The USCG classified 20 port safety risk factors that are grouped into one of six categories (Table 21).

As noted in USCG report documentation, the participants calibrated a risk measurement scale for each risk factor by assigning numbers to qualify risk levels. It is noted that the most important segment of the workshop consisted of discussions of port-specific problems relating to each Port Risk Model factor. The participants used the risk-measuring scales to numerically evaluate the risk levels in their port. The categories were ranked on a scale between 1 (low risk) and 9 (high risk). Discussion of existing risk mitigation strategies and appropriate ways to further reduce risk occurred next. The participants were asked to evaluate the efficacy and appropriateness of selection of VTM measures for addressing unmitigated risk, i.e., risk that was not well balanced by mitigation strategies already in place. Port Arthur's ratings are shown in Table 22.

Currently, VTS Port Arthur is a voluntary system operated in accordance with existing VTS regulations. VTS is designed to expedite ship movements, increase transportation system efficiency, improve all-weather operating capability, and enhance vessel safety and marine environmental protection.[18, 19] The VTS Center in Port Arthur monitors every ship, vessel, or boat that attempts to enter or leave the SNWW and the GIWW in the Port Arthur service area. Infrared cameras, along with radar, radio-telephone reports from vessel operators, and satellite surveillance sensors on towers along the SNWW allow VTS controllers to zoom-in on vessel activity at a moment's notice. The satellite-based Automatic Identification System (AIS), required by the Maritime Transportation Security Act of 2002, assists the VTS by determining exactly what a specific commercial vessel is carrying, along with its speed, dimensions, and destination.

[18] USACE. 2007. USCG, MSO, Port Arthur, "State of the Waterway" Presentation, January 28, 2007, USCG SETWAC Presentation, Slide 12.

[19] USCG. 2008. VTS Port Arthur Operating Procedures Guide. http://www.uscg.mil/d8/VTSPortArthur/Documents/VTS%20Port%20Arthur_Opertating-Guide.pdf (accessed March 9, 2008).

Table 21
Safety Risk Factors

| Composition | Traffic Conditions | Navigational Conditions | Waterway Configuration | Immediate Consequences | Subsequent Consequences |
|---|---|---|---|---|---|
| Percentage of High Risk Deep Draft | Volume of Deep-Draft Vessels | Wind Conditions | Visibility Obstructions | Number of People on Waterway | Economic Impacts |
| Percentage of High Risk Shallow Draft | Volume of Shallow-Draft Vessels | Visibility Conditions | Channel Width | Volume of Petroleum Cargoes | Environmental Impacts |
| | Volume of Fishing and Pleasure Craft | Tide and River Currents | Bottom Type | Volume of Hazardous Chemical Cargoes | Health and Safety Impacts |
| | Traffic Density | Ice Conditions | Waterway Complexity | | |

Source: USCG, Ports and Waterways Safety Assessments (PAWSA) Final Report, p. 4, date is 2003-period. http://www.navcen.uscg.gov/mwv/projects/pawsa/PAWSA_FinalReports.htm.

Table 22
Port Arthur's Safety Risk Factors

| Composition | Traffic Conditions | Navigational Conditions | Waterway Configuration | Immediate Consequences | Subsequent Consequences |
|---|---|---|---|---|---|
| Percentage of High Risk Deep Draft 4.1 | Volume of Deep Draft Vessels 6.5 | Wind Conditions 2.3 | Visibility Obstructions 4.7 | Volume of Passengers 1.4 | Economic Impacts 4.3 |
| Percentage of High Risk Shallow Draft 6.2 | Volume of Shallow Draft Vessels 7.4 | Visibility Conditions 2.8 | Passing Arrangements 6.7 | Volume of Petroleum Cargoes 9.0 | Environmental Impacts 5.2 |
| | Volume of Fishing and Pleasure Craft 2.8 | Tide and River Currents 3.0 | Bottom Type 3.0 | Volume of Hazardous Chemical Cargoes 5.2 | Health and Safety Impacts 3.4 |
| | Traffic Density 6.7 | Ice Conditions 1.0 | Waterway Complexity 8.4 | | |

Source: USCG, Port of Port Arthur, Texas, After Action Report, p. 6, date is 2003-period. http://www.navcen.uscg.gov/mwv/projects/pawsa/WorkshopReports/Port%20Arthur.pdf.

Most commercial vessels using the waterway were required to have AIS equipment installed by the end of 2004.[20] These include power-driven vessels 20 meters in length or longer; power-driven vessels of 100

[20] U.S. Coast Guard (USCG). 2004. Automatic Identification System Carriage Requirements. Available on the internet at http://www.navcen.uscg.gov/enav/ais/AIS_carriage_reqmts.htm.

gross tons or more carrying one or more passengers for hire; towing vessels 26 feet or longer while navigating, all dredges and floating plant likely to restrict or affect the navigation of other vessels; and all vessels required to participate in the Vessel Movement Reporting System. However, not all vessels are required to carry AIS; in particular, pleasure crafts, fishing boats, and warships are exempt. Until rules regarding VTS Port Arthur are published, vessels are exempt from all VTS and Vessel Movement Reporting System requirements, except the requirement for AIS continuous broadcasts. When VTS Port Arthur is included in the VTS regulation, participation will become mandatory. At that time, VTS Port Arthur will be authorized to designate temporary reporting points and procedures, impose vessel operating requirements or establish vessel traffic-routing schemes. During conditions of vessel congestion, restricted visibility, adverse weather or other hazardous circumstances, VTS may control or manage traffic by specifying times of entry, movement, or departure to, from, or within a VTS area. The existing VTS along the SNWW was evaluated as a nonstructural alternative. Although this service is managed by the USCG and thus is not within the jurisdiction of the USACE, it was evaluated because it appeared to be a potential alternative to structural plans and it was found to be a better alternative than the barge shelf proposal. While the VTS would help congestion and improve safety to some degree, the USCG's traffic management role is limited to specific circumstances when the SNWW is congested or experiencing hazardous conditions. The VTS assists vessel operators in making independent decisions regarding the safe navigation of their vessels, for which they retain complete responsibility. In this sense, VTS should be considered primarily a navigational aid, a tool for mariners to use along with numerous other tools to facilitate safe navigation,[21] and thus would not improve deep-draft navigation inefficiencies created by the need for lightering and associated vessel delays.

The effect of the channel indication from discussions with the industry is that channel widening and the Neches River anchorage basins will reduce the likelihood of accidents; however, the number of accidents remains small. The indication from discussion with the industry is increases in channel width, anchorages, and the VTS will all contribute to an overall reduction in accident probabilities. Most vessel accidents involve tows, and most of these occur in the Sabine-Neches Canal reach, with the majority being "intentional groundings."

There is not a historical record of vessel-tow accidents as the existing condition is avoidance. The USCG noted that while communication has always been good, improved deep-draft and barge vessel communication brought about through the USCG Southeast Texas Waterways Advisory Council (SETWAC) and the VTS activities have resulted in improved safety. The pilot rules place limitation on what vessels can meet where and when. For the without- and with-project future, the pilot rules will continue to limit the sizes of the vessels that can meet in each portion of the channel. Widening the channel up to the Taylor Bayou junction will result in a relaxation of the pilot rules as vessels will have an additional 200 feet of channel (i.e., the existing channel width is 500 feet and the with-project width for the Sabine Pass Channel and Port Arthur Canal, which leads up to Taylor Bayou, would be 700 feet. The expectation for the with- and without-project future is that pilot rules would continue to limit the possibility of vessel-to-

[21] USCG. 2008b. VTS Port Arthur Operating Procedures Guide. http://www.uscg.mil/d8/VTSPortArthur/Documents/VTS%20Port%20Arthur_Opertating-Guide.pdf (accessed March 9, 2008).

vessel and vessel-to-tow meetings in the Sabine-Neches Canal reach and that both vessel and shallow-draft tow movements would be scheduled through both VTS and communication between vessel pilots.

The relative impacts to tow-barge traffic are anticipated to generally be the same between the without- and with-project future. One difference is that for the with-project condition of channel deepening, there would be fewer oceangoing vessel trips and, therefore, an overall reduction in traffic density. The decision to forgo the barge shelf was made by the tow industry due to reconsideration of how vessels and barges would interact. The concern that was raised, and this was not physically modeled, was that the tow-barges could get pulled under or out into the channel as it either meet a deep-draft vessel or "held-up or idled" in the barge shelf. The tow operators originally thought that they wanted to shelf in case radio and/or other communication failed and a tow-barge could not clear the channel as a deep-draft vessel began its transit through the reach; however, the recent impact of the VTS has improved communication among vessel operators, and accident probabilities were not calculated for the without-project condition and benefits for reductions in casualties were not taken. The effect of the without-project condition is "avoidance behavior" in the form of "pilot rules."

## 3.2 OFFSHORE ALTERNATIVES

Offshore oil terminals were assessed as an alternative mode to landside port delivery of crude petroleum. Two offshore terminal alternatives were considered in the analysis, one existing and one proposed. The decision to use an offshore terminal instead of lightering or constructing a deeper channel is complicated but largely depends on the relative cost per ton, relative market volumes, and facility accessibility. While a detailed quantitative analysis of a LOOP alternative is beyond the scope of USACE's planning study, the overall infrastructure requirements were examined to the extent possible. Pipeline capacities and necessary expansions were identified, and the reasons for current and past choices were evaluated as were expectations about future interest.

The existing offshore terminal, the LOOP, is America's first and only deepwater port. LOOP is presently operating at capacity and has been since 2005. In addition to new customers brought on due to infrastructure damages associated with the 2005 hurricanes, recent increase in the LOOP is tied to utilization associated with domestic production in the U.S. Gulf. Access to LOOP for the SNWW market is periodically reviewed; however, actualization would require substantial investment as SNWW crude oil import volume nearly equals LOOP's capacity. LOOP's design capacity of 1.4 to 1.8 million barrels per day is only marginally higher than SNWW's 2003–2007 crude petroleum import volume which ranged from approximately 1.1 to 1.3 million barrels per day.[22]

While all of SNWW's crude oil could not currently transfer to LOOP, some tonnage could be diverted. The volume diverted depends upon various ranges of expansion of LOOP or construction of a new facility. The large fixed cost of expansion, and associated financing costs, necessitates participation by a

[22] The *Waterborne Commerce of the U.S.*, Part 2, Waterways and Harbors, Gulf Coast, Mississippi River System and Antilles shows crude petroleum imports of 60 million short tons in 2005 and 70 million in 2003 of crude oil imports for the SNWW. The standard conversion factor to put short tons per year to barrels per day is 0.0182. The link for the public website for waterborne commerce publications is shown below. Detailed vessel records are not contained in a public domain but can be provided upon request. http://www.iwr.usace.army.mil/ndc/wcsc/wcsc.htm.

consortium of companies. While LOOP is presently at capacity, the SNWW industries have not found the option of investing in LOOP, and the necessary associated infrastructure expansions, to be a cost-effective alternative to existing practices of either direct shipment or offshore lightering. The lack of incentive has remained since the 1970s. The SNWW users continue to consider LOOP along with other alternatives; however, continued practices suggest that LOOP is not a cost-effective alternative to the existing SNWW practice of its land-based ports. An additional variable pertinent to the current evaluation is that LOOP would appear to be a less attractive cost option when compared to lower shipping costs that the SNWW improvement project is expected to provide.

LOOP is located offshore of Grande Isle, Louisiana, in 110 feet of water. Grande Isle is 302 miles east of Port Arthur and Beaumont. LOOP was organized in 1972 as a Delaware corporation and converted to a limited liability company in 1996. Marathon Ashland Pipe Line LLC, Murphy Oil Corporation, and Shell Oil Company are LOOP's owners. LOOP is the only port in the U.S. capable of offloading deep-draft tankers known as Ultra Large Crude Carriers (ULCC) and VLCC. Along with offloading crude from VLCCs, LOOP also offloads smaller tankers. LOOP consists of three single-point mooring buoys used for the offloading of crude tankers and a marine terminal consisting of a two-level pumping platform and a three-level control platform.

A 48-inch-diameter pipeline connects the LOOP Marine Terminal located 23 miles offshore in the Gulf of Mexico to the Clovelly, Louisiana, storage facilities. Clovelly is approximately 260 miles east of the SNWW Port Arthur and Beaumont facilities. Four pipelines connect the onshore storage facility to refineries in Louisiana and along the Gulf Coast. The Clovelly facility provides interim storage for crude oil before it is delivered via connecting pipelines to refineries on the Gulf Coast and in the Midwest. The oil is stored in eight underground caverns leached out of a naturally occurring salt dome. In 1996, one cavern was dedicated to the production streams coming in from the deepwater Gulf of Mexico.

The domestic offshore crude oil system uses the same distribution system used by the foreign barrels. The caverns are capable of storing approximately 50 million barrels of crude oil (a barrel of oil is equal to 42 U.S. gallons). In addition, LOOP has an aboveground tank farm consisting of six 600,000-barrel tanks. LOOP operates the 53-mile, 48-inch LOCAP pipeline that connects LOOP to CAPLINE (Amoco Cushing-Chicago Pipeline Company) at St. James, Louisiana. CAPLINE is a 40-inch pipeline that transports crude oil to several Midwest refineries. St. James is 227 miles east of Port Arthur and Beaumont. LOOP is connected to over 50 percent of the U.S. refinery capacity and has offloaded over 7 billion barrels of foreign crude oil since its inception.

LOOP is designed to handle 1.4 million BPD, but depending on the sizes of ships being serviced, it can handle 1.8 million BPD. The variance relates to the pumping rates of the tankers using the facility. Larger tankers tend to have faster pumping rates with some capable of pumping 80,000 barrels per hour. Smaller tankers may only be able to pump 35,000 barrels per hour. When fully operational, LOOP is generally the largest point of entry for crude oil imports into the U.S. About 13 percent of all waterborne foreign imports pass through LOOP each day. Again, LOOP’s design capacity of 1.4 to 1.8 million BPD is only marginally higher than SNWW 2003–2007 crude petroleum import volume. Of SNWW’s over 1 million BPD import volume, terminals on the SNWW transport approximately 400,000 BPD of waterborne crude oil via pipelines to inland refineries including refineries in Texas, Louisiana, Oklahoma, Ohio, Arkansas,

and Kentucky.[23] In total, the SNWW delivers approximately 12–16 percent of the crude oil supplied to domestic refineries east of the Rockies. Refineries supplied via the Sabine-Neches provide transportation fuels and other products to consumers along the Gulf Coast, East Coast, and Midwest regions. The SNWW ports presently receive about 1 percent of their daily input through LOOP. Additional offshore and landside infrastructure would be necessary for an increase in volume to take place. Expansion of the infrastructure was discussed with industry and they periodically evaluate new proposals. It was noted two proposals were due in December 2007 and acceptance of the proposals depended on participation by a consortium of users. As of June 2010, there has not been any action on these proposals.

Although there are some competing markets, the SNWW and LOOP generally serve parallel markets, with LOOP consistently processing very large volumes and SNWW serving relatively smaller parcels. The sizes of the VLCCs using LOOP typically exceed 300,000 DWT, whereas the maximum-sized vessels using the SNWW are 175,000 DWT. The maximum design draft of these vessels is 55 feet or less. The minimum-sized crude oil tankers using SNWW are in the 70,000 to 80,000 DWT range and have design drafts between 40 and 48 feet. LOOP's foreign petroleum imports are from the Middle East, whereas SNWW's market consists of direct shipments from Mexico and Venezuela and lightened mother vessels and shuttles. It has been noted that the cost effectiveness of LOOP lessens for small vessel sizes. The SNWW has the ability to serve a more general market and range of users.

The most immediate obstacle to increased use of LOOP or a new offshore facility is lack of or major limitations for direct connection from LOOP to SNWW. A marginal increase in SNWW use of LOOP from its present 1 percent share would require LOOP pipeline connection modifications involving multiple pipelines and multiple companies. Such an investment may generate the necessity for higher throughput charges, which in turn may make access less cost effective than in the past. An industry analyst noted that to a large extent the companies demand that each segment, including pipeline transportation, stand on its own economically.[24] In discussions with local port and oil industry personnel, it is noted that LOOP and similar proposals serve crude petroleum but do not serve a full range of petroleum and bulk cargoes that use the SNWW. The long-term availability of LOOP since the 1970s and participation by SNWW companies indicate that LOOP and new offshore terminal proposal have not provided the market utilization incentives for significant shares of SNWW crude oil to shift towards these alternatives. The long-term trend is for domestic refining capacity to become more concentrated in regional centers and for imports of petroleum products to grow. This trend is evident with SNWW with crude oil import tonnage exceeding that of any other U.S. port and being equal to LOOP. Imports of refined products and partial refined crude oil have grown significantly as have the use of draft-constrained vessels for transporting these cargoes.

In 2001, construction of a new terminal (called the Bulk Oil Offshore Transfer System, or BOOTS) offshore of Sabine Pass, Texas, was proposed. The relatively long distance from LOOP to SNWW and the need for additional infrastructure suggest that a facility closer to SNWW would be an attractive alternative to LOOP for SNWW channel improvements. However, the BOOTS facility has not yet been constructed and the regulatory permit application is inactive. The USCG has had no update on the

[23] Martin Associates, Economic Benefits of Maintenance Dredging of the Waterway, July 6, 2006.

[24] Rabinow, Richard A., The Liquid Pipeline Industry in the United States, "Where It's Been, Where It's Going, a report for the Association of Oil Pie Lines, April 2004, p.14.

proposal and does not expect a submittal. At the present time, the potential user of the proposed project is the terminal proponent. They noted that their participation as sole supporter is not feasible financially. It was specifically noted that their feedstock needs were not sufficient to finance the expansions to LOOP.

The BOOTs project manager was contacted periodically, and it was found that a new location farther down the Texas Coast near Freeport is presently being considered. The Freeport, Texas, site is about 100 miles southwest of the BOOTS location. Access by the SNWW refineries to a Freeport site involves longer distances than the previous BOOTS location but it has advantages over LOOP. The Texas offshore terminal was reorganized as TOPS and announced plans for construction in August 2008. TOPS is a proposed offshore terminal project that would provide feedstock to Texas City, Houston, and Port Arthur. The Port Arthur Motiva refinery, which has terminals at Taylor Bayou and on the Neches River, was a major participant in TOPS. TOPS would connect from offshore Freeport to an existing landside pipeline from Freeport operated by Seaway Pipeline Company to Texas City. Connection to Port Arthur would necessitate a new pipeline from Texas City to Port Arthur, a distance of approximately 95 miles. TOPS was noted to serve as an addition and complement to existing methods of importing crude petroleum rather than a substitute for existing modes of shipment. A March 2009 press release revealed that the Port Arthur participant, Motiva, has put its participation on hold based on uncertainty associated with future crude petroleum import volumes and trade routes. Due to uncertainty, the use of an offshore alternative was evaluated as sensitivity (Section 8.2).

While recognizing potential diversion to the existing LOOP or to a new offshore terminal, an increase in the number of specially designed SNWW vessels was recently completed by one company and another has invested in Neches River dock modifications for the larger “Aframax” and “Suezmaz” vessels. The focus of immediate private sector petroleum vessel investments is concentrated on SNWW improvements rather than offshore or on the Sabine Pass Channel or Port Arthur Canal. Ongoing consultation with industry continues to show that commitments to offshore terminal investment have not materialized. During the 30 years since LOOP has become operational, several Texas Gulf Coast channel-improvement projects have been completed and the benefits have been accrued. Offshore terminals would not accommodate products other than crude oil, and a significant proportion of benefits for the SNWW project improvement are from refined petroleum products. The offshore terminal was found not to meet the efficiency objective for all waterway users as it addressed the needs of only one user and commodity (crude oil). For these reasons, this alternative was eliminated from further consideration. While crude petroleum represents a significant share of SNWW tonnage, use of draft-constrained vessels for dry bulk commodities such as iron ore, building stone, and chemicals prompted interest by the navigation district and port authorities in the channel deepening and widening alternatives.

In a general discussion with industry, a representative noted that offshore oil terminal projects surface periodically, but the cost of these alternatives keeps them from moving beyond the initial planning stage. It is noted that the attractiveness of offshore alternatives over existing use of the SNWW is diminished by its ability to only serve one commodity (i.e., crude petroleum). It was added that the various crude oil blends and grades of oil introduce a range of additional concerns that add to throughput costs.

As noted, a constraining or complicating issue is that the pipelines and associated infrastructure requirements vary between potential users, and mingling of products and grades of crude is complex and difficult to facilitate. The construction of an offshore terminal that can meet the needs of various users is a challenge with the costs to realize multiparty usage creating an impasse to these proposals moving beyond the initial planning stage. Recognition of the cost of multiple pipelines necessary to meet the needs of the large base of customers necessary to finance these project alternatives has resulted in a stalemate in the decision process. As noted, LOOP is an existing offshore alternative. Current use of LOOP by SNWW users is very limited, and future use would require extensive pipeline investment. The major users of LOOP consist of a few major companies with high throughput volumes. In addition to serving crude oil tankers delivering imports, LOOP is used to transport domestic crude produced in the Gulf of Mexico. When asked about LOOP, potential users on the SNWW noted that LOOP's availability is sometimes limited and SNWW imports are within 1 percent of LOOP's annual throughput. The investment necessary for LOOP to process SNWW's entire crude petroleum throughput would require a doubling of capacity. A new facility such as BOOTS requires substantial investment on the part of several oil companies. Present use of LOOP consists of Louisiana-based refineries and U.S. Gulf Coast state domestic offshore production interests. LOOP's existing base of customers uses it as one of several options for delivering crude oil to their Gulf Coast refineries.

## 3.3 VESSEL UTILIZATION AND OPERATING PRACTICES

Analysis of the vessel fleets and utilization, and existing and future constraints associated with crude petroleum, petrochemical products including LNG, grain, and aggregate products, such as iron ore, steel slab, limestone, and sand and gravel provided the basis for identifying the commodities expected to be transported in vessels loaded to channel depths over 40 feet and estimating specific percentage utilization for channel depths over 40 feet. Additional considerations were foreign port depths and constraints such as the Panama Canal. Completion of the Panama Canal expansion, from its present width restriction of 106 feet and approximate loaded draft limit of 39.6 feet, in the year 2014 will allow for more fully loaded vessel movements from deepwater ports in Western Mexico, South America, and the Far East. The canal expansion will accommodate maximum loaded drafts of 48 feet. Port depth, trade route, and historical vessel utilization data were used to identify the percentage of tonnage anticipated to benefit from the proposed SNWW depth increases.

Examination of the vessel sizes associated with the historic traffic base suggested that, if deeper depths were available, vessels used in the transport of crude petroleum and petroleum products could be loaded to drafts over 40 feet. In addition, but to a lesser extent, examination of the 1995–2007 vessels sizes, loaded drafts, design drafts, and parcel sizes indicated that some of the vessels used to transport grain, chemical products, and breakbulk cargo, such as iron ore, metal products, and limestone and other aggregate, warranted additional analysis. The existing 40-foot SNWW project depth was designed to efficiently and safely accommodate vessels of approximately 40,000 DWT with loaded drafts of 36 feet. Since the authorization of the existing project, the size and draft of vessels using the waterway increased to meet the competitive demand for more-efficient movements. Evaluation of SNWW's vessel utilization

patterns was initially made based on examination of historical trends. The historical trend analysis was followed-up with user interviews and trade route analyses.

Table 23 presents 1990–2007 vessel trips by loaded draft for deep-draft vessels. Analysis of the data showed that trips increased at an annual rate of 3.7 percent, with the highest rates of growth for 36 feet and greater. Total trips for drafts over 35 feet increased at an average annual rate of 7.3 percent, while trips for loaded drafts of 35 feet or less grew at 3.7 percent. For the period 1990–2007, total deep-draft tonnage grew at an average annual rate of 5.2 percent. SNWW's vessel utilization patterns were also reviewed in terms of the average tonnage per trip for 1965–2007. Figure 22 shows average tonnage per trip for oceangoing traffic. The graph shows trips increasing at a slightly decreasing rate and suggests an overall increase in average tonnage per trip. While the increases in the volume of tonnage per trip are primarily associated with crude petroleum and petrochemical products, larger vessels are being used for manufactured goods and crude materials. Since 1993, the volume of tonnage per vessel has increased as the variety of commodities using the waterway has diversified.

The largest vessels presently using the SNWW are crude petroleum tankers. Crude petroleum represents over 70 percent of 2007 deep-draft tonnage and 2005–2007 average deep-draft total. Trade routes, vessel sizes, and loaded drafts are of particular importance in calculating transportation costs. For the period 2005–2007, approximately 45 percent of SNWW crude petroleum imports were shipped from Mexico, Venezuela, Colombia, and Trinidad. Of the remaining 55 percent, 54.3 percent was shipped from the Middle East and Africa and 0.3 percent was shipped from Canada. In comparison to the Nation, the SNWW has a relatively higher share of imports from Mexico, the Caribbean, and South America, while also receiving relatively higher Middle East imports. The U.S. 2005–2007 distribution comprised 34 percent from Mexico, the Caribbean, and South America; 50 percent from the Middle East, Africa, and the North Sea; and 16 percent from Canada. In its Annual Energy Outlook, the EIA shows a 2030 U.S. distribution of 33 percent from Mexico, the Caribbean, and South America; 47 percent from the Middle East, Africa, and the North Sea; and 20 percent from Canada. Canadian imports include both ship and pipeline movements.

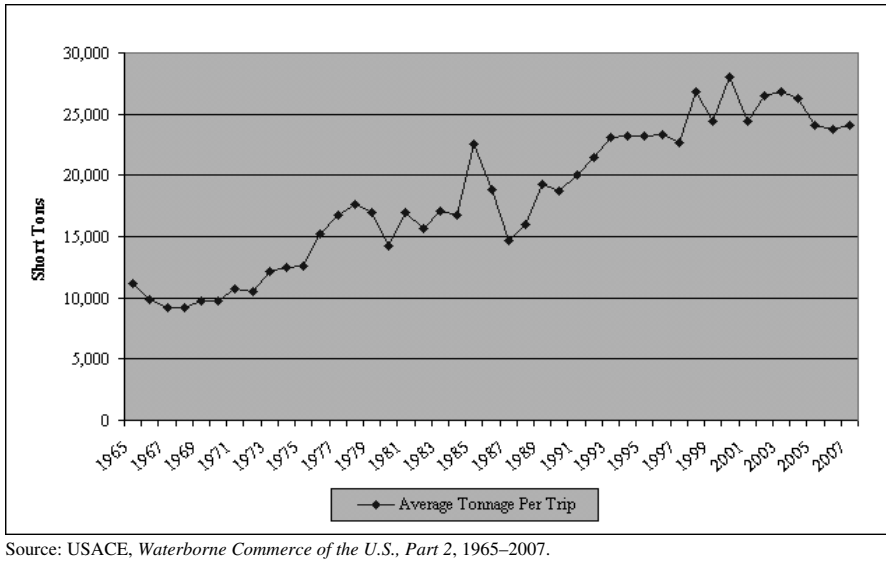
The following tables outline the distribution of tonnage by loaded vessel draft. Table 24 shows total import and export tonnage by loaded draft for select years. Table 25 shows the 1990–2007 distribution of SNWW's crude petroleum imports by loaded draft, respectively. Tables 26 and 27 present petroleum and chemical product imports and exports by loaded draft. Table 28 shows tonnage by loaded draft for groups other than petroleum and chemicals. Every effort was made to compile data for as many years as practical; however, the schedule of data releases results in some gaps. The purpose of the analyses associated with these presentations was to identify the existence of patterns and provide inputs for establishing base conditions. Based on this consideration, all relevant years are displayed.

Table 23
SNWW Trips by Loaded Draft (Includes Loaded and Light Vessels)

| Year/feet | ≥43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | ≤35 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| SNWW Total Inbound and Outbound Trips by Loaded Draft (feet) | | | | | | | | | | |
| 1990 | – | – | 39 | 42 | 123 | 82 | 80 | 52 | 1,511 | 1,929 |
| 1993 | 2 | – | – | 115 | 77 | 214 | 209 | 155 | 1,261 | 2,033 |
| 1996 | 1 | – | – | 160 | 192 | 277 | 279 | 168 | 1,274 | 2,351 |
| 1999 | – | 1 | – | 117 | 139 | 276 | 142 | 172 | 1,987 | 2,834 |
| 2000 | – | – | – | 107 | 139 | 325 | 156 | 155 | 2,096 | 2,978 |
| 2001 | 1 | – | – | 124 | 168 | 324 | 175 | 173 | 2,090 | 3,055 |
| 2002 | – | 2 | – | 167 | 112 | 441 | 167 | 146 | 2,258 | 3,293 |
| 2003 | 1 | – | 1 | 289 | 114 | 347 | 158 | 175 | 2,364 | 3,449 |
| 2004 | 2 | – | – | 248 | 232 | 300 | 167 | 147 | 2,508 | 3,604 |
| 2005 | – | – | – | 206 | 154 | 312 | 189 | 178 | 2,410 | 3,449 |
| 2006 | 1 | – | 1 | 185 | 148 | 545 | 231 | 78 | 2,136 | 3,425 |
| 2007 | – | – | 2 | 178 | 271 | 263 | 136 | 143 | 2,380 | 3,373 |
| Inbound Trips by Loaded Draft (feet) | | | | | | | | | | |
| 1990 | – | – | 14 | 38 | 102 | 69 | 55 | 33 | 610 | 921 |
| 1993 | 1 | – | – | 56 | 37 | 108 | 104 | 78 | 642 | 1026 |
| 1996 | 1 | – | – | 80 | 95 | 140 | 139 | 83 | 627 | 1,165 |
| 1999 | – | – | – | 101 | 121 | 250 | 126 | 135 | 657 | 1,390 |
| 2000 | – | – | – | 86 | 110 | 289 | 127 | 113 | 689 | 1,414 |
| 2001 | – | – | – | 101 | 147 | 301 | 147 | 114 | 646 | 1,456 |
| 2002 | – | – | – | 141 | 97 | 382 | 145 | 108 | 714 | 1,587 |
| 2003 | – | – | – | 254 | 102 | 289 | 130 | 121 | 746 | 1,642 |
| 2004 | 1 | – | – | 230 | 207 | 260 | 141 | 96 | 993 | 1,721 |
| 2005 | – | – | – | 181 | 141 | 280 | 164 | 104 | 762 | 1,632 |
| 2006 | – | – | 1 | 164 | 133 | 514 | 192 | 94 | 567 | 1,666 |
| 2007 | – | – | 2 | 148 | 252 | 209 | 107 | 73 | 869 | 1,660 |
| Outbound Trips by Loaded Draft (feet) | | | | | | | | | | |
| 1990 | – | – | 25 | 4 | 21 | 13 | 25 | 19 | 901 | 1,008 |
| 1993 | 1 | – | – | 59 | 40 | 106 | 105 | 77 | 619 | 1,007 |
| 1996 | – | – | – | 80 | 97 | 137 | 140 | 85 | 647 | 1,186 |
| 1999 | – | 1 | – | 16 | 18 | 26 | 16 | 37 | 1,330 | 1,444 |
| 2000 | – | 0 | – | 21 | 29 | 36 | 29 | 42 | 1,407 | 1,564 |
| 2001 | 1 | 0 | – | 23 | 21 | 23 | 28 | 59 | 1,444 | 1,499 |
| 2002 | – | 2 | – | 26 | 15 | 59 | 22 | 38 | 1,544 | 1,706 |
| 2003 | 1 | – | 1 | 35 | 12 | 58 | 28 | 54 | 1,618 | 1,807 |
| 2004 | 1 | – | – | 18 | 25 | 40 | 26 | 51 | 1,515 | 1,883 |
| 2005 | – | – | – | 25 | 13 | 32 | 25 | 74 | 1,648 | 1,817 |
| 2006 | – | – | – | 21 | 15 | 31 | 39 | 84 | 1,569 | 1,759 |
| 2007 | – | – | – | 30 | 19 | 54 | 29 | 70 | 1,511 | 1,713 |

Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1990–2007.

Figure 22
Sabine-Neches Waterway
Average Tonnage Per Trip for Oceangoing Vessels




Source: USACE, *Waterborne Commerce of the U.S., Part 2*, 1965–2007.

Table 24
Total Imports and Exports by Year and Loaded Draft
(1,000s of short tons)

| Year | ≥40 feet | 39 feet | 38 feet | 37 feet | 36 feet | ≤35 feet | Total |
|---|---|---|---|---|---|---|---|
| | Imports by Loaded Draft (feet) | | | | | | |
| 1990 | 2,586 | 6,641 | 4,540 | 3,155 | 1,119 | 4,909 | 22,950 |
| 1993 | 3,164 | 2,098 | 7,562 | 7,893 | 5,875 | 9,705 | 36,297 |
| 2002 | 10,851 | 7,185 | 28,404 | 10,902 | 7,149 | 9,901 | 74,393 |
| 2003 | 11,175 | 7,069 | 27,760 | 10,629 | 7,396 | 13,578 | 77,607 |
| 2004 | 17,486 | 15,353 | 19,282 | 10,086 | 5,505 | 11,201 | 78,914 |
| 2005 | 13,249 | 9,834 | 19,291 | 10,714 | 5,335 | 9,875 | 68,298 |
| 2006 | 12,321 | 9,448 | 14,279 | 12,638 | 4,238 | 11,920 | 64,845 |
| 2007 | 11,033 | 18,557 | 14,009 | 6,575 | 3,516 | 8,617 | 62,308 |
| | Exports by Loaded Draft (feet) | | | | | | |
| 1990 | 1,205 | 370 | 194 | 204 | 252 | 2,943 | 5,168 |
| 1993 | 46 | 217 | 95 | 25 | 14 | 7,719 | 8,115 |
| 2002 | 1,104 | 375 | 1,285 | 465 | 764 | 4,647 | 8,640 |
| 2003 | 1,471 | 149 | 1,327 | 365 | 1,331 | 5,017 | 9,659 |
| 2004 | 656 | 885 | 1,316 | 404 | 1,179 | 6,478 | 10,918 |
| 2005 | 827 | 268 | 754 | 502 | 1,673 | 5,634 | 9,658 |
| 2006 | 641 | 434 | 858 | 956 | 2,109 | 6,359 | 11,357 |
| 2007 | 1,045 | 583 | 1,665 | 399 | 1,883 | 6,808 | 12,384 |
| | % of Import and Export Tonnage by Loaded Draft (feet) | | | | | | |
| 1990 | 13.5 | 24.9 | 16.8 | 11.9 | 4.9 | 27.9 | 100.0 |
| 1993 | 8.7 | 5.8 | 20.8 | 21.7 | 16.2 | 26.7 | 100.0 |
| 2002 | 14.4 | 9.1 | 35.8 | 13.7 | 9.5 | 17.5 | 100.0 |
| 2003 | 14.5 | 8.3 | 33.3 | 12.6 | 10.0 | 21.3 | 100.0 |
| 2004 | 20.2 | 18.1 | 22.9 | 11.7 | 7.4 | 19.7 | 100.0 |
| 2005 | 18.1 | 13.0 | 25.7 | 14.4 | 9.0 | 19.9 | 100.0 |
| 2006 | 17.0 | 13.0 | 19.9 | 17.8 | 8.3 | 24.0 | 100.0 |
| 2007 | 16.2 | 25.6 | 21.0 | 9.3 | 7.2 | 20.7 | 100.0 |

Source: USACE, Navigation Data Center (NDC) detailed records, 1990–2007.

Table 25
Crude Petroleum Imports by Loaded Draft and Year

| Year | ≥40 feet | 39 feet | 38 feet | 37 feet | 36 feet | ≤35 feet | Total |
|---|---|---|---|---|---|---|---|
| | 1,000s of short tons Loaded Draft and Year | | | | | | |
| 1990 | 2,339 | 6,244 | 4,121 | 2,839 | 940 | 3,937 | 20,419 |
| 1993 | 2,655 | 1,648 | 7,317 | 7,672 | 5,739 | 7,609 | 32,639 |
| 1996 | 5,399 | 5,688 | 9,626 | 9,216 | 5,511 | 5,490 | 40,930 |
| 1997 | 7,691 | 8,863 | 13,782 | 10,142 | 5,800 | 4,793 | 51,070 |
| 1998 | 6,541 | 14,271 | 16,710 | 6,457 | 6,364 | 3,535 | 53,877 |
| 1999 | 8,605 | 8,496 | 17,284 | 7,032 | 6,676 | 5,741 | 53,834 |
| 2000 | 6,654 | 9,346 | 25,452 | 10,116 | 8,368 | 7,251 | 67,187 |
| 2001 | 6,744 | 10,730 | 21,743 | 11,196 | 7,465 | 6,349 | 64,226 |
| 2002 | 9,909 | 6,856 | 26,271 | 10,515 | 6,146 | 6,685 | 66,383 |
| 2003 | 18,703 | 7,620 | 20,308 | 8,771 | 7,817 | 6,939 | 70,158 |
| 2004 | 15,467 | 14,294 | 18,330 | 9,403 | 4,665 | 7,715 | 69,875 |
| 2005 | 11,945 | 9,207 | 18,391 | 9,706 | 4,346 | 6,097 | 59,691 |
| 2006 | 11,203 | 9,102 | 13,589 | 11,821 | 3,262 | 8,639 | 57,616 |
| 2007 | 9,856 | 18,265 | 13,477 | 6,072 | 2,689 | 5,729 | 56,088 |
| | % Loaded Draft and Year | | | | | | |
| 1990 | 11.5 | 30.6 | 20.2 | 13.9 | 4.6 | 19.3 | 100.0 |
| 1993 | 8.1 | 5.0 | 22.4 | 23.5 | 17.6 | 23.3 | 100.0 |
| 1996 | 13.2 | 13.9 | 23.5 | 22.5 | 13.5 | 13.4 | 100.0 |
| 1997 | 15.1 | 17.4 | 27.0 | 19.9 | 11.4 | 9.4 | 100.0 |
| 1998 | 12.1 | 26.5 | 31.0 | 12.0 | 11.8 | 6.6 | 100.0 |
| 1999 | 16.0 | 15.8 | 32.1 | 13.1 | 12.4 | 10.7 | 100.0 |
| 2000 | 9.9 | 13.9 | 37.9 | 15.1 | 12.5 | 10.8 | 100.0 |
| 2001 | 10.5 | 16.7 | 33.9 | 17.4 | 11.6 | 9.9 | 100.0 |
| 2002 | 14.9 | 10.3 | 39.6 | 15.8 | 9.3 | 10.1 | 100.0 |
| 2003 | 26.7 | 10.9 | 28.9 | 12.5 | 11.1 | 9.9 | 100.0 |
| 2004 | 22.1 | 20.5 | 26.2 | 13.5 | 6.7 | 11.0 | 100.0 |
| 2005 | 20.0 | 15.4 | 30.8 | 16.3 | 7.3 | 10.2 | 100.0 |
| 2006 | 19.4 | 15.8 | 23.6 | 20.5 | 5.7 | 15.0 | 100.0 |
| 2007 | 17.6 | 32.6 | 24.0 | 10.8 | 4.8 | 10.2 | 100.0 |

Source: USACE, NDC detailed records, 1990–2007.

Table 26
Petroleum Product Imports and Exports by Loaded Draft

| Year | 40 feet | 39 feet | 38 feet | 37 feet | 36 feet | ≤35 feet | Total |
|---|---|---|---|---|---|---|---|
| | Petroleum Product Imports (1,000s of Short Tons) by Loaded Draft (feet) | | | | | | |
| 1998 | 158 | 255 | 447 | 273 | 426 | 1,932 | 3,491 |
| 2002 | 732 | 500 | 1,935 | 715 | 475 | 671 | 5,028 |
| 2003 | 912 | 121 | 1,138 | 418 | 440 | 2,159 | 5,187 |
| 2004 | 1,543 | 937 | 529 | 391 | 412 | 2,190 | 6,002 |
| 2005 | 698 | 470 | 788 | 543 | 644 | 2,206 | 5,349 |
| 2006 | 356 | 117 | 508 | 544 | 640 | 1,655 | 3,820 |
| 2007 | 346 | 242 | 368 | 310 | 684 | 1,790 | 3,740 |
| | Petroleum Product Exports (1,000s of Short Tons) by Loaded Draft (feet) | | | | | | |
| 1998 | - | 168 | 216 | 44 | 295 | 3,606 | 4,329 |
| 2002 | 891 | 181 | 1,221 | 448 | 620 | 2,273 | 5,635 |
| 2003 | 1,324 | 35 | 1,174 | 285 | 1,147 | 2,608 | 6,573 |
| 2004 | 521 | 687 | 1,231 | 340 | 1,081 | 3,291 | 7,152 |
| 2005 | 564 | 235 | 642 | 447 | 1,445 | 3,020 | 6,354 |
| 2006 | 541 | 319 | 488 | 659 | 1,521 | 3,295 | 6,823 |
| 2007 | 714 | 514 | 1,257 | 139 | 1,566 | 2,501 | 6,691 |
| | Total Petroleum Product Imports and Exports by Loaded Draft (feet) | | | | | | |
| 1998 | 158 | 422 | 663 | 317 | 721 | 5,539 | 7,820 |
| 2002 | 1,623 | 681 | 3,156 | 1,163 | 1,095 | 2,944 | 10,663 |
| 2003 | 2,236 | 156 | 2,312 | 703 | 1,587 | 4,767 | 11,760 |
| 2004 | 2,064 | 1,624 | 1,760 | 731 | 1,493 | 5,482 | 13,154 |
| 2005 | 1,263 | 705 | 1,430 | 990 | 2,089 | 5,226 | 11,703 |
| 2006 | 897 | 436 | 996 | 1,203 | 2,161 | 4,950 | 10,643 |
| 2007 | 1,060 | 756 | 1,625 | 449 | 2,250 | 4,290 | 10,431 |
| | % of Import and Export Tonnage by Loaded Draft (feet) | | | | | | |
| 1998 | 2.0 | 5.4 | 8.5 | 4.1 | 9.2 | 70.8 | 100.0 |
| 2002 | 15.2 | 6.4 | 29.6 | 10.9 | 10.3 | 27.6 | 100.0 |
| 2003 | 19.0 | 1.3 | 19.7 | 6.0 | 13.5 | 40.5 | 100.0 |
| 2004 | 15.7 | 12.3 | 13.4 | 5.6 | 11.4 | 41.7 | 100.0 |
| 2005 | 10.8 | 6.0 | 12.2 | 8.5 | 17.8 | 44.7 | 100.0 |
| 2006 | 8.4 | 4.1 | 9.4 | 11.3 | 20.3 | 46.5 | 100.0 |
| 2007 | 10.2 | 7.2 | 15.6 | 4.3 | 21.6 | 41.1 | 100.0 |

Source: USACE, NDC detailed records, 1998–2007.

Table 27
Chemical Product Imports and Exports by Loaded Draft

| Year | 40 feet | 39 feet | 38 feet | 37 feet | 36 feet | ≤35 feet | Total |
|---|---|---|---|---|---|---|---|
| | Chemical Product Imports (1,000s of Short Tons) by Loaded Draft (feet) | | | | | | |
| 1998 | – | 0 | – | – | 8 | 132 | 140 |
| 2002 | – | – | 97 | 42 | 29 | 515 | 683 |
| 2003 | – | 63 | 8 | – | – | 363 | 434 |
| 2004 | – | 44 | 71 | 58 | 79 | 405 | 656 |
| 2005 | 40 | 62 | – | 41 | 109 | 831 | 1,084 |
| 2006 | 14 | 54 | – | 121 | 158 | 897 | 1,244 |
| 2007 | – | 1 | 9 | 15 | 163 | 768 | 955 |
| | Chemical Product Exports (1,000s of Short Tons) by Loaded Draft (feet) | | | | | | |
| 1998 | – | – | 18 | 51 | 30 | 867 | 966 |
| 2002 | 25 | 28 | 62 | 17 | 66 | 1,388 | 1,587 |
| 2003 | 27 | 24 | 97 | 34 | 61 | 1,313 | 1,555 |
| 2004 | 11 | 13 | 36 | 67 | 44 | 1,933 | 2,104 |
| 2005 | 5 | 33 | 54 | – | 106 | 1,692 | 1,891 |
| 2006 | 5 | 5 | 68 | 95 | 305 | 2,426 | 2,904 |
| 2007 | 12 | 7 | 44 | 46 | 210 | 2,850 | 3,169 |
| | Total Chemical Product Imports and Exports by Loaded Draft (feet) | | | | | | |
| 1998 | – | – | 18 | 51 | 30 | 867 | 966 |
| 2002 | 25 | 28 | 62 | 17 | 75 | 1,520 | 1,727 |
| 2003 | 27 | 24 | 194 | 75 | 90 | 1,828 | 2,238 |
| 2004 | 11 | 77 | 45 | 67 | 44 | 2,295 | 2,538 |
| 2005 | 5 | 77 | 125 | 58 | 185 | 2,097 | 2,547 |
| 2006 | 45 | 67 | 68 | 136 | 414 | 3,257 | 3,988 |
| 2007 | 25 | 61 | 44 | 167 | 369 | 3,747 | 4,413 |
| | % of Import and Export Tonnage by Loaded Draft (feet) | | | | | | |
| 1998 | 0.0 | 0.0 | 1.9 | 5.3 | 3.1 | 89.7 | 100.0 |
| 2002 | 1.5 | 1.6 | 3.6 | 1.0 | 4.3 | 88.0 | 100.0 |
| 2003 | 1.2 | 1.1 | 8.7 | 3.4 | 4.0 | 81.7 | 100.0 |
| 2004 | 0.4 | 3.0 | 1.8 | 2.6 | 1.7 | 90.4 | 100.0 |
| 2005 | 0.2 | 3.0 | 4.9 | 2.3 | 7.3 | 82.3 | 100.0 |
| 2006 | 1.1 | 1.7 | 1.7 | 3.4 | 10.4 | 81.7 | 100.0 |
| 2007 | 0.6 | 1.4 | 1.0 | 3.8 | 8.4 | 84.9 | 100.0 |

Source: USACE, NDC detailed records, 1998–2007.

Table 28
Total Tonnage Excluding Petroleum and Chemicals by Loaded Draft

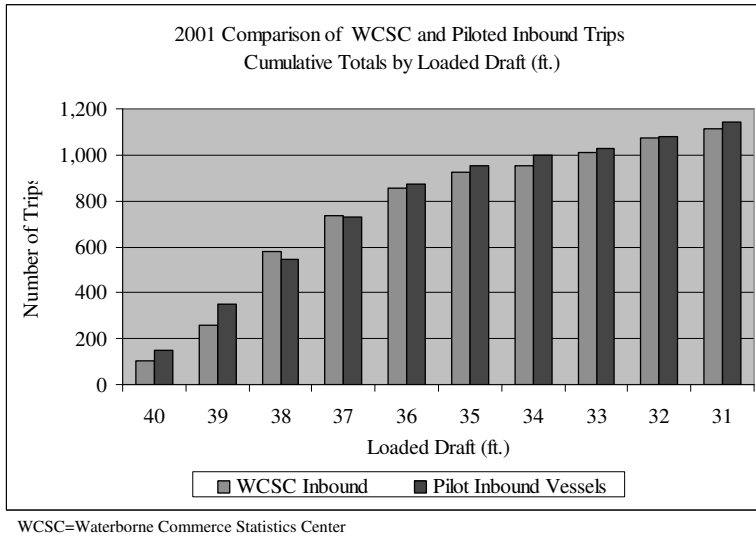
| Year | 40 feet | 39 feet | 38 feet | 37 feet | 36 feet | ≤35 feet | Total |
|---|---|---|---|---|---|---|---|
| | Imports (1,000s of Short Tons) by Loaded Draft (feet) | | | | | | |
| 1990 | 0 | 0 | 0 | 0 | 0 | 2,532 | 2,532 |
| 1993 | 179 | 96 | 0 | 17 | 17 | 619 | 928 |
| 2002 | 306 | 16 | 951 | 91 | 220 | 636 | 2,219 |
| 2006 | 749 | 174 | 183 | 150 | 180 | 730 | 2,166 |
| 2007 | 834 | 46 | 89 | 68 | 47 | 423 | 1,506 |
| | Exports (1,000s of Short Tons) by Loaded Draft (feet) | | | | | | |
| 1990 | 1,207 | 121 | 113 | 96 | 88 | 1,360 | 2,986 |
| 1993 | 47 | 153 | 1 | 25 | 0 | 4,094 | 4,319 |
| 2002 | 192 | 165 | 6 | 0 | 986 | 986 | 1,394 |
| 2006 | 97 | 111 | 305 | 204 | 295 | 618 | 1,630 |
| 2007 | 185 | 66 | 326 | 219 | 138 | 1,490 | 2,423 |
| | Total Import and Export Tonnage by Loaded Draft (feet) | | | | | | |
| 1990 | 1,207 | 121 | 113 | 96 | 88 | 3,892 | 5,518 |
| 1993 | 226 | 249 | 1 | 42 | 17 | 4,713 | 5,247 |
| 2002 | 498 | 181 | 957 | 91 | 1,206 | 1,622 | 3,613 |
| 2006 | 846 | 285 | 488 | 354 | 475 | 1,348 | 3,796 |
| 2007 | 1,019 | 112 | 415 | 287 | 185 | 1,913 | 3,929 |
| | % of Import and Export Tonnage by Loaded Draft (feet) | | | | | | |
| 1990 | 21.9 | 2.2 | 2.0 | 1.7 | 1.6 | 70.5 | 100.0 |
| 1993 | 4.3 | 4.7 | 0.0 | 0.8 | 0.3 | 89.8 | 100.0 |
| 2002 | 13.8 | 5.0 | 26.5 | 2.5 | 33.4 | 44.9 | 100.0 |
| 2006 | 21.6 | 7.3 | 12.5 | 9.0 | 12.1 | 34.4 | 100.0 |
| 2007 | 25.9 | 2.8 | 10.6 | 7.3 | 4.7 | 48.7 | 100.0 |

Source: USACE, NDC detailed records, 1990–2007.

The presentations show that a significant portion of crude petroleum imports and petroleum product imports and exports were transported in vessels with loaded drafts of 36 feet or more (see tables 25 and 26). The chemical import and export data presented in Table 27 show a more limited utilization of loaded drafts over 36 feet. Table 28 displays the distributions associated with "all other imports and exports." This group is largely comprised of bulk commodities.

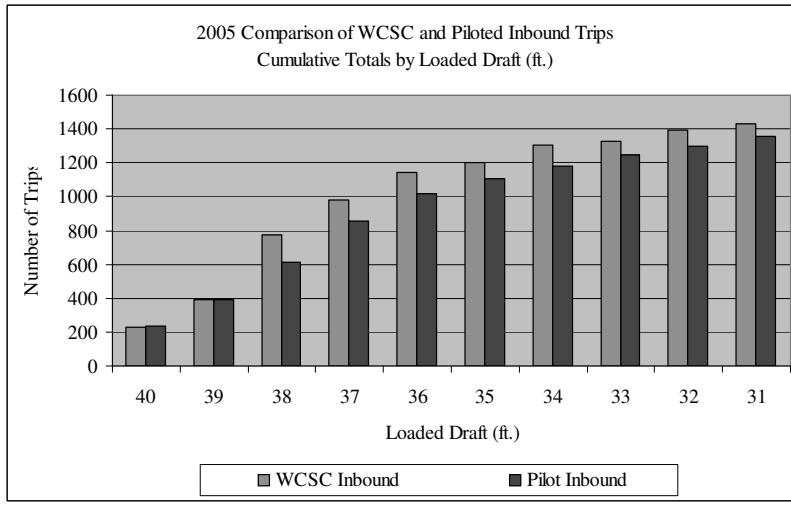
The data shown in tables 29–32 were compiled from the USACE foreign freight databases. A subsequent comparison of the loaded draft records from the USACE NDC databases with those in the pilots' records was made to identify differences in loaded drafts between the data sets. Comparisons of the data sets are displayed on figures 23 and 24.

Figure 23




WCSC=Waterborne Commerce Statistics Center

Figure 24



The primary use of the pilot data was to obtain specific information on trips by dock. Dock-specific information for foreign imports and exports is not available from the USACE databases. Dock-specific routings are available for SNWW domestic coastwise vessels; however, those routings were generally limited as domestic coastwise represented 5 percent of total trips in 2001 and 3.5 percent of 2005 total trips.

The trip comparisons displayed on figures 23 and 24 correspond to loaded drafts between 31 and 40 feet. While examination of the pilot data and the NDC foreign freight traffic data showed that the maximum loaded draft for inbound vessels was 40 feet, one U.S. outbound domestic coastwise vessel showed a loaded draft of 43 feet. Additionally, a few U.S. domestic coastwise 1996–2004 records show loaded drafts up to 43 feet. In comparison to the USACE records, the pilot records for 2001 and 2005 showed no vessels with sailing drafts over 40 feet. A sample of pilot data for April–May of 2002 did not contain any loaded drafts over 40 feet. Review of the 2004 and 2006 pilot data also showed no loaded drafts over 40 feet. Pilot data for years later than 2006 were not obtained.

For purposes of analysis, the pilot guidelines and the associated documentation of trips by draft are believed to be more accurate and consistent, if for no other reason than being collected by one entity using the same metrics. The expectation that the pilots' records are more accurate than the Waterborne Commerce Statistics Center (WCSC) records also relates to the risk associated with misreading a loaded draft, particularly during low tide or late in the dredging cycle. The pilots stated that they normally will not move any vessel if the loaded draft exceeds 40 feet fresh water. The restrictions are rigid due to insurance liability. It was noted that allowance of 40 feet fresh water assumes optimal weather and a well-maintained channel. One of the subject matter experts recognize that the USACE and pilot data are collected at different locations and in different metrics. For piloted vessels, a mandatory and consistent check of loaded drafts is made prior to departure from either the dock or the offshore pilot loading station. These recordings are in feet. The USACE WCSC records of imports and exports are not based on pilot logs but census data. The USACE detail contains counts of export trips by loaded draft. The U.S. Customs' manifest document is the most common source for inbound vessels but these records do not include a trip field. The domestic coastwise database includes a trip field. Loaded draft of inbound domestic vessels may be called in from the last port of call. For imports, the last port of call is generally outside of the U.S., and therefore draft information may be relayed in meters. It is interesting to note that comparison of the 1996–2007 inbound with the outbound records shown in Table 28 reveal that there are more outbound vessels with loaded drafts over 40 feet than inbound vessels. A reason cited for this difference is that the outbound vessels have the additional weight of bunker fuel. The indication is that vessels traveling from distant locations will burn bunker fuel in transit. The inclusion of bunker fuel will add approximately 1 foot of draft.[25] The result being that the arrival drafts may be different than the draft recorded in the manifest or other documentation.

The pilots noted that they are only aware of a few incidents when a draft over 40 feet was allowed and wondered if they were due to recording errors. It was also noted that a 3-foot minimum underkeel

[25] Personal communication with Institute of Water Resources (IWR) navigation analyst.

clearance requirement was issued by the USCG in the early 2000s. Exceptions to the 3-foot rule may only be made by a pilot master conference to discuss the specifics.

For the USACE's NED analysis, loaded draft is critical to the calculation of SNWW channel deepening benefits. Loaded draft is also a crucial analytical consideration for the widening analysis due to the fact that there are specific pilot rules restricting loaded drafts above a given threshold from meeting vessels of comparable loaded drafts, gross tonnage, beam width, or other specifications. The calculation of widening benefits is based on discrete loaded draft classes.

While the waterborne commerce records show a few vessels sailing at loaded drafts over 39 feet, discussion with the pilots and Galveston District's Operation Branch suggest that the dredging practice of 2 feet advance maintenance and 2 feet overdepth provides nearly all vessels at least 3 feet of underkeel clearance. Analysis of the pilots' policy application and examination of the number of trips with loaded drafts over 37 feet implies the availability of advance maintenance and overdepth. Comparison of the USACE data with the pilot records shows differences between recorded drafts, which are problematic. Review of the USACE data revealed that the USACE data come from several sources and are, therefore, more likely to reflect the introduction of recording discrepancies than the pilot data. Additionally, allowance of less than 3 feet underkeel clearance introduces insurance liability issues. Analysis of the data and pilot records showing recorded drafts over 37 feet implies the availability of at least 41 feet of still water. Water displacement due to vessel squat and trim implies the availability of additional depth in the Entrance Channel, where the existing authorized channel depth is 42 feet mean low tide. It has been noted in the past that the SNWW, like other Gulf Coast channels, has a relatively soft bottom. It has also been noted that the SNWW heavy traffic flows may work to help maintain the channel or slow the silting processes; however, discussions with the SPA and previous project studies also point towards an increasing concern about safety and a reduction in risk-taking behavior. In general, liability and personal responsibility concerns associated with potential casualties and actual vessel damages has become increasingly apparent due to incidents such as the *Exxon Valdez* oil spill off the coast of Alaska. On a much smaller scale, general reviews of USCG records for GIWW traffic has shown that casualties and oil spills occur on a less frequent basis than 10 to 20 years ago. The latter suggests a reduction in risk-taking behavior.

## 3.4 CRUDE PETROLEUM FLEET

This section contains discussion of SNWW's crude petroleum fleet and methods of shipment. Data through 2007 show an average of 80 percent of import tonnage shipped in vessels with loaded drafts of 30 feet or more, and over 40 percent of import tonnage was shipped in vessels with loaded drafts of 36 feet or more. The analysis also showed that over 75 percent of SNWW crude petroleum tonnage was shipped in 90,000 to 119,999 DWT tankers, up from 30 percent in 1990. The largest concentration of SNWW crude petroleum tonnage is in vessels between 100,000 and 119,999 DWT. Table 29 presents SNWW distributions of crude petroleum imports by vessel size for 1993, 1998, and 2002–2007. The DWT range from 90,000 to 119,000 represents the dominant class for all years shown. Comparison of the data for the

early 1990s with that for 2002–2007 shows a general decrease in the vessels less than 75,000 DWT and resurgence in the 75,000 to 85,000 DWT range.

Table 29
SNWW Crude Petroleum Imports,
Percentage of Imports by Vessel DWT
and Design Draft and Year Built

| DWT 1,000s | 1993 | 1998 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|
| <50 | 0.6 | 0.1 | 0.1 | 0.4 | 0.8 | 1.6 | 0.9 | 0.8 |
| 50–74.5 | 3.8 | 1.2 | 8.5 | 3.1 | 1.7 | 1.8 | 3.4 | 3.7 |
| 75–84.9 | 18.4 | 8.1 | 8.6 | 18.1 | 20.4 | 18.0 | 25.0 | 23.0 |
| 85–89.9 | 17.3 | 10.6 | 9.9 | 4.6 | 0.5 | 0.0 | 0.3 | 0.0 |
| 90–119.9 | 56.0 | 72.1 | 65.6 | 65.8 | 67.8 | 71.8 | 63.7 | 66.3 |
| 120–149.9 | 1.9 | 2.7 | 2.8 | 2.7 | 3.3 | 3.0 | 2.0 | 1.7 |
| 150–175 | 2.0 | 5.2 | 4.5 | 5.3 | 5.5 | 3.8 | 4.6 | 4.5 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, NDC unpublished data were used to compile the percentage distribution of tonnage by vessel size. The LRS were used to obtain the vessel DWT and associated characteristics.

Review of the annual vessel statistics and follow-up meetings with the ship pilots and terminal operators revealed that petroleum tankers beams have increased significantly in recent years, and that the vessel beam increase is compounding the effect of delays. Double-hulled tanker legislation was initiated under 46 USC§3703a after the *Exxon Valdez* oil spill. The U.S. Congress passed the Oil Pollution Act of 1990 requiring double-hull tankers now, but allowing the transportation companies until 2015 to replace existing tankers. Table 30 provides comparison of the beam widths associated with the 1981 and 2003 world tanker fleets. The table illustrates the transition in tanker sizes to wider beam vessels and also illustrates an increase in cargo-carrying capacity at less draft.

Table 30
1981 and 2003 World Tanker Fleet
Comparison of Vessel Beam by DWT and Design Draft

| Beam Range (feet) | Median Beam (feet) | Median DWT | Design Draft (feet) |
|---|---|---|---|
| 1981 World Tanker Fleet (sample): Average Vessel Age: 7 years | | | |
| 120–124 | 122 | 87,800 | 44 |
| 125–129 | 127 | 88,058 | 46 |
| 130–139 | 135 | 128,439 | 54 |
| 140–158 | 145 | 156,000 | 58 |
| 160–175 | 169 | 228,054 | 66 |
| World Fleet (Vessels Built Between 1991–2003): Average Vessel Age: 4 years | | | |
| 120–124 | 120 | 49,999 | 35 |
| 125–129 | 125 | 84,999 | 46 |
| 130–139 | 138 | 105,000 | 48 |
| 140–158 | 149 | 114,980 | 48 |
| 160–175 | 164 | 158,982 | 52 |

Source: The 1981 fleet distribution was prepared based on a sample taken from Clarkson Research Studies, Ltd, The Tanker Register, London, 1981.

## 3.5 PORT ARTHUR AND BEAUMONT VESSEL FLEETS

Port Arthur's and Beaumont's specific distributions are shown in tables 31 and 32. Port Arthur's two petroleum refineries are located inside the Taylor Bayou complex. The existing width at the mouth of Taylor Bayou and the configuration of the docks within Taylor Bayou limit the allowable vessel size. Widening of the mouth of the bayou and the west turning basin bottleneck curve was evaluated as part of the current study. The result of widening the mouth would facilitate increased use of larger vessels that are presently restricted from using this portion of the channel. The most common crude oil tankers unloading at the Taylor Bayou terminals are 85,000 DWT, have design drafts of 45 feet, and beams of approximately 124 feet. It was found that the design drafts associated with the current fleet of 75,000 to 85,000 DWT vessels are slightly greater than in the earlier period. Several new tankers in this group were constructed in the early 2000s and are presently using the Port Arthur portion of the channel. The maximum size using the Taylor Bayou facilities is generally in the 110,000 to 116,000 DWT class. Widening of the mouth of the entrance to Taylor Bayou will occur under the with-project future and this will allow better vessel maneuverability. Widening of the mouth was recommended as a result of the ERDC vessel simulation modeling. The Taylor Bayou current fleet is specially designed for that project reach, and the vessels are characteristically wider and shorter than other tankers in the 80,000 to 90,000 DWT class. The Taylor Bayou configuration currently makes it difficult to maneuver longer vessels, and therefore, the design of the Taylor Bayou fleet reflects wider beams. Based on application of the pilot rules (see Table 3), inbound 124-foot beam Taylor Bayou vessels cannot meet common-beam-range outbound Neches River tankers of 135 to 145 feet. Present beam restrictions for the 500-foot-wide Sabine

Pass Channel and Port Arthur Canal reaches stipulate that the combined beam width of meeting vessels cannot exceed 50 percent of the channel width. The proposed increase to a project width of 700 feet would enable Taylor Bayou tankers to meet the relatively wider Neches River tankers in the channel reaches up to the Taylor Bayou junction.

Table 31
Port Arthur Crude Petroleum Imports
Percentage of Imports by Vessel DWT

| DWT (1,000s) | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| ≤50 | 0.1 | 0.7 | 0.7 | 1.5 | 0.0 | 0.9 |
| 50–74.5 | 55.5 | 6.2 | 3.0 | 3.1 | 4.5 | 7.9 |
| 75–84.9 | 14.5 | 75.8 | 93.7 | 66.0 | 93.1 | 82.2 |
| 85–89.9 | 5.3 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| 90–119.9 | 21.9 | 15.2 | 2.6 | 26.0 | 2.4 | 4.4 |
| 120–149.9 | 0.8 | 0.0 | 0.0 | 0.8 | 0.0 | 1.0 |
| 150–175 | 1.9 | 1.4 | 0.0 | 2.6 | 0.0 | 3.6 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, *Waterborne Commerce of the U.S.*, 2002–2007. The LRS was used to obtain the vessel DWT and associated characteristics.

Table 32
Channel to Beaumont Crude Petroleum Imports
Percentage of Imports by Vessel DWT

| DWT (1,000s) | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| ≤50 | 0.6 | 0.4 | 0.8 | 1.6 | 1.1 | 0.7 |
| 50–74.5 | 2.3 | 2.5 | 1.5 | 1.6 | 3.2 | 2.8 |
| 75–84.9 | 8.1 | 6.2 | 8.2 | 9.1 | 9.6 | 9.7 |
| 85–89.9 | 9.8 | 5.4 | 0.5 | 0.0 | 0.4 | 0.0 |
| 90–119.9 | 71.2 | 76.2 | 78.8 | 80.2 | 77.6 | 80.2 |
| 120–149.9 | 2.9 | 3.3 | 3.9 | 3.5 | 2.5 | 1.9 |
| 150–175 | 5.2 | 6.1 | 6.5 | 4.0 | 5.7 | 4.7 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, *Waterborne Commerce of the U.S.*, 2002–2007. The LRS was used to obtain the vessel DWT and associated characteristics.

The maximum sized vessels using the Channel to Beaumont are in the 150,000 to 170,000 DWT range. The maximum length for that group is approximately 900 feet, with a corresponding beam width of 164 feet. One percent of Beaumont's crude petroleum imports are associated with this group. Table 33 presents fleet-specific data corresponding to Beaumont and Port Arthur. Table 34 displays Beaumont's and Port Arthur's distributions by loaded draft. The annual distributions of tonnage by loaded draft exhibit large variance and also show distinct differences between the two ports.

Table 33
Crude Petroleum Vessel Characteristics
Representative of the Existing Fleet Through 2006
Vessel Length, Beam, and Design Draft (feet) and Year Built

| | Port Arthur Taylor Bayou | | | | Channel to Beaumont | | | |
|---|---|---|---|---|---|---|---|---|
| DWT (1,000s) | LOA | Beam | Design Draft | Year Built | LOA | Beam | Design Draft | Year Built |
| ≤50 | 580 | 102 | 36 | 1999 | 598 | 103 | 38 | 1998 |
| 50–74.5 | 748 | 106 | 45 | 2003 | 748 | 106 | 45 | 2002 |
| 75–84.9 | 758 | 124 | 45 | 2002 | 785 | 122 | 40 | 1988 |
| 85–89.9 | 800 | 131 | 43 | 1985 | 787 | 150 | 42 | 1992 |
| 90–119.9 | 810 | 138 | 45 | 1998 | 800 | 138 | 48 | 1998 |
| 120–149.9 | 892 | 150 | 56 | 2002 | 899 | 150 | 53 | 1996 |
| 150–175 | 899 | 158 | 52 | 2004 | 899 | 157 | 55 | 2003 |

Source: USACE, *Waterborne Commerce of the U.S.*, 2002–2006. The Fairplay/Lloyds Register of Ships (LRS) was used to obtain the vessel DWT and associated characteristics.

Table 34
SNWW Crude Petroleum 2002–2007 Imports by Loaded Draft

| | Port Arthur Crude Petroleum Imports | | | | | |
|---|---|---|---|---|---|---|
| Loaded Draft (feet) | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| <35 | 7.6 | 2.6 | 0.3 | 9.5 | 5.0 | 4.6 |
| 35–37 | 10.5 | 8.6 | 0.0 | 47.6 | 56.7 | 19.0 |
| >37 | 81.9 | 88.8 | 99.7 | 42.9 | 38.3 | 92.2 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | Beaumont Crude Petroleum Imports | | | | | |
| <35 | 10.5 | 10.5 | 12.7 | 10.3 | 17.2 | 7.3 |
| 35–37 | 27.3 | 27.0 | 23.5 | 19.1 | 19.3 | 22.6 |
| >37 | 62.2 | 62.5 | 63.8 | 70.6 | 63.5 | 70.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, *Waterborne Commerce of the U.S.*, 2002–2007. The LRS was used to obtain the vessel DWT and associated characteristics.

In comparison of Port Arthur and Beaumont relative port statistics, it was noted that for some years a greater percentage of crude tonnage is loaded to drafts of 38 feet or more for Port Arthur than for Beaumont. This is due to Port Arthur receiving a higher share of direct shipments from Mexico than Beaumont does. Generally, vessels will be loaded to deeper drafts for longer-distance direct routes. In comparison, Beaumont receives a higher share of lightered tonnage from both lightened mother vessels and shuttles. While there are cost incentives for loading to the maximum allowable depth, it was found that the average loaded drafts for the lightened mother vessels and shuttles were lighter than vessels associated with direct shipments. Deepening the Taylor Bayou reach would allow the present fleet of crude carriers to load to drafts over 40 feet; however, the transition to a larger DWT class is unlikely due to turning-area constraints. The turning-area constraints are unlikely to change even with channel deepening; however, industry representatives noted that a deeper channel will facilitate loading additional cargo on the existing range of vessels. While maximum vessel size ranges from 110,000 to 116,000 DWT, with design drafts of 49 feet, the most common crude oil tankers unloading at the Taylor Bayou terminals are 85,000 DWT and have design drafts of 43 feet. This common size is related to the entrance to Taylor Bayou for which widening was evaluated. A large portion of the vessels in the 85,000 and 110,000 to 116,000 DWT classes using Taylor Bayou were constructed in 2002–2003, which suggests that they will be utilized for another 20 years. The maximum beam width routinely allowed is 124 feet. Examination of vessel transits shows that the median and average beam for Taylor Bayou crude tankers is 124 feet and the maximum beam is 149 feet, with 92 percent of tonnage being transported in vessels with beam of 124 feet. The 124-foot beam corresponds to 85,000 DWT tankers, and the 149-foot beam corresponds to 116,000 DWT tankers. The maximum vessel length for Taylor Bayou vessels is approximately 758 feet. Vessels longer than 758 feet cannot easily be turned given Taylor Bayou boundaries and dimensions. For the Channel to Beaumont, 92 percent of tonnage is associated with beam widths over 130 feet. The vessel beams of both Port Arthur's and Beaumont's vessels causes them to be regularly impacted by the present 500-foot width of the Sabine Pass Jetty Channel and Port Arthur Canal.

### 3.5.1 Methods of Shipment for Crude Petroleum

The methods of shipping crude include direct, lightered, lightened, and transshipped. Direct shipment, as the name implies, is the transfer of tonnage by vessel between two coastal ports. Lightering is defined as the process involving ship-to-ship transfer of oil cargo, and it is extremely cost effective for long hauls. U.S. Gulf Coast lightering occurs in the international waters of the Gulf of Mexico and involves the transfer of tonnage from a larger vessel, called a VLCC, onto one or more shuttle vessels.

Figure 25 shows the U.S. Gulf offshore lightering zones. With lightering, the VLCC does not enter the coastal receiving port. A frequent alternative to either direct shipment or lightering is lightening. The term lightening describes the process where enough cargo is offloaded from a tanker to permit the light-loaded vessel to enter a confined channel system. The tanker sizes associated with lightening on the Texas Coast generally range from 120,000 to 175,000 DWT. Tankers larger than 175,000 DWT are normally lightered; however, there is a gap in the world tanker fleet between 175,000 and 250,000 DWT. The reason for the gap is that is not cost effective to use tankers significantly larger than 175,000 DWT for direct shipment even for channel depths of less than 55 feet. Analyses of the cost per ton transportation

costs also show that it is not cost effective to use vessels smaller than 250,000 DWT for lightering. An increase in channel depth to the SNWW would provide opportunity for these shuttles to be more fully loaded.

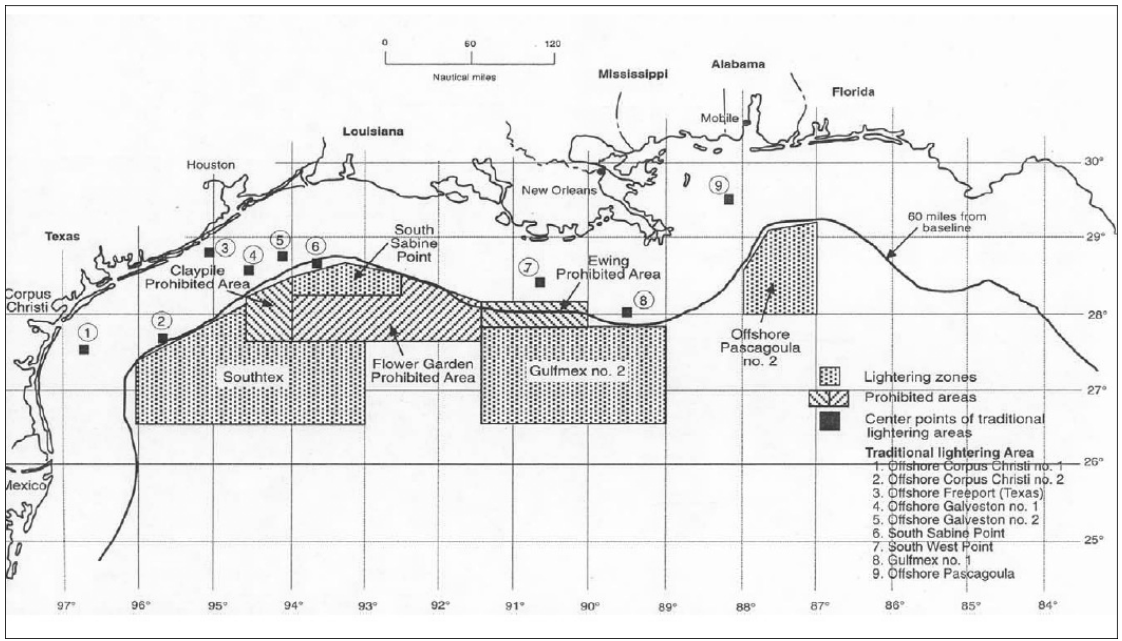
Africa, Mediterranean, and Europe movements are either lightened or shipped direct. The tanker sizes associated with lightening on the Texas Coast generally range from 120,000 to 175,000 DWT.[26] Tankers larger than 175,000 DWT are normally totally lightered offshore onto shuttles. Shipments from Africa, the Mediterranean, and Europe are usually transported in tankers between 90,000 and 175,000 DWT, with direct shipments generally using tankers between 90,000 and 120,000 DWT.

Transshipping is the fourth method of shipment. Crude oil is also transshipped through deepwater ports in the Caribbean. Crude is transported on VLCCs to the transshipped sites and later transferred to 90,000 to 114,000 DWT range shuttle tankers for shipment to the SNWW.

The primary sized vessel used on the Mexico/Eastern South America route for direct shipments into the SNWW is presently 90,000 to 114,000 DWT. Review of the 2007 *Fairplay Tanker Register* showed that the design drafts associated with tankers of 90,000 to 114,000 DWT generally range from 40 to 51 feet, with the average being 48 feet. An increase in channel depth to Port Arthur and Beaumont would provide opportunity for these shuttles to be more fully loaded. The size of the largest tankers using the SNWW in 2005–2007 on a regular basis is 169,146 DWT. The length, beam, and design draft for this vessel is 935x148x61 feet. In addition to transportation cost incentives, vessel selection is also related to the way crude petroleum is currently sold and how crude oil is shipped. Presently, parcels are generally sold in 500,000 to 650,000 barrels. A 500,000- to 650,000-barrel parcel converts to approximately 75,000 to 95,000 short tons. Many vessels arrive in the international waters of the Gulf of Mexico with double parcels. Cost analyses show that the most economical sized vessel for single parcels is between 75,000 and 100,000 DWT given the existing channel depth of 45 feet. For double parcels, the most efficient size is between 150,000 and 175,000 DWT.

[26] USACE, unpublished data.

Figure 25
U.S. Gulf Coast Crude Petroleum Lightering Zones




Source: Ellis, John, "Commonality of GoM [Gulf of Mexico] Lightering, Experience with GoM Shuttling", Floating Production, Storage and Offloading Global Workshop, September 25, 2002, http://lovie.org/pdf/John- Ellis.pdf.

Gulf Coast industry personnel indicated that parcel size and associated ship size are primarily a function of the existing channel dimensions. The indication suggests that an increase in channel dimensions would likely result in a shift to larger parcel sizes and larger vessels. Comparison of the parcel sizes associated from the early 1990s with 2007 crude oil imports revealed that the distribution of tonnage by parcel size increased for Texas ports where the channel operating depths increased from 40 to 45 feet. Comparison of crude oil import records from the early 1990s with 2007 records illustrates that larger parcels are being shipped today and suggests that the channel deepening from 40 to 45 feet facilitated this transition.

Lightening is a common alternative to either direct shipment or lightering for some routings, and it describes the process where enough cargo is offloaded from a tanker to permit the light-loaded mother vessel to enter a confined channel system. Africa, Mediterranean, and Europe movements are either lightened or shipped direct. The tanker sizes associated with lightening on the Texas Coast generally range from 120,000 to 175,000 DWT. Tankers larger than 175,000 DWT normally are totally lightered offshore onto shuttles. Shipments from Africa, the Mediterranean, and Europe are usually transported in tankers between 90,000 and 175,000 DWT, with direct shipments generally using tankers between 90,000 and 120,000 DWT.

Shipments from the Europe/North Sea/Africa trade route are usually transported in tankers between 90,000 and 175,000 DWT, with direct shipments generally using tankers between 90,000 and 120,000 DWT. Tankers larger than 175,000 DWT are normally lightered. The primary sized vessel used on the Mexico/Eastern South America route for shipments into the SNWW and other U.S. Gulf Coast ports is 90,000 to 114,000 DWT; however, vessels up to 120,000 DWT are not uncommon.[27] Review of the 2007 *Fairplay Tanker Register* showed that the design drafts associated with tankers of 90,000 to 114,000 DWT generally range from 40 to 51 feet, with the average being 48 feet. The limited volumes of direct shipments from the Middle East are usually shipped in vessels between 90,000 and 120,000 DWT; however, direct shipment of crude originating in the Middle East is not a cost-effective choice.

The logistics associated with offshore transfers introduce higher degrees of uncertainty than direct shipment and, therefore, generate large cost variances. Industry indicated that lower cost differences between direct versus offshore transfer costs may increase the likelihood of direct shipment. Industry personnel indicated that the number of days to completely lighter a VLCC normally ranges from 4 to 10 and that the average number of days to completely lighter 200,000 to 300,000 DWT vessels is 5.5; however, it was noted that 2 weeks is not uncommon. Five and one-half days equate to 1.5 times the in-port unloading rate. Utilization of the upper limit of 2 weeks appears to relate to a less than optimal number of shuttles and shuttle turnaround rate.

Identification of the number of days used for the SNWW analysis was based on inputs from industry including data outlined in the Skaugen PetroTrans' publication "Introduction to Lightering."[28] The mother vessels used for Gulf Coast lightering are generally in the 300,000 to 350,000 DWT range. The SNWW

[27] USACE, unpublished data.

[28] Skaugen Petro Trans Inc., Introduction to Lightering, October 25, 2006. http://www.teekay.com/PDFs/Lightering101.pdf.

cost calculations were based on a VLCC of 320,000 DWT, which is the largest tanker presented in the USACE's EGM. The Skaugen publication includes a graphic with three shuttle vessels taking 3 days to totally offload a VLCC. While not noted in that publication, the use of three shuttles implies a channel depth of 45 feet or more, as each shuttle would need to accommodate 100,000 tons of cargo in order to offload a 300,000 DWT mother vessel. The maximum cargo load that can be transported on tankers between 100,000 and 150,000 DWT, given a 40-foot channel depth, ranges from approximately 70,000 to 86,000 short tons (see Table 109). Given a channel depth of 40 feet, four shuttles are needed to totally offload a 300,000 DWT vessel. Identification of the number of shuttle vessels needed by channel depth is outlined later in this document (see Table 110).

Discussion with industry personnel, including Skaugen, revealed that unloading rates for crude oil would generally range from 4,038 to 5,250 short tons per hour. It was also noted that the rate of 4,038 would be representative for offshore operations; therefore, this rate was used for the SNWW offshore vessel calculations. Given an unloading rate of 4,038 short tons per hour, a 300,000 DWT vessel carrying a full load of 291,000 short tons would take 3 days, or 72 hours, to completely unload based on optimal logistics. Using the same unloading rate, a 350,000 DWT vessel carrying a full load of 339,500 short tons would take 84 hours, or 3.5 days, to completely unload. The SNWW lightering cost calculations are based on the mother vessel being offshore for 24 hours for each shuttle vessel used. Based on 24 hours, the mother vessel would be offshore for a total of 96 hours given four shuttles and 72 hours given three shuttles.

An increase in channel depth would reduce the number of shuttles. For instance, a three-shuttle operation would take 72 hours, down from 84 hours for a four-shuttle operation. The affect of using greater and lesser offshore times on channel depth optimization is evaluated in the sensitivity section (Section 8.6).

The mother vessels associated with lightening are generally in the 150,000 to 175,000 DWT range. Given an unloading rate of 4,038 short tons per hour, a 175,000 DWT vessel carrying a full load of 160,050 short tons would take 19.8 hours, or 0.8 day, to discharge one-half of its cargo. The lightening cost calculations are based on one day or 24 hours. The 24 hours includes a combination of unloading at sea and waiting at sea. Travel time to port was calculated as a separate line item as was unloading time in port. The effect of using greater and lesser times on channel depth optimization is evaluated in the sensitivity section (Section 8.3).

Comparison of direct shipment costs with those for lightering or lightening for the Africa, Mediterranean, and Europe route revealed that while the average cost for lightering or lightening is less than the average cost for shipping direct, the percentage difference between direct shipment costs and the offshore alternatives is considerably less than for either Mexico/South America or Middle East and Far East origins. The relative closeness in the costs between shipping methods for Africa, Mediterranean, and Europe tonnage and, in particular, the variance associated with the number of days necessary to complete the offshore transfer process contributes to a higher percentage of direct shipment for this route than optimal or than least-cost computations would suggest. A risk of delays, in association with the closeness in costs between shipping methods, contributes to a proportion of direct shipments that is higher than

what might occur if the variance associated with the cost of lightering did not overlap with the cost of shipping direct. Examination of the cost data suggests that an increase in channel dimensions would probably result in an increase in direct shipment movements for Africa, Mediterranean, and Europe shipments.

Comparison of the method of shipment costs for Eastern South America and the Persian Gulf did not show that channel depth increases over 50 feet provided cost incentives to switch from one method of shipment to another, given channel depth constraints between 43 and 48 feet. In general, lightening is not cost effective for tonnage on the Persian Gulf trade route because the economies of scale associated with existing practices result in a lower cost for lightering than what would be attained through lightening. The reason lightering is cheaper than lightening for Persian Gulf/Indian Subcontinent shipments is because the magnitude of the mileage component of the per ton cost is large enough to offset the relatively large fixed cost attributable to having the mother vessel remain offshore for 5.5 days. For similar reasons, the relatively short distance and high fixed costs associated with either lightening or lightering eliminates any incentive for Mexico/Eastern South America shipments to shift to lightening. Despite the clear lack of economic rationale for lightering Mexico/Eastern South America tonnage or shipping Persian Gulf/Indian Subcontinent tonnage direct, relatively inefficient shipping methods are used for some shipments on these trade routes. The decision to lighter Mexico/Eastern South America tonnage or ship Persian Gulf/Indian Subcontinent tonnage direct results from less than perfect world market conditions. For purposes of analysis, the least-cost practical alternative was assumed given existing technology and anticipated future innovations. Specifically, the cost calculations were made using direct shipment for the Americas; lightering for the Middle East and Far East; and lightening for Africa, Europe, and the Mediterranean for the 40-foot channel with a transition to direct shipment for increased channel depth alternatives based on transportation cost efficiencies.

Regardless of trade route, the vessel size utilized is sometimes related to the way crude petroleum is sold. Currently, crude petroleum is traditionally sold in parcels of 500,000 barrels. A 500,000-barrel parcel converts to approximately 75,000 short tons. The most economical size vessel for a 75,000-ton parcel is between 75,000 and 100,000 DWT. For 150,000-ton parcels, the most efficient size is between 150,000 and 175,000 DWT. Ninety-four percent of the 100,000 to 140,000 DWT vessels in the world fleet have design drafts in excess of 45 feet, and 32 percent of the vessels between 75,000 and 100,000 DWT have design drafts over 45 feet. The SNWW channel deepening alternatives were formulated assuming that the maximum ship size for both direct shipments and lightered vessels would be 175,000 DWT. Vessels over 100,000 DWT would continue to be light-loaded under the with-project condition; however, there would be a reduction in the number of feet light-loaded. U.S. Gulf Coast industry personnel indicated that parcel size and associated ship size is primarily a function of the existing channel dimensions and that an increase in channel dimensions would likely result in a shift to larger parcel sizes and larger vessels.

Evaluation of the percentage of SNWW tonnage transported in vessels anticipated to utilize depths over 40 feet was primarily based on the relative change in per ton transportation cost between the existing 40-foot channel depth and increased channel depths. Cost analysis suggested that nearly all vessels used to transport crude petroleum from Mexico, Venezuela, and Central and South America would be loaded to

depths over 45 feet. Expectations concerning the percentage of Middle East and Africa movements are subject to greater uncertainty. Nearly all Middle East tonnage is presently lightered. Lightering is also the least-cost alternative for Far East tonnage.

Table 35 presents Port Arthur and Beaumont crude petroleum imports by trade route. The format of the USACE's WCSC's shipping records obtained by the USACE through the Bureau of Census do not provide sufficient information to distinguish lightened tonnage from direct or lightered tonnage. Industry discussions revealed that lightened tonnage is primarily limited to shipments from Western Africa, and transportation cost analysis conducted by the USACE for SNWW confirmed this. While the port loading facilities in Western Africa do presently accommodate the VLCCs associated with lightering, this situation could change over the 50-year period of analysis, and the affect of changing this variable is evaluated in the sensitivity analysis.

The data presented in Table 35 include a "trade route classification" titled "lightered." The tonnage included under this classification includes shuttle vessels associated with lightering and lightening; however, it does not completely reflect the total volume of tonnage associated with the lightering or "offshore transfer" process. In particular, a large part of the tonnage included under West Africa, North Europe, and the Mediterranean, and, to some degree, the Middle East and Far East is partially offloaded onto shuttle vessels. The port classification noted in the Census data for these lightening mother vessels is the country of origin. The port of origin shown for all shuttle vessels is the "international waters of the Gulf of Mexico." Using the data provided, it is not possible to reconstruct the specific routing. For this reason, the costs associated with lightering and lightening need to be reconstructed to determine what the most efficient method of shipment is. While it is cost effective to lighten crude shipped from West Africa and it is cost effective to lighter VLCCs from the Middle East, some tonnage from these routes is presently shipped direct. Additionally, some tonnage from Mexico is lightered. While the method of shipment for all cargo may not represent the most cost effective means, the transportation cost calculations were prepared assuming that the most cost effective method of shipment would be chosen under the without- and with-project future.

Table 35
SNWW Percentage of Crude Petroleum Imports by Trade Route

| Trade Route | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| | Port Arthur Imports by Trade Route | | | | | |
| Mexico | 67.6 | 79.6 | 94.0 | 72.0 | 94.9 | 88.8 |
| Central and South America and Caribbean | 0.0 | 0.0 | 0.9 | 0.4 | 1.1 | 0.4 |
| Venezuela and Colombia | 3.6 | 4.2 | 1.7 | 9.2 | 0.0 | 1.1 |
| Western South America | 0.0 | 1.9 | 0.6 | 1.9 | 0.0 | 0.0 |
| Northern Europe and Mediterranean | 12.3 | 1.2 | 0.8 | 4.0 | 1.5 | 2.5 |
| Western Africa | 0.0 | 0.7 | 0.0 | 1.4 | 0.0 | 1.5 |
| Middle East | 11.1 | 0.0 | 0.0 | 4.1 | 0.5 | 0.7 |
| Lightered | 5.3 | 12.4 | 2.0 | 7.0 | 2.0 | 5.0 |
| Port Arthur Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | Beaumont Imports by Trade Route | | | | | |
| Canada | 4.2 | 1.5 | 0.0 | 0.4 | 0.6 | 0.7 |
| Mexico | 32.6 | 23.0 | 21.8 | 24.4 | 22.6 | 22.4 |
| Central and South America and Caribbean | 0.5 | 1.4 | 1.8 | 2.7 | 2.3 | 2.5 |
| Venezuela | 6.1 | 10.7 | 7.8 | 8.7 | 7.1 | 8.4 |
| Colombia | 3.7 | 3.2 | 2.8 | 2.2 | 1.6 | 1.4 |
| Brazil and Argentina | 0.5 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 |
| Western South America | 0.2 | 0.3 | 0.1 | 0.1 | 0.1 | 0.3 |
| Northern Europe and Mediterranean | 8.7 | 5.4 | 12.3 | 12.3 | 16.1 | 6.7 |
| Western Africa | 4.7 | 2.2 | 8.9 | 7.1 | 9.1 | 3.3 |
| Middle East | 24.5 | 0.4 | 25.4 | 21.2 | 34.5 | 19.5 |
| Far East | 0.1 | 0.1 | 0.1 | 0.2 | 0.0 | 0.0 |
| Lightered | 14.2 | 51.8 | 18.6 | 20.7 | 6.1 | 34.9 |
| Beaumont Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, *Waterborne Commerce of the U.S.*, 2002–2007.
The LRS was used to obtain the vessel DWT and associated characteristics.

Table 36 presents comparative trade route data for PADD III. Table 37 presents SNWW's trade route distribution. The SNWW data were compiled were from USACE NDC, and the PADD III data were compiled from the EIA data records.[29] The first part of the top shows PADD III imports. Comparison of PADD III data with SNWW indicates the SNWW receives a higher percentage of its crude oil imports from Mexico and a lower percentage from Venezuela than PADD III. Additionally, based on the combined total of Middle East and "lightered tonnage," the SNWW receives a much higher percentage of Middle Eastern crude than PADD III; however, SNWW's "lightered tonnage" also includes shuttle vessels associated with lightening of tankers from West Africa.

[29] USDOE, EIA, Imports by Country of Origin (includes vessel and pipeline movements).

Table 36
PADD III Percentage of Crude Petroleum Imports by Trade Route

| Trade Route | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|
| Canada | 1.1 | 0.5 | 0.3 | 0.4 | 1.1 | 1.7 | 2.0 |
| Mexico | 27.0 | 26.8 | 26.2 | 26.0 | 27.4 | 24.6 | 22.1 |
| Central and South America and Caribbean | 1.8 | 1.6 | 1.2 | 1.3 | 1.2 | 0.8 | 0.5 |
| Venezuela | 20.4 | 19.5 | 20.1 | 18.3 | 17.3 | 17.6 | 16.4 |
| Colombia | 2.7 | 1.9 | 1.5 | 1.6 | 1.5 | 1.5 | 2.0 |
| Brazil and Argentina | 0.6 | 0.4 | 0.4 | 0.8 | 0.0 | 1.2 | 1.8 |
| Western South America | 0.1 | 0.5 | 1.2 | 1.4 | 1.1 | 0.8 | 0.9 |
| Northern Europe and Mediterranean | 8.4 | 8.8 | 7.4 | 9.7 | 10.0 | 9.4 | 8.0 |
| Western Africa | 7.9 | 10.3 | 13.5 | 14.6 | 16.6 | 18.1 | 18.2 |
| Middle East | 29.1 | 29.1 | 27.0 | 24.6 | 23.8 | 24.1 | 28.1 |
| Other (not identified) | 1.0 | 0.7 | 1.3 | 1.5 | – | – | – |
| Lightered (not available) | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| PADD III Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USDOE, compiled from the EIA website, 2009.

Table 37
SNWW Percentage of Crude Petroleum Imports by Trade Route, 2002–2007

| Trade Route | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| Canada | 3.6 | 1.3 | 0.0 | 0.3 | 0.5 | 0.7 |
| Mexico | 37.4 | 32.7 | 32.1 | 32.0 | 35.9 | 11.1 |
| Central and South America and Caribbean | 0.4 | 1.1 | 1.6 | 2.1 | 1.9 | 2.8 |
| Venezuela | 5.7 | 9.3 | 6.9 | 8.5 | 5.8 | 9.5 |
| Colombia | 3.2 | 2.9 | 2.4 | 2.1 | 1.3 | 1.4 |
| Brazil and Argentina | 0.4 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| Western South America | 0.2 | 0.5 | 0.2 | 0.4 | 0.1 | 0.3 |
| Northern Europe and Mediterranean | 9.2 | 4.7 | 11.9 | 14.3 | 13.6 | 9.1 |
| Western Africa | 4.0 | 2.0 | 8.9 | 7.3 | 8.0 | 4.8 |
| Middle East | 22.7 | 0.3 | 25.1 | 26.7 | 29.8 | 20.1 |
| Other (Far East) | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.0 |
| Gulf of Mexico Lightering | 13.0 | 45.0 | 10.6 | 6.2 | 2.9 | 40.0 |
| Beaumont Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, *Waterborne Commerce of the U.S.*, 2002–2007.

Under the current and future without- and with-project conditions, the "mother vessels" offload partial cargoes to shuttle vessels and both vessels come into port. The lightened mother vessels were modeled in the ERDC ship simulation. These "lightened mother vessels" are the "design vessels." The analysis for the offshore transfer process was based exclusively on operating costs. The duration of the transfer, number of shuttle tankers, supply boats, and equipment was estimated in terms of a "range of time," and

the costs for vessels and equipment were determined. The shuttle vessel costs and additional pilot and tug charges were identified.

For a with-project condition that includes deepening, the mother vessels would discharge less cargo offshore. Based on the mother vessel discharging less cargo offshore, the with-project condition would affect the number and sizes of the shuttle vessels. For direct shipments, a with-project condition where the channel is deepened would allow for fewer vessel trips as the existing range of vessels would be able to carry more cargo. The specific differences in the without- and with-project conditions are outlined in the transportation cost analysis section (Section 6).

The trade route forecast for SNWW's crude petroleum imports was prepared based on analysis of U.S. import and world production forecasts and application of recent historical SNWW and U.S. Gulf Coast routings. The U.S. and Gulf Coast 2006 period base distribution and the EIA 2010–2030 trade route forecast are presented in Table 38. The EIA is forecasting significant decrease in imports from Mexico. The SNWW ports have historically received over 30 percent of its crude petroleum imports from Mexico; however, in 2007 imports from Mexico only represented 11 percent. The EIA forecasts indicate that the majority of U.S. crude oil imports will come from the Middle East, Europe, and Africa. The principal sources for Middle East and European shipments are included under the following origins: Persian Gulf, Russia,, Asia, Eurasia, and China.

Table 38
EIA Production Forecast Conventional Crude Production and
Sources of U.S. Crude Oil Imports and SNWW Application

| | U.S. Imports by Trade Route (%) | | | |
|---|---|---|---|---|
| Trade Region | 2006 | 2010 | 2019 | 2029 |
| Mexico | 5.1 | 3.3 | 2.9 | 2.9 |
| South and Central America | 8.5 | 8.5 | 9.1 | 0.106 |
| Europe and West Africa | 42.4 | 44.5 | 43.8 | 43.0 |
| Middle East and Asia | 44.0 | 43.7 | 44.1 | 43.6 |
| Total | 100.0 | 100 | 100 | 100 |

| | PADD III Imports (%) | | | SNWW Imports (%) | | |
|---|---|---|---|---|---|---|
| Trade Region | 2006 | 2007 | 2008 | 2006 | 2007 | 2019/2029 |
| Mexico | 27.4 | 24.6 | 22.1 | 35.9 | 11.0 | 10.0 |
| South and Central America | 21.1 | 23.8 | 21.6 | 9.1 | 14.0 | 17.0 |
| Europe and West Africa | 27.7 | 27.5 | 28.2 | 30.3 | 41.3 | 37.7 |
| Middle East and Asia | 23.8 | 24.1 | 28.1 | 24.8 | 33.8 | 35.3 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: Application of AEO2009 forecasts and EIA and USACE base data.

The trade route forecast presented in Table 38 was then applied to the crude petroleum tonnage projections. Mileages were weighted based on existing and anticipated percentage of tonnage by trade region. Trade regions were grouped based on general regions and similar vessel utilization patterns and port constraints.

## 3.6 PETROLEUM PRODUCT CARRIERS

Examination of the vessel characteristics and geographic routings associated with SNWW petroleum products suggests that some product carriers could be more fully loaded. Distribution of SNWW petroleum product imports and exports by vessel DWT class is displayed in Table 39. Analysis of product imports showed that from 32 to 54 percent of 1998–2007 imports and 5 to 27 percent of exports were transported in vessels of 60,000 DWT or more. In 2007, 42 percent of product imports and 14 percent of exports were transported in vessels of 60,000 DWT or more. As noted in Section 2.2, product import variability is also reflected in the distribution of the U.S. products types. This distribution is characterized by annual fluctuations prompted by conditions where outputs fall short or are preempted by other market drivers.

Table 39
SNWW Petroleum Product Import Tonnage by Vessel DWT

| | SNWW Percentage of Imports by DWT Range | | | | | |
|---|---|---|---|---|---|---|
| DWT Range | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 |
| <10,000 | 4.3 | 0.0 | 0.4 | 0.0 | 0.4 | 1.3 |
| 10,000 to 29,999 | 12.1 | 6.2 | 2.8 | 4.4 | 1.1 | 4.4 |
| 30,000 to 49,999 | 45.8 | 48.9 | 41.3 | 48.7 | 58.1 | 45.6 |
| 50,000 to 59,999 | 5.5 | 3.0 | 1.4 | 1.1 | 2.2 | 7.1 |
| 60,000 to 69,999 | 3.8 | 15.1 | 16.7 | 9.3 | 12.8 | 6.9 |
| 70,000 to 79,999 | 2.7 | 0.0 | 15.2 | 18.4 | 17.0 | 21.2 |
| 80,000 to 89,999 | 4.0 | 8.9 | 5.4 | 7.3 | 0.0 | 0.0 |
| 90,000 to 99,999 | 15.8 | 5.4 | 3.7 | 3.3 | 2.1 | 0.5 |
| 100,000 to 116,000 | 6.0 | 12.6 | 13.2 | 7.5 | 6.4 | 13.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | SNWW Percentage of Exports by DWT Range | | | | | |
| <10,000 | 2.9 | 2.5 | 3.0 | 1.0 | 1.4 | 1.7 |
| 10,000 to 29,999 | 14.3 | 11.9 | 9.5 | 15.5 | 7.2 | 8.6 |
| 30,000 to 49,999 | 67.3 | 57.0 | 69.0 | 72.9 | 77.6 | 61.2 |
| 50,000 to 59,999 | 7.2 | 1.4 | 10.0 | 4.2 | 8.7 | 14.5 |
| 60,000 to 69,999 | 4.1 | 12.1 | 4.4 | 1.7 | 2.7 | 5.5 |
| 70,000 to 79,999 | 1.9 | 11.4 | 4.0 | 4.7 | 0.6 | 8.5 |
| 80,000 to 89,999 | 2.2 | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 |
| 90,000 to 99,999 | 0.1 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| 100,000 to 116,000 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, *Waterborne Commerce of the U.S.*, 1998–2007.

The Fairplay/Lloyds Register of Ships (LRS) was used to obtain the vessel DWT and associated characteristics. Vessel DWT, design drafts over 40 feet, and parcel size were among the variables examined to help evaluate the potential transition to deeper vessel loads. Tables 40 and 41 present product imports and exports by major commodity type and shows the annual percent of each grouping transported in vessels of 60,000 DWT or more.

Examination of the data in tables 40 and 41 shows that there are large annual variances in the percentage of annual tonnage associated with the draft and parcel size. Based on this variance and planning guidance, depths at trading ports and comparable operations at similar ports were also evaluated. Discussions with local shippers also indicated that product carriers for some trade routes and customers would be loaded to depths over 40 feet if the channel was deepened. Examination of petroleum product import and exports transported through other U.S. Gulf Coast ports with channel depths over 40 feet showed that 34 percent of distillate imports were loaded to drafts of 42 feet or greater and 24 percent of petroleum coke exports were loaded to drafts of 42 feet or more. Many of these shipments were associated with ports in Russia, North Africa, Venezuela, and Brazil. Other routings include the Far East. The use of the Panama Canal for all of the Far East and over half of the South America destinations will limit the sizes of vessels used for that trade until the Panama Canal expansions are completed after 2014.

Table 42 shows the world petroleum product fleet data as compiled from the LRS. The table includes the percentage of vessels on order as of January 2009. Table 42 shows that 45 percent of the petroleum product tankers on order in 2009 have design drafts of 47 to 49 feet or more and 12 percent have design drafts of 50 feet or more.

Table 40
Imports and Exports Shipped in Vessels of 60,000 DWT or Larger
SNWW Petroleum Product Imports
1998–2007 (select years)

| Major Commodity Group | Total Imports by Commodity Group (1,000s of short tons) | | | | | | Percent of Imports Transported in Vessels ≥60,000 DWT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | – | 33 | 1,613 | 2,213 | 1,678 | 1,096 | – | 0 | 6 | 14 | 8 | 15 |
| Distillate Fuel | 102 | 572 | 728 | 1,286 | 1,267 | 1,872 | 40 | 75 | 73 | 7 | 78 | 67 |
| Residual Fuel | 57 | 25 | 810 | 804 | 351 | 355 | 100 | 100 | 59 | 94 | 74 | 16 |
| Lube Oil and Greases | 2,140 | 700 | 619 | 50 | 71 | 2 | 83 | 90 | 80 | 0 | 39 | 39 |
| Naphtha and Solvents | 808 | 1,138 | 1,977 | 595 | 368 | 719 | 21 | 5 | 81 | 49 | 16 | 16 |
| Asphalt, Tar and Pitch | 11 | – | – | 7 | – | – | – | – | – | – | – | – |
| Petroleum Coke | 250 | 266 | 255 | 365 | 84 | 276 | 10 | – | 21 | 48 | – | 10 |
| Other | 124 | – | – | 29 | – | – | 6 | – | – | – | – | – |
| Total Imports | 3,492 | 2,734 | 6,003 | 5,349 | 3,819 | 3,744 | 58 | 42 | 54 | 46 | 39 | 40 |

Source: USACE, *Waterborne Commerce of the U.S.*, 1998–2007.
The LRS was used to obtain the vessel DWT and associated characteristics.

Table 41
SNWW Petroleum Product Exports
1998–2007 (select years)

| Major Commodity Group | Total Exports by Commodity Group (1,000s of short tons) | | | | | | Percent of Exports Transported in Vessels ≥60,000 DWT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 | 1998 | 2001 | 2004 | 2005 | 2006 | 2007 |
| Gasoline | 1,376 | 1,258 | 19,49 | 1,778 | 1,777 | 1,970 | 1 | – | 3 | – | 1 | 10 |
| Distillate Fuel | 602 | 179 | 449 | 371 | 371 | 345 | 42 | – | – | 11 | 9 | 58 |
| Residual Fuel | 206 | 12 | 0 | 51 | 68 | – | 12 | – | – | – | 50 | – |
| Lube Oil and Greases | 41 | 63 | 57 | 99 | 117 | 60 | 10 | – | – | – | 10 | 10 |
| Naphtha and Solvents | 0 | 146 | 8 | 58 | 94 | 22 | 4 | – | – | – | 4 | – |
| Petroleum Coke | 1,622 | 3,447 | 4,688 | 4,362 | 4,362 | 4,210 | 13 | 35 | 13 | 14 | 6 | 9 |
| Other | 463 | 17 | 0 | 104 | 33 | – | – | – | – | – | – | – |
| Total Imports | 4,328 | 5,122 | 7,151 | 6,823 | 6,822 | 6,607 | 8 | 23 | 9 | 9 | 5 | 15 |

Source: USACE, *Waterborne Commerce of the U.S.*, 1998–2007.
The LRS was used to obtain the vessel DWT and associated characteristics.

Table 42
World Petroleum Product Fleet

| Design Draft (feet) | Median DWT | Percentage of Total DWT | |
|---|---|---|---|
| | | Built 1985–2004 | On Order as of January 2009 |
| <36 | 13,000 | 13 | 4 |
| 36–38 | 38,500 | 14 | 2 |
| 39–40 | 46,000 | 23 | 13 |
| 41–42 | 47,000 | 26 | 12 |
| 43–44 | 68,000 | 5 | 12 |
| 45–46 | 85,000 | 7 | 0 |
| 47–49 | 99,900 | 9 | 45 |
| 50–51 | 110,000 | 2 | 12 |
| | Total | 100 | 100 |

Source: LRS, 2009.
* Excludes crude oil and chemical tankers.

While it is anticipated that annual variance will continue, the use of draft-constrained vessels for several markets served by the SNWW is also anticipated to continue and likely increase due to increases in maximum beam width and loaded draft for Panama Canal transits that will open trade opportunities to additional markets. SNWW petroleum coke exports are expected to remain steady due to the construction of an additional coker and increased refinement of high-sulfur crude oil. Table 43 displays the major destinations for U.S. petroleum coke exports. Of the destinations shown in Table 43, the U.S. Gulf Coast primarily serves the North and South American and European markets; however, expansion of the U.S. Gulf Coast share to include Pacific markets may increase after 2014 as a result of the Panama Canal expansion. While published forecasts of specific trade routes are not available, the SNWW presently serves markets that can accommodate more fully loaded product carriers, and it was assumed that some cargo movements would transition to more fully loaded vessels based on the economics of scale of loading to increased depths and availability of channel depths in excess of 40 feet at some trading ports. As shown in tables 40 and 41, relatively large carriers are used for high-volume commodities such as distillate and residual fuel imports and petroleum coke exports.

Table 43
U.S. Petroleum Coke Exports by Major Destination
(Percentage)

| | Western Hemisphere | | | Europe and Mediterranean | | | Pacific | | | Major | All |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Canada | Mexico | Brazil | Italy | Netherlands | Spain | China | India | Japan | Importers | Other |
| 2002 | 4.5 | 7.4 | 6.5 | 8.0 | 3.6 | 12.5 | 2.7 | 0.3 | 14.5 | 42.4 | 57.6 |
| 2003 | 6.1 | 9.4 | 7.2 | 10.2 | 3.0 | 10.8 | 5.0 | 0.8 | 11.9 | 46.8 | 53.2 |
| 2004 | 6.3 | 7.7 | 7.1 | 7.7 | 3.7 | 10.6 | 0.9 | 1.7 | 13.1 | 43.1 | 56.9 |
| 2005 | 6.9 | 8.9 | 8.9 | 7.5 | 4.0 | 8.9 | 1.7 | 2.0 | 13.5 | 45.2 | 54.8 |
| 2006 | 6.6 | 11.2 | 9.3 | 8.5 | 3.3 | 8.7 | 1.4 | 1.9 | 12.6 | 47.5 | 52.5 |
| 2007 | 6.3 | 12.8 | 11.2 | 7.7 | 1.9 | 11.2 | 1.6 | 3.0 | 11.7 | 51.1 | 48.9 |
| 2008 | 7.7 | 13.3 | 9.3 | 7.7 | 2.7 | 8.8 | 1.3 | 2.4 | 12.5 | 49.3 | 50.7 |

Source: USDOE, compiled from the EIA website, 2009.

For petroleum product imports and exports, a steady volume of domestic coastwise product tankers use Port Arthur and Beaumont. Domestic coastwise movements primarily consist of gasoline, distillate, and residual fuel shipments. These products are refined at the SNWW ports and then shipped to the U.S. East Coast, specifically eastern Florida. In 2006, coastwise shipments totaled 3.6 million short tons. Coastwise receipts were 978,000 short tons. Examination of vessel specifics showed that approximately 10 percent of outbound coastwise shipments were transported in draft-restricted tankers. These product carriers generally are between 60,000 and 70,000 DWT with design drafts in the 41- to 43-foot range. The vessels used are all U.S. flag vessels, Jones' Act vessels. The median age of the current fleet exceeds 10 years, with most vessels built in the 1980s. The combination of U.S. tanker availability, depths at trading ports, parcel size demand, the cost effectiveness of loading to greater drafts, and industry discussion suggest that the percentage of tonnage that would utilize channel depths over 40 feet would be closer to 10 percent in the short term increasing to 20 percent over the period of analysis

## 3.7 CHEMICAL PRODUCT CARRIERS

For the period 2002–2007, chemical imports and exports represented approximately 3 percent of both SNWW and U.S. total foreign tonnage. Evaluation of 1998–2007 chemical exports showed that the percentage of tonnage associated with design drafts between 40 and 44 feet ranged from zero to 14 percent, averaging 4 percent annually. An average of 16 percent of 1998–2006 export tonnage was transported in loaded drafts between 36 and 40 feet. In 2007, 18 percent of SNWW chemical products were transported in vessels with loaded drafts between 36 and 40 feet. Export tonnage represented 75 percent of SNWW 2002–2006 import-export total. Approximately two-thirds of 2002–2007 exports were shipped from Beaumont and the remainder from Port Arthur. Seventy-nine percent of 2002–2007 imports were shipped into Beaumont and the remainder to Port Arthur.

Review of the chemical carrier fleet showed the youngest fleet sector includes a large number of vessels between 30,000 and 49,999 DWT. This portion of the fleet represents over 50 percent of the total fleet. Tables 44 and 45 present data associated with the existing chemical fleet and with vessels on order. Table 44 shows the chemical fleet through 2004, and Table 45 provides comparison of the percentage of total deadweight tonnage for representative classes for 1985–2004 and 2009. Table 45 shows that 21.8 percent

of the chemical tankers on order in 2009 have design drafts of 43 feet or more, and 1.6 percent of chemical tankers on order have design drafts of 47 feet or more.

Consideration of "vessel-on-order" records, world port development trends, and the Panama Canal expansion represent indicators used for projecting future vessel use. Integral to estimating changes in vessel selections is the operational goal of minimizing vessel transportation cost. Minimization of transportation cost, given trade route constraints and commodity parcel needs, recognizably drives long-term vessel choices. Of the vessels on order, 1.6 percent of vessels have design drafts of 48 feet. Review of existing cargo loads suggests that the draft-constrained tonnage will likely consist of metallic salt exports, ammonia imports and acyclic hydrocarbon exports. Project benefits were calculated assuming that approximately 10 percent of future chemical imports and 15 percent of future chemical export tonnage would be transported in vessels with loaded drafts between 40 and 49 feet.

Table 44
World Chemical Product Fleet, Vessels Built between 1985 and 2004

| | Total | % of | Median Vessel Characteristics | | | | Year |
|---|---|---|---|---|---|---|---|
| DWT Range | DWT | DWT | DWT | LOA | Beam | Design Draft | Built |
| <10,000 | 2,793,389 | 9.9 | 5,780 | 338 | 54 | 21 | 1997 |
| 10,000 to 20,000 | 3,479,986 | 12.4 | 14,364 | 454 | 71 | 29 | 1999 |
| 20,000 to 30,000 | 1,593,037 | 5.7 | 25,415 | 557 | 84 | 34 | 1998 |
| 30,000 to 39,999 | 6,544,848 | 23.3 | 37,068 | 599 | 91 | 36 | 2001 |
| 40,000 to 49,999 | 11,246,740 | 4.0 | 45,632 | 599 | 106 | 40 | 2000 |
| 50,000 to 59,999 | 568,838 | 2.0 | 50,600 | 600 | 106 | 44 | 1987 |
| 60,000 to 69,999 | 129,976 | 0.5 | 64,988 | 750 | 106 | 43 | 2000 |
| 70,000 to 79,999 | 146,521 | 0.5 | 73,261 | 749 | 106 | 47 | 1996 |
| 80,000 to 102,000 | 1,620,338 | 5.8 | 83,987 | 750 | 106 | 53 | 1988 |
| Total | 28,123,673 | 100.0 | | | | | |

Source: LSR, 2006.

Table 45
Chemical Product Fleet

| Design Draft (feet) | Median DWT | Percentage of Total DWT | |
|---|---|---|---|
| | | Built 1985–2004 | On Order as of Jan 2009 |
| <36 | 13,000 | 36.1 | 34.1 |
| 36–38 | 38,500 | 23.6 | 18.6 |
| 39–40 | 46,000 | 24.2 | 17.7 |
| 41–42 | 47,000 | 6.6 | 6.2 |
| 43–44 | 50,000 | 3.5 | 21.8 |
| 45–46 | 85,000 | 0.9 | – |
| 47–49 | 95,000 | 5.1 | 1.6 |
| 50–51 | n/a | – | – |
| | Total | 100.0 | 100.0 |

Source: LRS, 2009.

## 3.8 GRAIN EXPORTS

Grain is exported from the Beaumont elevator located just below the Port of Beaumont main turning basin. Wheat presently composes 100 percent of Beaumont's grain exports for the most recent 5-year period and represented 5 percent of U.S. 2007 wheat exports. During earlier years, wheat represented 85 percent, sorghum 10 percent and corn 5 percent. Table 46 displays Beaumont's 2001–2007 grain export tonnage by grain type and loaded draft.

Table 46
Beaumont Bulk Grain Export
Distribution of Tonnage by Grain Type
and Loaded Vessel Draft

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|
| Bulk Grain Export Totals by Year (Short Tons) | | | | | | | |
| Total Exports | 831,000 | 835,000 | 1,125,000 | 1,329,000 | 1,080,639 | 1,214,010 | 1,632,000 |
| % by Grain Type | | | | | | | |
| Wheat | 79.0 | 88.8 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Corn | 6.5 | 8.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sorghum | 14.5 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| % by Loaded Draft (feet) | | | | | | | |
| ≤35 | 56.8 | 65.8 | 65.3 | 67.8 | 62.8 | 35.5 | 50.8 |
| 36–37 | 6.7 | 5.5 | 11.6 | 9.0 | 15.2 | 25.7 | 18.5 |
| 38–40 | 36.5 | 28.7 | 23.1 | 23.2 | 22.0 | 38.8 | 30.7 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USACE, Waterborne Commerce Database, 2001–2007.

Thirty percent of 2002–2007 grain export tonnage was shipped in vessels with design drafts over 40 feet. The maximum DWT presently used for grain exports is in the 60,000 to 75,000 DWT range, with 68 percent of 2006 exports. These vessels have design drafts between 42 and 43 feet. The large increase in the concentration of larger vessels since 2006 was due to exports to Iraq. For 2003–2007, the destination for the larger vessels primarily consisted of Egypt, Jordan, and Lebanon. Until the early 1990s, grain carriers in excess of 100,000 DWT used the SNWW. These larger vessels were associated with Eastern Europe grain shipments. The deeper-loaded vessels are nearly all associated with wheat shipments. Review of grain exports for other U.S. Gulf Coast ports with channel depths of 45 feet showed that bulk carriers transporting wheat exports are loaded to 45 feet.[30] The specific type of bulk carriers used for grain is "load-on/load off" or "LoLo" vessels. LoLo vessels are also used for SNWW steel slab, limestone, and wood product tonnage. The median year of construction for the range of vessels transporting grain from Beaumont is 1985, which is older than the median of 1998 associated with the world fleet. Review of the distribution of vessels on order and the port depths at receiving ports indicates that some transition in the average DWT range from the existing 60,000 to 75,000 DWT into the 80,000 to 94,000 DWT range is reasonable to expect. Table 47 displays the existing fleet of LoLo vessels in the world fleet; the table also displays LoLo vessels on order.

[30] USACE, unpublished data.

Table 47
LoLo Bulk Dry Cargo Carriers (World Fleet)

| | Vessels in Operation | | | | |
|---|---|---|---|---|---|
| DWT Range | Total DWT | Percent DWT | Median DWT | Design Draft (feet) | Year Built |
| <25,000 | 5,825,500 | 3 | 20,035 | 30 | 1996 |
| 25,000 to 44,000 | 31,009,518 | 14 | 32,755 | 34 | 1994 |
| 45,000 to 64,000 | 33,235,975 | 15 | 49,061 | 39 | 2000 |
| 65,000 to 79,000 | 58,832,687 | 27 | 73,445 | 45 | 1998 |
| 80,000 to 94,000 | 3,716,652 | 2 | 88,405 | 43 | 2000 |
| 95,000 to 106,999 | 414,221 | 0 | 105,712 | 50 | 2001 |
| 107,000 to 169,999 | 38,252,170 | 18 | 151,257 | 57 | 1994 |
| 170,000 to 260,000 | 45,324,613 | 21 | 172,964 | 58 | 2000 |
| Total | 216,611,336 | 100 | | | |

| | Vessels on Order | | | |
|---|---|---|---|---|
| DWT Range | Total DWT | Percent DWT | Median DWT | Design Draft (feet) |
| <25,000 | 775,191 | 1 | 18,500 | 28 |
| 25,000 to 44,000 | 4,430,571 | 8 | 34,525 | 34 |
| 45,000 to 64,000 | 11,825,398 | 21 | 54,500 | 41 |
| 65,000 to 79,000 | 9,044,747 | 16 | 75,750 | 46 |
| 80,000 to 94,000 | 9,382,833 | 17 | 82,788 | 47 |
| 95,000 to 106,999 | 815,150 | 1 | 100,000 | 44 |
| 170,000 to 199,999 | 18,990,990 | 34 | 177,015 | 59 |
| Total | 55,264,880 | 100 | | |

Source: LRS, 2006.

## 3.9 STEEL SLAB AND IRON ORE CARRIERS

For the period, 2002–2006, an average of 2.5 percent of U.S. iron ore and steel slab imports were transported through the SNWW ports. For the period 2002–2007, imports ranged from a low of 240 thousand short tons in 2007 and a high of 1,136 thousand short tons in 2005. The 2002–2006 average annual import volume of 783 thousand short tons is over 100 percent higher than 1990–1993 average levels. The decline in 2007 appears to be reflective of the U.S. market. It is noted that imports were unusually high in 2006 partially due to increased demand and higher prices paid in the U.S. market in comparison to foreign markets.[31] As a result, U.S. inventories increased in 2006. In 2007, import orders were slowed by the excessive inventory and foreign demand. It was emphasized in the *U.S. and International Market Outlook for 2007* that the origin of U.S. steel imports is evolving. It is noted that the shift in the origin of U.S. steel imports applies not only to simpler items like bars and rods but also to more-sophisticated products like oil country goods, cold-rolled coils, and hot-dip galvanized coils. Thus, in oil country goods the leader in 2006 was China; in cold-rolled coils the leaders were Brazil and China; in hot-dip coils India and China. The price of steel scrap dropped in 2007. Long-term expectations are that the market will rebound. Table 48 displays the 2005–2007 countries of origin for SNWW iron and steel imports. India is the seventh largest producer of steel in the world and supplied 26 percent of SNWW steel slab imports in 2007. Steel products are shipped from the Indian port of Dhamra on the eastern coast where channel deepening commenced in 2007. Dhamra will be the deepest port of India with a draught of 18 meters, which can accommodate super cape-size vessels up to 180,000 DWT. The master plan provides for 13 berths, capable of handling more than 83 million tons per annum of dry bulk, liquid bulk, breakbulk, and containerized cargo. The project is expected to be completed by March 2010.[32]

Presently, the most common carriers used on the SNWW for the transport of steel slab and iron ore are LoLo bulkers in the 45,000 to 53,000 DWT range, with a maximum vessel size of 78,000 DWT. Review of the Lloyd's/Fairplay Vessel Register (2003) showed that 23 percent of bulk carriers constructed over the past decade are in the 66,000 to 78,000 DWT range. As noted, this is the same vessel type that is used for grain; however, the specific vessels are different with each cargo having dedicated carriers. Examination of the foreign ports of call for 1998–2001 SNWW tonnage showed that an average of 8 percent of tonnage was transported through world ports with channel depths of 44 to 47 feet. Examination of 2005–2007 routings shows a similar distribution of foreign ports as in 1998–2001. Vessel usage and general indicators, such as depths at trading ports and the design drafts for new vessel orders, suggests that, in the short-term, a minimum of 10 percent of present iron ore movements would utilize channel depths over 40 feet. Expansion of the Panama Canal is expected to increase the percentage to 50 percent by the year 2014. Project benefits were calculated assuming that 10 percent of 2015–2020 tonnage and 50 percent of 2020–2069 would be transported in vessels with loaded drafts between 40 and 49 feet.

[31] Phelps, David, President, American Institute for International Steel, U.S. and International Market Outlook for 2007 and Trade Policy Update, presentation at the 5th International Steel Market and Trade Conference 2007 in Guangzhou, China, March 2007.
[32] http://www.dhamraport.com/default.asp.

Table 48
Percentage of SNWW Iron and Steel Product Imports by Country of Origin

| Country | 2005 | 2006 | 2007 |
|---|---|---|---|
| Argentina | 0.2 | – | – |
| Brazil | 11.3 | 16.0 | 0.2 |
| Colombia | 0.0 | 0.0 | – |
| Mexico | 52.2 | 43.8 | 17.0 |
| Venezuela | 3.0 | 2.8 | 25.1 |
| | | | |
| Denmark | – | – | 1.0 |
| Federal Republic Germany | – | – | 3.2 |
| Italy | 0.1 | – | – |
| Netherlands | 0.3 | – | 1.0 |
| Portugal | – | – | – |
| Poland | – | 0.1 | – |
| Russia | 7.5 | 7.1 | 17.7 |
| United Kingdom | 0.4 | 0.0 | 1.0 |
| | | | |
| China (Mainland) | 1.9 | 3.7 | 1.8 |
| Hong Kong | – | – | 1.0 |
| India | – | – | 26.0 |
| New Zealand | – | 0.5 | – |
| Thailand | – | – | 5.0 |
| | | | |
| Other (via crude oil tankers) | 23.1 | 26.2 | 0.0 |
| Total | 100.0 | 100.0 | 100.0 |
| Total Imports (short tons) | 1,138,000 | 826,000 | 240,000 |

Source: USACE, *Waterborne Commerce of the U.S.*, 2005–2007, detailed files; LRS, 2006.

## 3.10 LIMESTONE AND ROCK CARRIERS

SNWW aggregate tonnage primarily consists of imports of limestone, rock, and other raw building materials. For the period 2005–2007, 3 percent of U.S. limestone and rock imports were transported through the SNWW ports. Table 49 displays SNWW aggregate tonnage. Presently, the most common carriers used on the SNWW are in the 46,000 to 77,000 DWT range. Table 50 displays the fleet used for SNWW 2002–2007 aggregate imports. Presently nearly all tonnage is transported in vessels with design drafts over 40 feet. Current vessel usage and general indicators, such as depths at trading ports and the design drafts for new vessel orders, suggests that some 50 percent of iron ore movements would utilize channel depths over 40 feet due to the expansion of the Panama Canal. The shipments of clay and refractory materials are associated with vessels with loaded drafts over 37 feet and design drafts over 40 feet.

Table 49
SNWW Building Material Imports and Exports (1,000s of short tons)

| | Sand, Gravel, and Limestone Imports (Total Imports and Estimated Port Share) | | | Sulphur and Refractory Material Exports (Total Exports and Estimated Port Share ) | | | Estimated % of Combined Tonnage Transported in Vessels with Design Drafts ≥40 feet | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Total | Port Arthur | Beaumont | Total | Port Arthur | Beaumont | Sand and Gravel | Limestone | Sulphur and Refractory Materials |
| 1999 | 617 | 90 | 10 | 0 | 0 | 0 | 100 | 0 | 0 |
| 2000 | 495 | 36 | 64 | 13 | 0 | 100 | 99 | 60 | 0 |
| 2001 | 635 | 18 | 82 | 40 | 0 | 100 | 99 | 37 | 0 |
| 2002 | 1,117 | 20 | 80 | 16 | 12 | 88 | 99 | 78 | 0 |
| 2003 | 658 | 40 | 60 | 46 | 2 | 100 | 99 | 57 | 0 |
| 2004 | 642 | 35 | 65 | 104 | 28 | 72 | 99 | 100 | 0 |
| 2005 | 815 | 36 | 64 | 91 | 12 | 88 | 100 | 100 | 21 |
| 2006 | 816 | 44 | 56 | 261 | 18 | 82 | 99 | 100 | 0 |
| 2007 | 829 | 41 | 59 | 463 | 12 | 88 | 99 | 99 | 11 |

Source: USACE, *Waterborne Commerce of the U.S.*, 1999–2007.

Table 50
SNWW Aggregate Tonnage Fleet, 2002–2007

| | | | Vessel Characteristics | | | |
|---|---|---|---|---|---|---|
| Vessel DWT | Loaded Draft (feet) | Estimated % of 2002–2006 Imports | Length (feet) | Beam (feet) | Design Draft (feet) | Year Built |
| 46,606 | 33 | 11 | 615 | 106 | 37 | 1995 |
| 62,594 | 40 | 4 | 747 | 106 | 44 | 1982 |
| 67,044 | 35–40 | 54 | 753 | 106 | 43 | 1984 |
| 77,499 | 40 | 26 | 804 | 106 | 46 | 1991 |
| <40,000 | n/a | 5 | n/a | n/a | n/a | n/a |
| | Total | 100 | | | | |

Source: USACE, *Waterborne Commerce of the U.S.*, 2002–2007, detailed files.

## 3.11 WOOD PRODUCT CARRIERS

For 1998–2006, approximately 1 percent of U.S. wood product tonnage was transported through the SNWW ports. Wood products also represent 1 percent of the SNWW 1998–2006 foreign total. The largest wood product carriers used on the SNWW are in the 50,000 to 60,000 DWT range. The design drafts of these ships are right at 40 feet; and it was found that wood chip carriers, like container vessels, characteristically reach capacity in terms of volume before they reach their design drafts. Review of 2002–2006 data showed that the load patterns were the same as for 1998–2001. The nature of wood chip cargo suggests it is unlikely that the current fleet could be loaded to depths greater than 40 feet and, therefore, deepening benefits were not calculated for wood products. Discussion with industry representatives confirmed this. Additionally, review of the LRS showed that the maximum design draft

for wood chip carriers built between 1995 and the present is 39.4 feet. Analysis of the parcel sizes and 1995 to present construction and ships on order suggests that wood products are unlikely to realize benefits from channel depths over 40 feet in the near future. Analysis of 2002–2007 wood product movements and consultation with industry representatives confirmed these initial findings.

## 3.12 LIQUEFIED NATURAL GAS (LNG) FLEET

Discussion with industry representatives and review of the vessels on order revealed that LNG vessels with design drafts of 40 feet or more are being constructed. The existing vessel sizes and underkeel clearance requirements suggest that channel depths of 43 to 44 feet would be necessary. Table 51 displays the world LNG fleet, including vessels on order.

Table 51
World Liquefied Natural Gas Fleet

| Year Built | DWT Total | Percent of DWT | DWT | Length of Ship (feet) | Beam (feet) | Design Draft (feet) |
|---|---|---|---|---|---|---|
| Constructed Between 1980–2002 (Average Vessel Dimensions) | | | | | | |
| 1980–1990 | 1,742,877 | 25.6 | 69,715 | 910 | 142 | 38 |
| 1991–2002 | 5,064,932 | 74.4 | 67,532 | 889 | 144 | 37 |
| Total | 6,807,809 | 100.0 | | | | |
| Vessels Constructed After 2002 (Average Vessel Dimensions) | | | | | | |
| Design Draft Range (feet) | Total DWT | Percent of DWT | DWT | Length of Ship (feet) | Beam (feet) | Design Draft (feet) |
| 36.6 to 39.9 | 2,868,168 | 66.0 | 74,852 | 927 | 147 | 38 |
| 40.0 to 41.1 | 1,453,796 | 34.0 | 77,750 | 930 | 144 | 41 |
| Total | 4,321,964 | 100.0 | | | | |
| Vessels on Order 2007 (Average Vessel Dimensions) | | | | | | |
| 21 to 30 | 83,242 | 0.7 | 8,200 | 450 | 98 | 24 |
| 35 to 41 | 230,250 | 1.8 | 58,900 | 825 | 127 | 38 |
| 37 to 41 | 5,516,514 | 43.9 | 74,400 | 945 | 145 | 39 |
| 37 to 40 | 2,102,350 | 16.7 | 83,000 | 928 | 142 | 38 |
| 39 to 45 | 3,129,719 | 24.9 | 100,000 | 1,033 | 164 | 45 |
| 39 to 45 | 1,499,200 | 11.9 | 125,600 | 1,132 | 176 | 39 |
| Total | 12,561,275 | 100.0 | | | | |

# 4.0 COMMODITY AND FLEET FORECASTS

Commodity and fleet forecasts were prepared for crude petroleum and petroleum and chemical products, grain, iron and steel products, limestone and building materials, and LNG. The remaining oceangoing commodity groups, which were found either not to be transported in draft-constrained vessels at the current time or were of limited volumes, were analyzed in the aggregate. Estimation of total traffic was needed for the widening analysis and also provided critical input for the shore erosion effects evaluation performed by ERDC.

National forecast data and general indicators were assessed in relationship to the study area's historical commodity-specific tonnage flows for the purpose of evaluating the relationship between historical U.S. tonnage volumes and study area tonnage. The vessel fleet forecasts incorporate recent historical practices, which reflect continued and increased utilization of draft-constrained vessels under the without- and with-project futures.

The outputs of the commodity and fleet projections were based on forecasts published by Global Insight, USDOE's EIA *Annual Energy Outlook* (AEO2008) and (AEO2009); Global Insight, *The U.S. Economy, The 30-Year Focus*, First Quarter 2008 and Second Quarter 2009; USDA *Agricultural Baseline Projection Tables, USDA Baseline Projections Report to 2018*, February 2008 and February 2009; and from indices developed from historical trend data. The EIA forecasts extend through 2030. The Global Insight forecasts extend through 2035. The USDA forecasts extend through 2018.

The commodity forecasts presented in this document were initially prepared in 2008. The effect of 2009 EIA, Global Insight, and USDA 2009 forecast releases were evaluated and some changes were made to the SNWW projections based on the 2009 forecast releases. The effects of recent forecasts not incorporated into the base analysis are addressed in the sensitivity analysis.

## 4.1 REVIEW OF PETROLEUM FORECASTS

Table 52 presents the current range of U.S. crude petroleum import forecasts outlined in the AEO2008, AEO2009 and AEO2010. The forecasts presented include the AEO 2008 (January 2008), AEO2009 (March 2009), AEO2010 (May 2010) Global Insight, and Purvin and Gertz's. The AEO2010 data was received late in the report preparation process; therefore, discussion of it is not included in the text. The AEO2009 forecast shows U.S. crude oil imports declining at an annual rate of approximately –2.0 percent between 2007 and 2030. The AEO2009 forecast reflects the effect of the American Recovery and Reinvestment Act of 2009 in February 2009 and shows U.S. demand for liquid fuels growing by only 1 million BPD between 2007 and 2030 and shows no growth in oil consumption over the forecast period. Oil use is curbed due to the combined effects of a rebounding oil price, more-stringent corporate average fuel economy standards, and requirements for the increased use of renewable fuels. A key difference between the AEO and Global Insight forecasts is that the relative percentage crude oil and petroleum imports reflects higher volumes of products than the Global Insight forecast. Comparison of the relative distributions of U.S. and SNWW imports between crude oil and refined products shows that SNWW's

distribution reflects a significantly higher relative percentage of crude oil than products. Table 53 displays distributions of SNWW and U.S. relative percentages of crude petroleum versus refined products. Comparison of the SNWW and U.S. distributions shows that SNWW receives a significantly higher share of crude petroleum than the Nation as a whole. As a major refinery center, the SNWW distribution shown in Table 53 is expected to continue without- and with-project future conditions.

Table 52
U.S. Crude Oil Imports Comparative Projections
(Millions of Barrels Per Day)

| | AEO Reference | | | AEO 2010 Low Price | Purvin & Gertz | | | Global Insight | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | 2008 | 2009 | 2010 | | 2008 | 2009 | 2010 | 2008 | 2009 | 2010 |
| 2007 | 10.0 | 10.0 | 10.0 | 10.0 | n/a | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| 2015 | 10.2 | 8.1 | 8.9 | 10.1 | n/a | n/a | 11.8 | 12.0 | 11.1 | 9.7 |
| 2025 | 11.0 | 6.7 | 8.7 | 11.7 | n/a | 12.4 | 12.3 | 13.7 | 12.1 | 10.6 |
| 2030 | 11.9 | 7.0 | 8.7 | 12.7 | n/a | 12.7 | n/a | 14.5 | 12.5 | 11.7 |
| 2035 | n/a | n/a | 8.7 | 13.6 | n/a | n/a | n/a | n/a | 12.9 | n/a |

Source: USDOE, AEO2008, 2008, and 2010. Global Insight 2035 forecast value was obtained from non-published back-up data obtained from Global Insight.

Table 53
U.S. and SNWW Distribution of Crude Oil and Petroleum Imports
Relative Percentage of Crude Petroleum Imports Versus Refined Products

| | U.S. Import Distribution | | SNWW Import Distribution | |
|---|---|---|---|---|
| Year | Crude Oil | Petroleum Products | Crude Oil | Petroleum Products |
| 1990 | 74 | 26 | 90 | 10 |
| 1995 | 82 | 18 | 95 | 5 |
| 2000 | 79 | 21 | 93 | 7 |
| 2001 | 79 | 21 | 93 | 7 |
| 2002 | 79 | 21 | 92 | 8 |
| 2003 | 79 | 21 | 92 | 8 |
| 2004 | 76 | 24 | 94 | 6 |
| 2005 | 74 | 26 | 94 | 6 |
| 2006 | 74 | 26 | 94 | 6 |
| 2007 | 75 | 25 | 94 | 6 |

Source: Global Insight and USACE, *Waterborne Commerce of the U.S.*, 1990–2007.

Another major difference between AEO and Global Insight is that the EIA reference forecast reflects higher domestic crude oil production throughout the projection period. Additionally, the EIA shows domestic production increasing rapidly instead of gradually. As noted on the EIA website, their forecast not only shows higher domestic production, it also shows rapid increase in domestic production.

In spite of differences in the relative distribution of crude oil versus products, analysis of the national and regional crude petroleum import volumes showed a high degree of correlation between study area and U.S. tonnage levels. The high correlation rates suggested that application of U.S. forecast trends to the study area is generally appropriate (Section 2); evaluations also showed that SNWW's overall rate of growth is higher than for the U.S. and Gulf Coast (see Table 8). Continuation of historical trends suggests that SNWW crude petroleum imports would grow at higher rates than the region (PADD III) and the Nation. Refineries in PADD III provide significant product supply to both the East Coast and Midwest. For example, about 60 percent of all gasoline produced in PADD III refineries is moved to other regions for consumption. In 2008, nearly half of the gasoline consumed in the East Coast region (PADD I)–about 1.6 million BPD–was supplied from PADD III. PADD III refineries supplied about 18 percent or approximately 0.5 million BPD of gasoline consumed in the Midwest (PADD II). PADD III also supplies a small amount of gasoline to the West Coast region (PADD V), mainly Arizona. Most of the gasoline volume moved from PADD III to those regions travels by pipeline (80 percent by pipeline into PADD I, 90 percent into PADD II, and virtually all into PADD V).

The historical trendline and anticipated 2012 completion of the 325,000 barrel per day crude petroleum refinery capacity in Port Arthur suggests that downward growth rate reflected in the AEO2009 forecast does not characterize SNWW's future. The Port Arthur and Beaumont terminals transport 400,000 BPD of waterborne crude oil via pipelines to inland refineries including refineries in Texas, Louisiana, Oklahoma, Ohio, Arkansas, and Kentucky.[33] The SNWW refineries supply 15 percent of the product on Colonial's system and 13 percent of the product on Explorer's system (see Figure 10). SNWW's capacity represents 6 percent of the U.S. total. Specific capacity is 572,000 BPD for Port Arthur and 577,000 BPD for Beaumont. SNWW capacity levels for 2009 are presently 12 percent higher than in 2004, and 31 percent higher than in 1994. The Motiva expansion of 600,000 BPD will result in a 52 percent increase in SNWW refinery capacity from the current volume of 1,149,000 BPD to 1,749,000 BPD. The Motiva expansion will make it the largest refinery in the U.S. and one of the largest in the world.

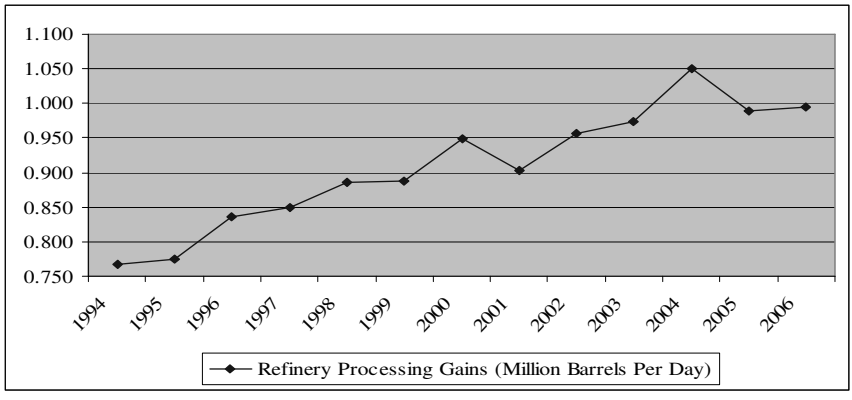
SNWW's crude oil imports were prepared using the Global Insight forecast shown in Table 52. The Global Insight's forecast reflects continuous increases in refinery processing gains through 2035. Refinery gains, which are measured by the differences in volumetric gains and are reflected by total outputs greater than input due to the processing of crude into products, were significant over the last 12 years (Figure 26). Review of the data presented on Figure 26 shows a maximum processing gain of 1.05 million BPD in 2004. Global Insight forecast of refinery gains exceed historical levels by approximately 5 percent in 2019 and 15 percent by 2030.

Other considerations in forecasting include the geographical source of imports or the use of oceangoing vessels versus pipeline, and, as noted, the share of conventional versus nonconventional liquids. Both the AEO and Global Insight project increases in nonconventional energy production and trade. SNWW

[33]Martin Associates. 2006. Economic Impacts of the Sabine-Neches Waterway and Economic Benefits of Maintenance Dredging of the Waterway. Martin Associates, Lancaster, Pennsylvania.

presently receives some conventional Canadian crude by vessel and through existing pipelines; however, annual volumes are low due to pipeline limitations and market logistics that favor other locations.

Figure 26
U.S. Refinery Processing Gains
1994–2006 Data




Source: Global Insight, 1994–2007.

Canadian crude oil has historically been consumed in five market areas that include Ontario, British Columbia, Washington State, U.S. Rocky Mountains, and U.S. Midwest.[34] The TransCanada Corporation is in the process obtaining permits for expansion to the Keystone Pipeline System. While the system that stretches from Alberta, Canada, to Cushing, Oklahoma, is completed, an additional extension from Cushing to the U.S. Gulf Coast is under evaluation. Financial commitments for the extensions to the Texas Gulf Coast are not expected before 2011.[35]

## 4.2 SNWW CRUDE PETROLEUM FORECAST APPLICATION

Identification of the specific range of import volumes was estimated by incorporating the forecast volumes into a regression equation using SNWW imports as a function of U.S. imports. Table 54 displays SNWW's regression equation application using the Global Insight forecast results shown in Table 52. The equation is based on 1990–2007 data. An R Square of 0.903 was produced from the equation. The t-value and F statistic for the equation are significant at statistical confidence levels exceeding 99.999 percent. The resulting application shown in Table 54 includes the application of one standard deviation from the mean. The mean values range from 86,639 thousand short tons in 2019 to 101,016 thousand short tons in 2035. The band associated with the standard deviation produces import estimates of plus and minus

[34] Canadian Association of Petroleum Producers, "Crude Oil Pipeline Forecast, Markets, and Pipeline Expansions, June 2007 Expansion Project Summary Report," February 2005, reference to the Muse, Stancil and Company Report.
[35] March 2008 RebObit News Article.

approximately 41 percent, which produces a 2035 minimum of 60,218 thousand and a maximum of 141,813 thousand sort tons, with 101,016 thousand representing the mean.

Table 54
1990–2007 Regression Equation Data for
SNWW Crude Oil Imports

| Component | Description of Data and Outputs |
|---|---|
| Dependent Variable | SNWW Crude Imports (1990–2007) |
| Independent Variable | U.S. Crude Imports |
| Adjusted R Square | 0.903 |
| No. of Observations | 17 |
| Degrees of Freedom | 1 |
| F Statistic | 150.02 |
| Significance of F statistic and t values | 0.9999 |

| | Regression Equation Data | | |
|---|---|---|---|
| | Base | Application of Standard Deviation | |
| | Output | Minus 1 | Plus 1 |
| Constant | –41677.6 | –57644.2 | –25711 |
| Standard Error of Y Estimate | 5456.66 | 5456.66 | 5456.66 |
| X Coefficient: U. S. Crude Oil Imports | 0.2009 | 0.1660 | 0.2360 |

| | | SNWW (1,000s of Short Tons) 2003–2007 | | | |
|---|---|---|---|---|---|
| Historical | U.S. | | Base | Application of Standard Deviation | |
| Year | Imports | Actual | Estimate | Minus 1 | Plus 1 |
| 2003 | 528,703 | 70,158 | 70,158 | 30,128 | 99,045 |
| 2004 | 553,337 | 69,875 | 69,875 | 34,218 | 104,858 |
| 2005 | 553,923 | 59,691 | 59,691 | 34,315 | 104,996 |
| 2006 | 553,489 | 57,615 | 57,615 | 34,243 | 104,894 |
| 2007 | 547,958 | 56,088 | 58,110 | 33,324 | 103,588 |

| | | SNWW Regression Based Forecast a/ | | |
|---|---|---|---|---|
| Forecast | U.S. | Base | Application of Standard Deviation | |
| Year | Imports | Estimate | Minus 1 | Plus 1 |
| 2015 | 614,522 | 81,835 | 44,375 | 119,295 |
| 2019 | 638,425 | 86,639 | 48,343 | 124,936 |
| 2030 | 689,959 | 96,997 | 56,899 | 137,096 |
| 2035 | 709,951 | 101,016 | 60,218 | 141,813 |

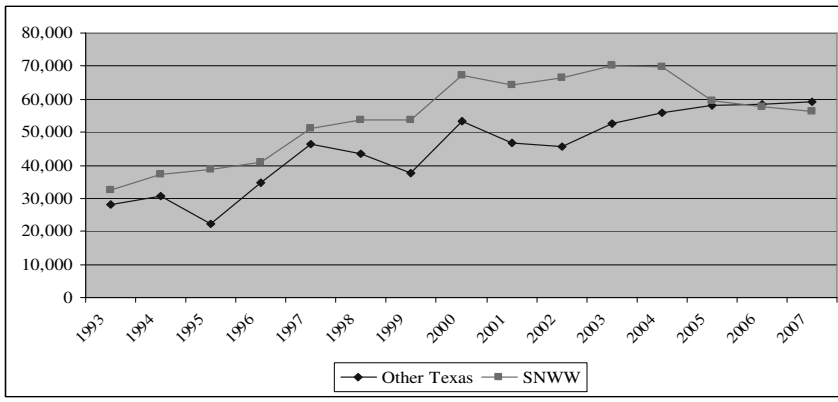
Source: USACE, *Waterborne Commerce of the U.S*. 2003–2007 and USDA, EIA, Presentation of Global Insight Forecast, USDOE/EIA-0383(2009), Table 20, Comparison of Liquids Projections.

a/ SNWW 2019 Imports = –41677.6 + (0.5456.66 * 638,425) with 638,425 short tons being U.S. imports in 2019.

The SNWW regression equation results presented in Table 54 reflect the inclusion of several variables that reduce future estimated volumes. One variable is the effect of Hurricane Rita. Declines in 2005–2007 imports are largely attributable to supply disruptions associated with Hurricane Rita, which devastated the SNWW region in September 2005. The hurricane surge resulting from Rita resulted in sand bars at the offshore Entrance Channel and silting of the Neches River Channel to Beaumont. Silting of the Neches River Channel severely limited transit of the upper reaches for several months and resulted in tonnage diversions to other ports due to loaded-draft limitations. The effect of shoals in the Entrance Channel and

silt deposits in the Neches River due to the hurricane surge had a particularly strong effect on crude petroleum traffic due to the use of large heavily loaded vessels. Comparison of SNWW crude petroleum tonnage with comparable ports is shown on Figure 27. The figure helps to illustrate the effect on short-term trends and resulting changes in the distribution of imports.

Figure 27
SNWW and Other Texas Ports
Crude Petroleum Imports (1,000s of short tons)




Source: USACE, *Waterborne Commerce of the U.S.*, 2005–2007, unpublished data.

Based on concerns from SNWW industry interests, the effect of excluding 2005–2007 data was examined. The results of excluding 2005–2007 produces a higher volume of long-term imports and reduces the standard error associated with the Y estimate (Table 55). The mean values range from 94,229 thousand short tons in 2019 to 110,765 thousand short tons in 2035. The band associated with the standard deviation produces import estimates of plus and minus approximately 21 percent.

Figure 28 displays the regression estimate associated with equations using SNWW imports as a function of U.S. imports. Figure 29 displays 1990–2004 actual imports and the statistical estimated, including the 95 percentile confidence interval. Excluding 2005–2007 from the regression based forecast helps to account for the short-term effects of Hurricane Rita; however, there are other variables that are likely to result in higher future import volumes than the 1990–2004 based regression equation would suggest. The key variable that cannot be measured accounted for in regression is refinery capacity expansions. Construction on the 325,000 BPD crude petroleum refinery capacity in Port Arthur is expected to be completed in the first quarter of 2012. This addition will result in a 28 percent increase in SNWW refinery capacity from the current volume of 1,149,000 BPD to 1,473,000 BPD.

Table 55
1990–2004 Regression Equation Data for
SNWW Crude Oil Imports

| Component | Description of Data and Outputs |
|---|---|
| Dependent Variable | SNWW Crude Imports (1990–2004) |
| Independent Variable | U.S. Crude Imports |
| Adjusted R Square | 0.9784 |
| No. of Observations | 15 |
| Degrees of Freedom | 1 |
| F Statistic | 633.52 |
| Significance of F statistic and t values | 0.9999 |

| | Regression Equation Data | | |
|---|---|---|---|
| | Base | Application of Standard Deviation | |
| | Output | Minus 1 | Plus 1 |
| Constant | –53,360.3 | –62,129.2 | –44,591.4 |
| Standard Error of Y Estimate | 2,691.57 | 2,691.57 | 2,691.57 |
| X Coefficient: U. S. Crude Oil Imports | 0.2312 | 0.2114 | 0.2510 |

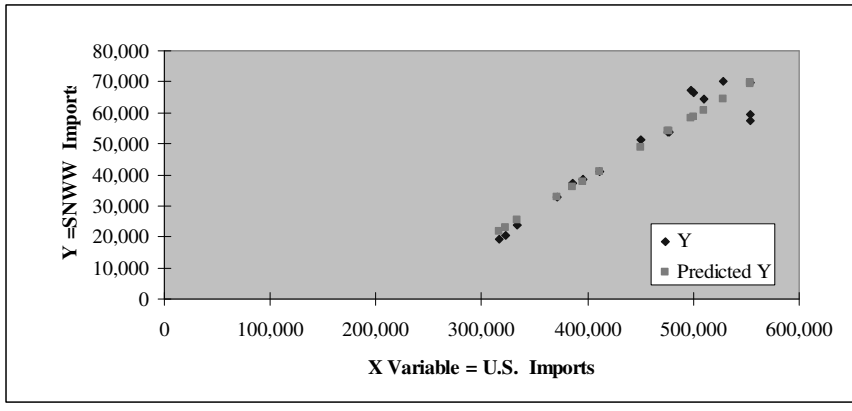
| | | SNWW (1,000s of Short Tons) 2003–2007 | | | |
|---|---|---|---|---|---|
| Historical | U.S. | | Base | Application of Standard Deviation | |
| Year | Imports | Actual | Estimate | Minus 1 | Plus 1 |
| 2003 | 528,703 | 70,158 | 68,864 | 49,605 | 88,124 |
| 2004 | 553,337 | 69,875 | 74,559 | 54,811 | 94,307 |
| 2005 | 553,923 | 59,691 | 74,694 | 54,934 | 94,454 |
| 2006 | 553,489 | 57,616 | 74,594 | 54,843 | 94,346 |
| 2007 | 547,958 | 56,088 | 73,315 | 53,674 | 92,957 |

| | | SNWW Regression Based Forecast a/ | | |
|---|---|---|---|---|
| Forecast | | | Application of Standard Deviation | |
| Year | U.S. Imports | Base Estimate | Minus 1 | Plus 1 |
| 2015 | 614,522 | 88,704 | 67,741 | 109,666 |
| 2019 | 638,425 | 94,229 | 72,793 | 115,666 |
| 2030 | 689,959 | 106,143 | 83,684 | 128,602 |
| 2035 | 709,951 | 110,765 | 87,909 | 133,621 |

Source: USACE, *Waterborne Commerce of the U.S.* 2003–2007 and USDOE, EIA, Presentation of Global Insight Forecast, USDOE/EIA-0383(2009), Table 20, Comparison of Liquids Projections.

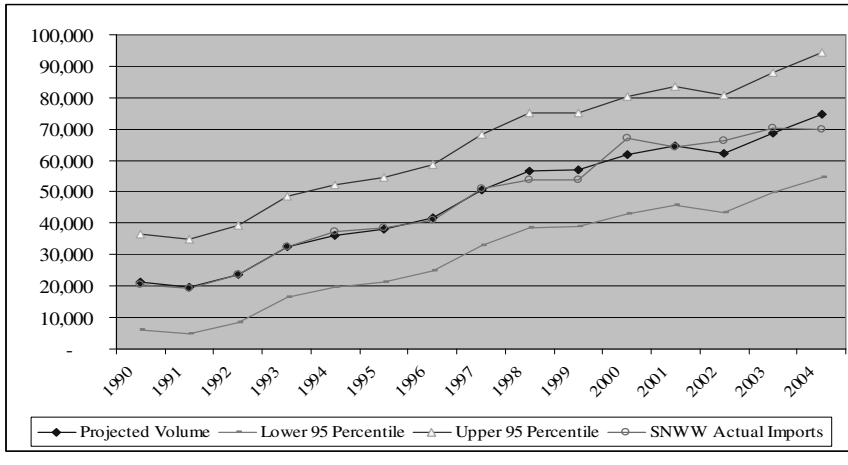
a/ SNWW 2019 Imports = –53360.3 + (0.2312 * 638,425) with 638,425 short tons being U.S. imports in 2019.

Figure 28
SNWW and U.S. Crude Petroleum Imports, 1990–2004
1,000s of Short Tons




Source: USACE, *Waterborne Commerce of the U.S.*, Part 2, 1990–2006 and EIA (2008).

Figure 29
SNWW Crude Petroleum Imports Projected and Actual Volumes (1,000s of Short Tons)



Other forecasting methods considered include trendline estimates. Table 56 presents the outputs of trendline estimates using 1980–2004 and 1990–2007 input data. As shown in Table 56, the mean values associated with the base are reasonable but the range of the 95 percentile confidence interval does not produce meaningful results.

Table 56
SNWW Trendline Equation Output
SNWW 1980–2007 and 1990–2007 Crude Oil Imports as a Function of Time

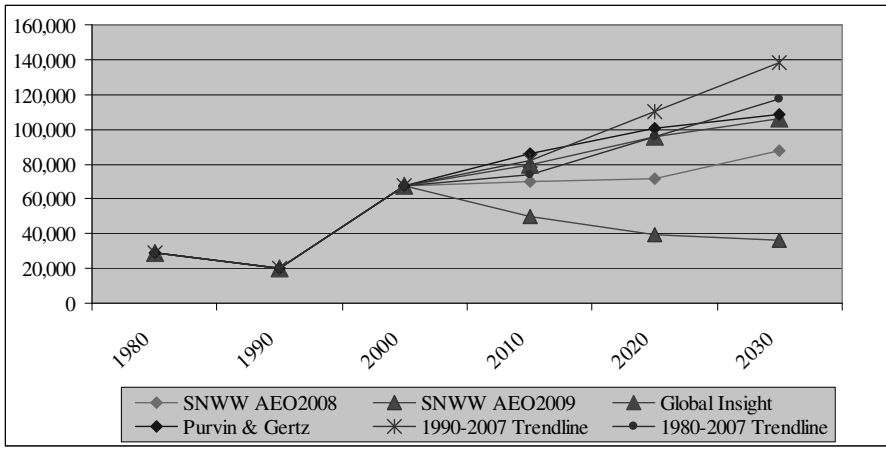
| Base Period | 1980–2007 | 1990–2007 |
|---|---|---|
| Adjusted R Square | 0.7903 | 0.7673 |
| No. Observations | 28 | 18 |
| Constant | –4,253,310 | –5,623,692 |
| X Coefficient Value | 2,153 | 2,839 |
| F Statistic | 102.81 | 57.061 |
| t-value | –10.14 | –7.484 |
| Standard Error of Y | 9,075.98 | 8,271.30 |
| 95 Percentile Confidence Level Associated with Constant and X Coefficient | | |
| Lower 95% Constant | –5,123,406 | –7,215,714 |
| Lower 95% X Coefficient Value | 1,717 | 2,041 |
| Upper 95% Constant | –3,383,213 | –4,031,670 |
| Upper 95% X Coefficient Value | 2,589 | 3,635 |

| | 1980–2007 Trendline SNWW Imports (1,000s of Short Ton) | | | 1990–2007 Trendline SNWW Imports (1,000s of Short Ton) | | |
|---|---|---|---|---|---|---|
| | Base | Standard Deviation Application | | Base | Standard Deviation Application | |
| Year | Estimate | Minus 1 | Plus 1 | Estimate | Minus 1 | Plus 1 |
| 2003 | 59,220 | –1,685,113 | 1,803,553 | 61,931 | –3,125,692 | 3,249,555 |
| 2004 | 61,373 | –1,683,397 | 1,806,142 | 64,770 | –3,123,650 | 3,253,190 |
| 2005 | 63,526 | –1,681,680 | 1,808,732 | 67,609 | –3,121,608 | 3,256,825 |
| 2006 | 65,679 | –1,679,963 | 1,811,321 | 70,447 | –3,119,566 | 3,260,461 |
| 2007 | 67,832 | –1,678,247 | 1,813,911 | 73,286 | –3,117,524 | 3,264,096 |
| 2015 | 85,056 | –1,664,514 | 1,834,627 | 95,994 | –3,101,189 | 3,293,177 |
| 2019 | 93,668 | –1,657,648 | 1,844,985 | 107,348 | –3,093,021 | 3,307,718 |
| 2030 | 117,352 | –1,638,766 | 1,873,469 | 138,572 | –3,070,560 | 3,347,704 |

Source: USACE, *Waterborne Commerce of the U.S.*, Part 2, 1980–2007.

Figure 30 displays comparison of the AEO2008, AEO2009, Global Insight, Purvin and Gertz, and 1980- and 1990–2007 trendline SNWW projection estimates. Comparison of the slopes associated with the SNWW's 1980–2000 base data illustrates higher historical rate of growth for most years. The presentation shows that application of the AEO2009 forecast produces declining imports for 2010–2030. The other forecasts presented on Figure 25 show a range of increasing import volumes. SNWW high growth between 1990 and 2004 strongly affects SNWW's future trendline. The Global Insight import estimates shown on Figure 30 correspond to the regression outputs shown in Table 55; these volumes were used for the base case. Sensitivity analyses were performed based on the AEO2009 forecast.

Figure 30
SNWW Crude Petroleum Import Forecast Comparisons




Source: USACE, *Waterborne Commerce of the U.S.*, Part 2, 1980–2006, Global Insight (2008), and EIA (2008).

Additional equations were calculated based on the inclusion of year in combination with the AEO2008, AEO2009, Global Insight, and Purvin and Gertz import forecasts. Those equations produced adjusted R squared values in the 85 to 90 percent range; however, they exhibited higher ranges of variances than the trendline output shown in Table 55. Other variables evaluated included world petroleum production. These variables performed poorly individually and in combination with U.S. imports and refinery capacity variables. It was concluded that U.S. crude oil imports by itself performed better statistically than any other single variable or combination of variables. Table 57 presents the SNWW crude petroleum import forecast.

Table 57
SNWW Crude Oil Imports, 2002/2004 to 2069
(1,000s of Short Tons)

| Trade Route | 2002–2004 Average | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| | | | Beaumont | | | | |
| Canada | 1,110 | 1,764 | 2,257 | 2,436 | 2,485 | 2,536 | 2,587 |
| Mexico | 15,034 | 8,057 | 8,961 | 9,514 | 9,708 | 9,905 | 10,105 |
| Central and South America | 7,556 | 12,963 | 14,416 | 15,307 | 15,619 | 15,937 | 16,258 |
| Western South America | 123 | 683 | 762 | 808 | 822 | 839 | 878 |
| Europe and Africa | 8,862 | 30,253 | 33,741 | 35,779 | 36,436 | 37,156 | 38,887 |
| Middle East | 25,782 | 28,305 | 31,569 | 33,476 | 34,090 | 34,764 | 36,383 |
| Total | 58,467 | 81,980 | 91,463 | 97,152 | 99,136 | 101,149 | 103,189 |
| | | | Port Arthur | | | | |
| Canada | 2 | 136 | 158 | 168 | 172 | 175 | 179 |
| Mexico | 8,348 | 1,217 | 1,357 | 1,441 | 1,471 | 1,501 | 1,531 |
| Central and South America | 362 | 1,955 | 2,179 | 2,311 | 2,353 | 2,400 | 2,513 |
| Western South America | 95 | 103 | 115 | 122 | 125 | 127 | 130 |
| Europe and Africa | 474 | 4,565 | 5,091 | 5,407 | 5,518 | 5,630 | 5,743 |
| Middle East | 1,057 | 4,271 | 4,763 | 5,059 | 5,163 | 5,267 | 5,374 |
| Total | 10,338 | 12,248 | 13,663 | 14,509 | 14,800 | 15,100 | 15,469 |
| | | | SNWW Total Crude Petroleum Imports | | | | |
| Canada | 1,112 | 1,838 | 2,086 | 2,377 | 2,623 | 2,728 | 179 |
| Mexico | 23,382 | 9,281 | 10,351 | 10,978 | 11,183 | 11,404 | 11,896 |
| Central and South America | 7,918 | 15,715 | 17,525 | 18,584 | 18,925 | 19,299 | 20,196 |
| Western South America | 218 | 785 | 874 | 928 | 947 | 966 | 986 |
| Europe and Africa | 9,336 | 34,818 | 38,832 | 41,187 | 41,954 | 42,786 | 44,630 |
| Middle East | 26,839 | 32,576 | 36,332 | 38,535 | 39,253 | 40,031 | 41,757 |
| Total | 68,587 | 94,229 | 105,126 | 111,661 | 113,937 | 116,248 | 118,659 |
| Total Tonnage Used for the Benefit Calculations | | 89,052 | 99,282 | 105,139 | 106,899 | 108,967 | 116,347 |

## 4.3 PETROLEUM PRODUCT IMPORTS

Forecast of SNWW petroleum product imports and exports is based on analysis of regional data and national trends. Large increases for U.S. imports of gasoline and distillate occurred over the last 16 years, with the SNWW generally experiencing comparable or greater increases. For instance, SNWW 2004–2006 average distillate import volume of 1,668,000 short tons is 1800 higher than 1990–1992 levels. SNWW distillate imports presently make up 3.1 percent of the U.S. distillate import total. SNWW gasoline imports averaged 11,000 short tons for 1990–1992, with the 2004–2006 average increased to 1,696,000 short tons. Table 58 displays U.S. and SNWW 1994/1996 and 2004/2006 average import volumes by major commodity group. Inclusion of 2007 data reduces SNWW's most recent 3-year average to 4,202 thousand short tons from the 2004–2006 average of 5,057 thousand short tons shown in Table 58. In spite of downturns in 2007, SNWW experienced significant overall increases in gasoline and distillate imports (see Table 13). Inclusion of 2007 data reduces the 2004–2006 U.S. average by approximately 1 percent.

Table 58
U.S. and SNWW Petroleum Product Imports
1994/1996 and 2004/2006 Averages
1,000s of Short Tons

| | U.S. Petroleum Product Imports | | | SNWW Petroleum Product Imports | | |
|---|---|---|---|---|---|---|
| Product | 1994–1996 | 2004–2006 | Average Annual Growth (%) | 1994–1996 | 2004–2006 | Average Annual Growth (%) |
| Gasoline | 15,459 | 59,343 | 14.4 | 72 | 1,696 | 37.2 |
| Kerosene | 4,120 | 1,657 | –8.7 | 0 | 0 | – |
| Naphtha | 12,445 | 7,912 | –4.4 | 203 | 581 | 11.1 |
| Distillate Fuel Oil | 14,188 | 53,408 | 14.2 | 127 | 1,668 | 29.4 |
| Residual Fuel Oil | 30,025 | 12,478 | –8.4 | 70 | 628 | 24.5 |
| Lube Oil | 9,453 | 3,776 | –8.8 | 764 | 247 | –10.7 |
| Petroleum Coke | 1,935 | 5,127 | 10.2 | 179 | 235 | 2.8 |
| LNG | 4,212 | 19,125 | 16.3 | 126 | 3 | –31.2 |
| Other | – | – | – | 4 | 0 | – |
| Total | 91,836 | 162,828 | 5.9 | 1,544 | 5,057 | 12.6 |

Source: USACE, *Waterborne Commerce of the U.S.*, Parts 2 and 5, 1990–2006.

While SNWW 2002–2007 product imports are at historical highs, overall U.S. product imports are projected to decline from 2010–2030. Table 59 shows comparison of the AEO2008 projections with Global Insight's forecast. The Global Insight forecast shows product imports increasing after 2030.

Table 59
Comparison of AEO2008 and Global Insight Forecasts
U.S. Net Petroleum Product Imports
(1,000s of Barrels Per Day)

| Year | U.S. Net Petroleum Product Imports 2003–2007 | |
|---|---|---|
| 2003 | 2,599 | |
| 2004 | 3,137 | |
| 2005 | 3,588 | |
| 2006 | 3,589 | |
| 2007 | 3,422 | |
| | U.S. Net Petroleum Product Imports 2010–2035 | |
| | Global Insight | AEO2009 |
| 2010 | 2,682.1 | 3,106.2 |
| 2015 | 2,356.5 | 2,585.6 |
| 2019 | 2,114.4 | 2,367.5 |
| 2020 | 1,869.6 | 2,103.2 |
| 2025 | 2,201.2 | 1,946.9 |
| 2029 | 2,321.8 | 2,213.4 |
| 2030 | 2,321.8 | 2,213.4 |
| 2034 | 3,074.6 | n/a |
| 2035 | 3,300.0 | n/a |
| Average Annual Growth Rates | | |
| 2003/2007 to 2030 | –1.3% | –1.5% |
| 2003/2007 to 2035 | 0.03% | n/a |

Source: EIA/Annual Energy Outlook (AEO2009), March 2009 and Global Insight, October 2007.

## 4.4 FUEL OIL IMPORTS

Comparison of the national and regional fuel oil volumes shows some correlation between study area and U.S. product imports. While total product volumes are correlated with the U.S. levels, the specific correlations with SNWW's distillate and residual fuel oils are weaker. Regional growth for distillate and residual fuel is considerably higher than the U.S. rates. While the EIA notes in earlier publications that structural shifts occurred over the last few decades in the mix of products and that residual fuel oil imports are projected to decline and be replaced by unfinished gasoline and gasoline blending components, analyses conducted for the current SNWW waterway study show that PADD III residual fuel imports have continued to increase. Table 60 presents SNWW 1990–2006 residual and distillate fuel imports and the region's respective shares. Current indications suggest that PADD III and SNWW waterborne imports of distillate, which is a light product, will increase some in the future.

Table 60
Comparison of SNWW and Regional and National Totals
Petroleum Product Imports
(1,000s of short tons)

| Year | SNWW Distillate Imports | U.S. Distillate Imports | SNWW Distillate % of U.S. | SNWW Residual Imports | U.S. Residual Imports | SNWW Residual % of U.S. |
|---|---|---|---|---|---|---|
| 1990 | 74 | 13,644 | 0.5 | 1,035 | 41,502 | 2.5 |
| 1995 | 12 | 12,915 | 0.1 | 72 | 25,914 | 0.3 |
| 1998 | 102 | 23,291 | 0.4 | 57 | 35,327 | 0.2 |
| 1999 | 230 | 25,781 | 0.9 | 49 | 35,229 | 0.1 |
| 2000 | 1,047 | 21,111 | 5.0 | 319 | 40,361 | 0.8 |
| 2001 | 572 | 20,589 | 2.8 | 25 | 40,891 | 0.1 |
| 2002 | 566 | 19,936 | 2.8 | 541 | 35,411 | 1.5 |
| 2003 | 1,337 | 29,115 | 4.6 | 56 | 31,330 | 0.2 |
| 2004 | 2,008 | 53,876 | 3.7 | 728 | 13,955 | 5.2 |
| 2005 | 1,728 | 52,679 | 3.3 | 804 | 13,757 | 5.8 |
| 2006 | 1,268 | 53,670 | 2.4 | 351 | 9,723 | 3.6 |
| 2007 | 1,872 | 55,627 | 3.4 | 355 | 10,771 | 3.3 |

Source: USACE, *Waterborne Commerce of the U.S.*, Parts 2 and 5, 1990–2007.

Figure 31 shows total U.S. distillate imports for 1990–2007, and Figure 32 presents a comparison of U.S. waterborne distillate imports with SNWW volumes. Comparisons of U.S. and SNWW residual fuel oil imports are shown on figures 33 and 34. Figure 31 includes waterborne and land route imports. As noted, Table 60 is limited to waterborne movements, and does not include Canadian products transported by pipeline, rail, or truck.[36] Overall, analyses of the EIA databases showed that approximately 16 percent of 2004–2006 U.S. product imports are from Canada.

[36] Unless otherwise noted, tables and figures only include waterborne traffic.

Figure 31
U.S. Imports of Distillate Fuel
Waterborne and Land Routes, 1990–2007

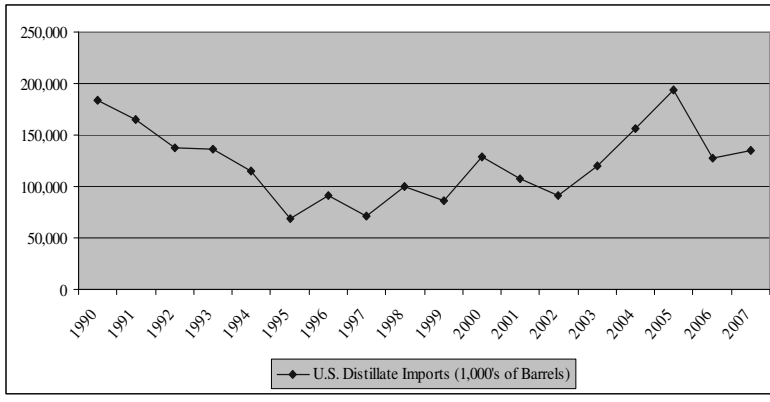



Figure 32
U.S. and SNWW Distillate Fuel Imports, 1990–2007 (Waterborne Routes Only)

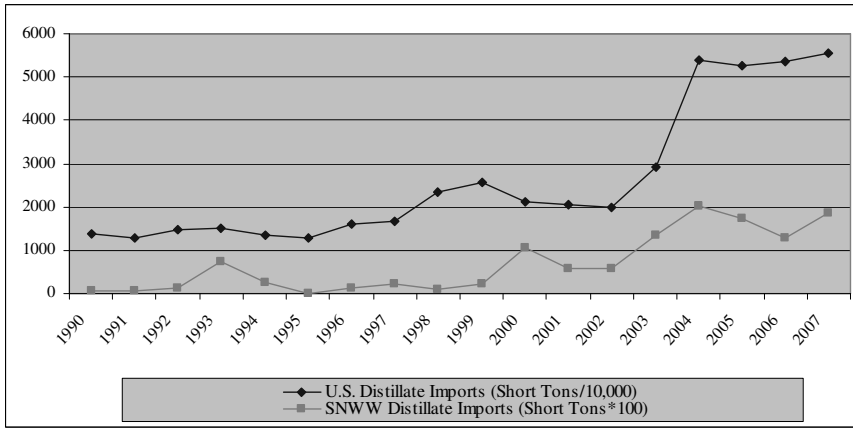


Figure 33
U.S. Imports of Residual Fuel,
Waterborne and Land Routes 1990–2007

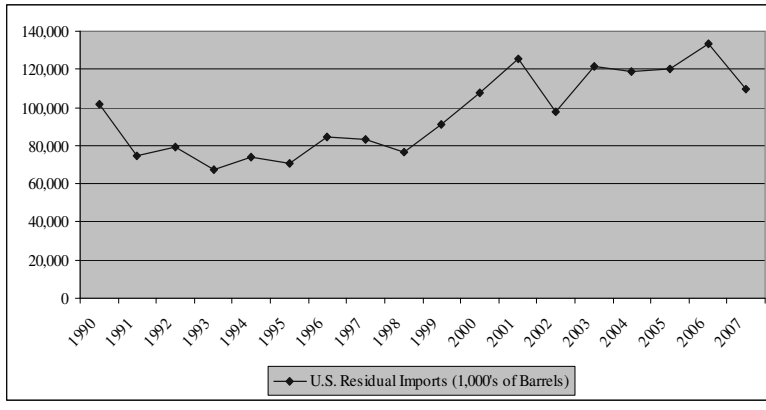
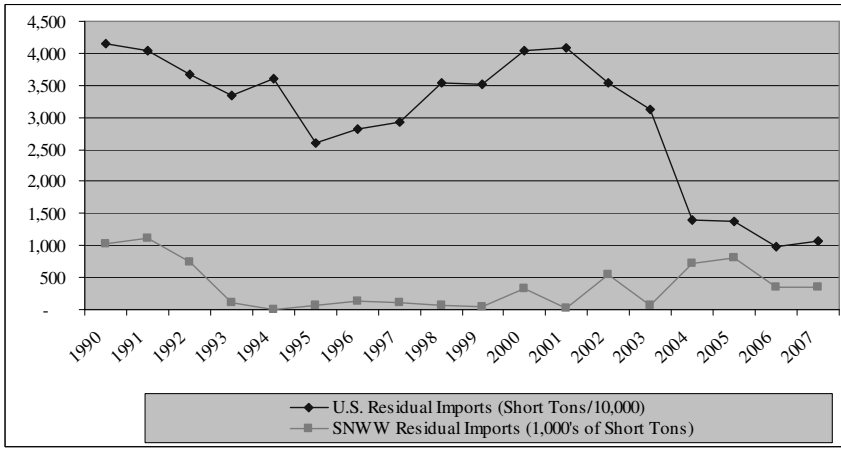



Figure 34
U.S. and SNWW Residual Fuel Imports 1990–2007 (Waterborne Routes Only)



The percentage of U.S. petroleum products imported from Canada increased by 74 percent from 1994/1996 to 2004/2006. The EIA shows Canadian production of conventional fuel declining relative to its oil sand production. Historically, imports of products from Canada to the SNWW ports are low due to the relatively longer distances compared to other markets in the Midwest and the East Coast. Expectations about expansion of Canadian crude and products to the Gulf Coast are uncertain, but recognizably could significantly affect SNWW's tonnage forecast. PADD III imports of Canadian petroleum products decreased by 8 percent over the same period.

The AEO2008 is forecasting that 2006–2030 imports of "blending components" decrease by –1.1 percent. Blending components include oxygenates, but consist mainly of products that could be classified as finished gasoline in other jurisdictions or products that require little additional blending to be classified as finished gasoline. For purposes of the waterborne commerce classification, blending components are classified as gasoline. Distillate is contained in the EIA classification of "unfinished oils." Unfinished or light oils are produced by partial refining of crude oil and include naphtha and lighter oils, kerosene and light gas oils, heavy gas oils, and residuum. Based on direct application of AEO and Global Insight anticipated trends, residual SNWW imports could decline; however, due to its use as an input in the refining process and for the production of specialized products, anticipated regional declines, if any, will be less than for the Nation. At the same time it is recognized that petroleum products contribute to a significantly smaller percentage of total petroleum imports (see Table 53) Comparison of 2002–2007 U.S. and PADD III residual fuel imports shown in Table 61 illustrates that while both U.S. and regional imports grew in 2007, regional growth was considerably higher. The presentation shows that PADD III residual fuel imports increased at significantly higher rates than the U.S. and East Coast rates. The East Coast is contained in PADD II and is presented here to illustrate its large market share and its weighted effect on national averages.

Light products and unfinished oils, including gasoline, naphtha, distillate, and, liquefied natural gas, are projected to increase at higher rates than heavy products. The EIA definition of unfinished oils includes light products. While imports of heavy products such as residual fuel oil are projected to decline and be replaced by unfinished gasoline and gasoline blending components, the market for residual may remain relatively high for SNWW and other Texas refinery centers that process heavy, or high-sulfur, crude petroleum. Texas Gulf Coast oil company transportation analysts verified that an increase in refined product imports would be necessary to meet processing needs and associated demand with growing imports for both light and heavy products. The Gulf Coast imports a significant amount of feedstock to support its role as the main U.S. refining and petrochemical center. The AEO forecast shows low growth for unfinished product imports, with an average annual growth rate of 0.1 percent from 2006 to 2030. Again, expectations are for slightly higher regional growth of unfinished products imports. An additional item worth noting is that the current U.S. volume of 0.69 million BPD represents an estimated 41 percent increase of the 2004 volume and, therefore, provides a significantly higher base level for the forecast application.

Table 61
U.S. Residual Fuel Imports, 2002–2007
1,000s of Barrels

| Year | Total U.S. Imports of Residual Fuel Oil Imports | U.S. Imports of Residual Fuel Oil with Less than 0.31% Sulfur | U.S. Imports of Residual Fuel Oil with 0.31 to 1.00% Sulfur | U.S. Imports of Residual Fuel Oil with Greater than 1.00% Sulfur |
|---|---|---|---|---|
| 2002 | 90,896 | 15,617 | 19,135 | 56,144 |
| 2003 | 119,496 | 18,174 | 36,429 | 64,893 |
| 2004 | 156,024 | 32,563 | 51,347 | 72,114 |
| 2005 | 193,294 | 33,824 | 63,872 | 95,598 |
| 2006 | 127,761 | 11,541 | 28,740 | 87,480 |
| 2007 | 135,545 | 16,700 | 32,642 | 86,203 |
| AAG a/ | 8.3% | 1.4% | 11.3% | 9.0% |
| PADD II (U.S. East Coast) | | | | |
| 2002 | 70,422 | 12,646 | 17,514 | 40,262 |
| 2003 | 95,382 | 14,658 | 30,682 | 50,042 |
| 2004 | 122,133 | 24,605 | 42,943 | 54,585 |
| 2005 | 147,101 | 28,365 | 48,879 | 69,857 |
| 2006 | 88,161 | 6,275 | 21,403 | 60,483 |
| 2007 | 77,974 | 11,986 | 14,645 | 51,343 |
| AAG a/ | 2.1% | -1.1% | -3.5% | 5.0% |
| PADD III Imports (U.S. Gulf Coast) | | | | |
| 2002 | 6,717 | 1,664 | 901 | 4,152 |
| 2003 | 9,673 | 1,775 | 3,702 | 4,196 |
| 2004 | 19,526 | 5,414 | 6,352 | 7,760 |
| 2005 | 28,489 | 2,870 | 12,627 | 12,992 |
| 2006 | 20,452 | 2,183 | 5,002 | 13,267 |
| 2007 | 42,486 | 4,227 | 15,038 | 23,221 |
| AAG a/ | 44.6% | 20.5% | 75.6% | 41.1% |

Source: Compiled from the EIA web data. 2008.
a/ Average annual growth rate (AAG).

Comparison of 2002–2007 U.S. distillate imports with PADD volumes show that while both U.S. and regional imports grew in 2007, growth for the U.S. Gulf Coast, as represented by PADD III, was considerably higher. Again, the variance in regional growth rates can be seen based on the data presented in Table 62. The presentation shows that distillate imports for PADD III increased relative to U.S. and East Coast rates.

SNWW fuel oil import forecasts are based on the assumption that the region will maintain its recent historical share of the U.S. market with imports increasing. Forecasts were prepared for distillate, residual

and gasoline imports. As shown in Table 62, the U.S. 2002–2007 average annual growth rate of 2.4 percent compares to the PADD III recent historical rate of 71.6 percent.

Table 62
U.S. Distillate Fuel Imports, 2002–2007
1,000s of Barrels

| Year | Total U.S. Imports Distillate Fuel Oil Imports | U.S. Imports of Distillate Fuel Oil with Less Than 500 ppm Sulfur a/ | U.S. Imports of Distillate Fuel Oil with Greater Than 500 ppm Sulfur a/ |
|---|---|---|---|
| 2002 | 97,603 | 38,945 | 58,658 |
| 2003 | 121,672 | 49,400 | 72,272 |
| 2004 | 119,118 | 54,266 | 64,852 |
| 2005 | 120,009 | 56,793 | 63,216 |
| 2006 | 133,126 | 68,847 | 64,279 |
| 2007 | 109,875 | 67,313 | 42,562 |
| AAG | 2.4% | 11.6% | -6.2% |
| | | PADD II (U.S. East Coast) | |
| 2002 | 90,092 | 32,387 | 57,705 |
| 2003 | 112,903 | 42,115 | 70,788 |
| 2004 | 102,512 | 41,464 | 61,048 |
| 2005 | 106,151 | 45,981 | 60,759 |
| 2006 | 109,232 | 50,320 | 58,912 |
| 2007 | 84,539 | 47,933 | 35,606 |
| AAG | –1.3% | 8.2% | –9.2% |
| | | PADD III Imports (U.S. Gulf Coast) | |
| 2002 | 594 | 490 | 104 |
| 2003 | 924 | 332 | 592 |
| 2004 | 4,043 | 2,045 | 1,998 |
| 2005 | 4,130 | 3,484 | 646 |
| 2006 | 6,672 | 4,549 | 2,023 |
| 2007 | 8,848 | 2,866 | 5,982 |
| AAG | 71.6% | 42.4% | 124.9% |

Source: compiled from the EIA web data. 2008.
a/ Parts per million (ppm).

Table 63 displays SNWW distillate fuel oil import forecast. Comparison of SNWW 1994–1996 and 2004–2006 rates with those for the Nation showed that the region historically experienced higher growth rates than the Nation. A 1 percent growth rate was used for 2019–2069. While recognizably subject to uncertainty, the SNWW increases represent a new market, and short-term higher growth is anticipated. The effects of this uncertainty were evaluated in the sensitivity section of the Final Feasibility Report and are discussed in the risk section of this report. Figure 35 shows the SNWW forecast applications.

SNWW's low growth scenario assumes that regional distillate import growth will be comparable to the U.S. import rate. The scenario used for the benefit calculations was prepared using the expectation that the average annual growth rate for SNWW distillate imports would increase at approximately 1 percent annually through 2069. This forecast is included in the third column in Table 63.

Table 63
SNWW 2004/2006 to 2069 Distillate Fuel Oil Imports
(1,000s of Short Tons)

| Year | Base Line Trendline | 1% Growth Rate | Low Growth Sensitivity |
|---|---|---|---|
| 2004–2006 | 1,668 | 1,668 | 1,668 |
| 2006 | 1,268 | 1,268 | 1,268 |
| 2007 | 1,872 | 1,872 | 1,872 |
| 2010 | 1,878 | 1,668 | 1,227 |
| 2015 | 2,486 | 1,753 | 1,235 |
| 2019 | 3,022 | 1,896 | 1,188 |
| 2020 | 3,095 | 1,918 | 1,178 |
| 2025 | 3,484 | 2,036 | 1,140 |
| 2029 | 3,831 | 2,136 | 1,254 |
| 2030 | 3,923 | 2,240 | 1,289 |
| 2039 | 4,973 | 2,524 | 1,289 |
| 2049 | 6,304 | 2,844 | 1,289 |
| 2059 | 6,963 | 3,204 | 1,289 |
| 2069 | 7,692 | 3,610 | 1,289 |
| 2004/2006–2019 | 4.3% | 0.9% | –2.4% |
| 2004/20006–2069 | 2.4% | 1.2% | –0.4% |

Figure 35
SNWW Distillate Imports 2000–2030
(1,000s of Short Tons)
Comparison of AEO2008 U.S. Forecast and SNWW Applications

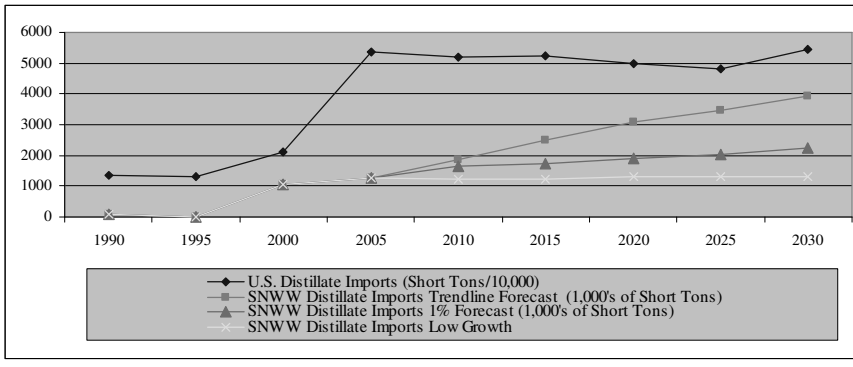



Table 64 displays SNWW residual fuel oil import forecast. Due to uncertainty associated with residual imports, SNWW residual fuel import forecasts were assumed to grow at 1 percent annually between 2004/06 and 2069. While specific residual fuel import forecasts are not published by the EIA or Global Insight, Global Insight publishes a residual and distillate demand forecast. The growth rates associated with Global Insight's demand forecasts were considered, along with SNWW distillate and residual import tonnage, in estimating future imports. Table 65 summarizes Global Insight's residual and distillate fuel demand forecasts.

Table 64
SNWW 2004/2006 to 2069 Residual Fuel Oil Import Forecast
(1,000s of Short Tons)

| Year | Base Line | No Growth Sensitivity |
|---|---|---|
| 2004–2006 | 628 | 628 |
| 2010 | 660 | 628 |
| 2015 | 693 | 628 |
| 2019 | 664 | 628 |
| 2020 | 672 | 628 |
| 2025 | 714 | 628 |
| 2029 | 750 | 628 |
| 2030 | 760 | 628 |
| 2038 | 838 | 628 |
| 2039 | 848 | 628 |
| 2049 | 958 | 628 |
| 2059 | 1,083 | 628 |
| 2069 | 1,223 | 628 |
| 2004/2006–2019 | 0.4% | 0.0% |
| 2004/2006–2069 | 1.0% | 0.0% |

Table 65
Global Insight U.S. Residual and Distillate Fuel Oil Import Demand Forecasts
(1,000s barrels per day)

| | Residual Fuel Oil | | | Distillate Fuel Oil | | |
|---|---|---|---|---|---|---|
| Year | Industrial | Commercial | Power Generation | Industrial | Commercial | Power Generation |
| 2000 | 13.29 | 0.00 | 8.28 | 245.27 | 40.61 | 36.81 |
| 2004 | 21.93 | 0.39 | 32.75 | 224.62 | 20.77 | 1.9 |
| 2005 | 40.93 | 0.34 | 16.2 | 235.31 | 25.98 | 5.6 |
| 2006 | 39.91 | 0.33 | 2.81 | 237.54 | 24.71 | 3.91 |
| 2010 | 40.84 | 0.34 | 9.48 | 242.1 | 25.58 | 13.09 |
| 2015 | 41.44 | 0.34 | 8.82 | 247.41 | 25.37 | 12.19 |
| 2020 | 42.17 | 0.33 | 8.19 | 251.95 | 25.14 | 11.31 |
| 2025 | 42.36 | 0.33 | 8.03 | 253.1 | 25.14 | 11.09 |
| 2030 | 43.30 | 0.33 | 7.25 | 258.92 | 25.21 | 10.02 |
| 2004/2006 to 2030 Average Annual Growth Rates | | | | | | |
| | 0.9% | –0.3% | –3.4% | 0.4% | 0.2% | 4.0% |

Source: Global Insight, *The U.S. Economy, The 30-Year Focus*, First Quarter 2008.

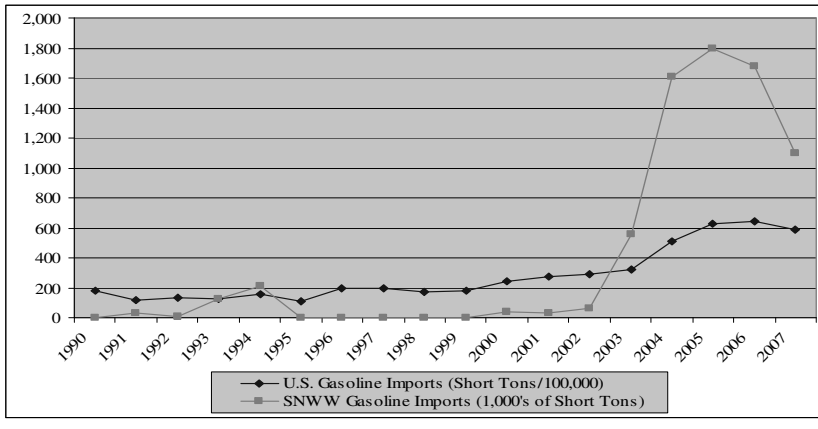
## 4.5 GASOLINE IMPORTS

SNWW gasoline imports increased significantly since the early 1990s, with current volumes exceeding 1.6 million short tons. SNWW gasoline imports presently compose approximately 3 percent of the U.S.

total waterborne gasoline imports. For the most recent 10-year period, approximately 90 percent of SNWW gasoline imports were shipped to Beaumont, with the remaining 10 percent to Port Arthur. Figure 36 presents a comparison of U.S. 2000–2006 gasoline imports with combined Beaumont and Port Arthur imports.

While U.S. gasoline imports have also increased dramatically, the EIA shows reductions in U.S. imports of gasoline blending components from 2006 to 2030. Increases in U.S. refinery capacity may be contributing to expected decline in the need for U.S. gasoline imports by allowing for increased domestic production. Over 98 percent of SNWW gasoline imports arrive by ship. In comparison, over 75 percent Midwest gasoline imports are transported by land from Canada. Canadian imports to the U.S. increased from 7 percent for 1994–1996 to 13 percent for 2004–2006.

Figure 36
U.S. and SNWW Waterborne Gasoline Imports and SNWW Gasoline Imports
(1,000s of Short Tons)




SNWW gasoline imports are expected to increase at slower rates than those recently experienced and, while future expectations are subject to a high level of uncertainty, regional imports forecasted to increase for the SNWW base scenario. The base scenario assumes that SNWW gasoline imports will grow at 1 percent annually from 2006 to 2069. Table 66 presents SNWW 2004–2069 gasoline import forecast. SNWW gasoline import forecast was assumed to grow at approximately 1 percent annually between 2004/06 and 2069. In its December 2007 report to Congress, the GAO[37] notes petroleum is a key impetus for growth in global trade in petroleum products and that there has been a structural surplus in production

[37] United States Government Accountability Office, Report to Congressional Requesters, GAO report number GAO-08-14 entitled 'Energy Markets: Increasing Globalization of Petroleum Products Markets, Tightening Refining Demand and Supply Balance, and Other Trends Have Implications for U.S. Energy Supply, Prices, and Price Volatility' released January 18, 2008. http://www.gao.gov/htext/d0814.html.

of gasoline and a deficit in production of diesel in Europe. They note that the surplus of gasoline is largely the result of a "systematic switch" in European countries toward automobiles with diesel-powered engines, which are more efficient than gasoline-powered engines. European regulators promoted diesel fuel use in Europe by taxing diesel at a lower rate, and European demand for diesel fuel-powered vehicles rose. The European refining and marketing sector responded to this change in demand by importing increasing amounts of diesel and exporting a growing surplus of gasoline to the U.S. A conclusion was that the effect of this structural imbalance within the European Union will continue for the foreseeable future, and perhaps widen, resulting in more exports of European gasoline and blending components to the U.S.

Table 66
SNWW Gasoline Import Forecast
(1,000s of short tons)

| Year | Baseline | Sensitivity |
|---|---|---|
| 2004 | 1,611 | 1,611 |
| 2005 | 1,800 | 1,800 |
| 2006 | 1,678 | 1,678 |
| 2007 | 1,096 | 1,096 |
| 2019 | 1,835 | 1,096 |
| 2029 | 2,027 | 1,096 |
| 2039 | 2,239 | 1,096 |
| 2049 | 2,474 | 1,096 |
| 2059 | 2,732 | 1,096 |
| 2069 | 3,018 | 1,096 |
| 2004/2006–2019 | 0.6% | 0.0% |
| 2004/2006–2069 | 0.9% | 0.0% |

## 4.6 PETROLEUM PRODUCT EXPORT FORECAST

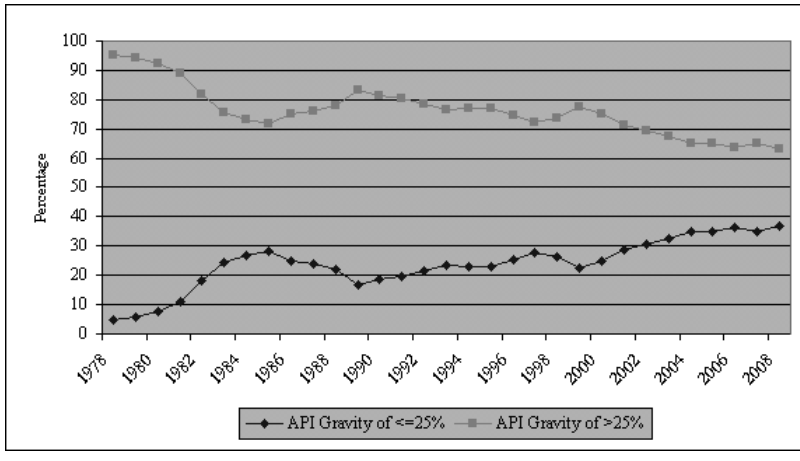
U.S. petroleum product exports primarily consist of petroleum coke (47 percent), distillate fuel (16 percent), gasoline (16 percent), and residual fuel oil (13 percent). SNWW exports primarily consist of petroleum coke (67 percent) and gasoline (25 percent). Analysis of SNWW's specific export groups, particularly petroleum coke and gasoline exports, show fair to good degrees of correlation between the study region and the U.S. For instance, the R square using 1990–2007 period data is 0.79 for petroleum coke and is 0.78 for gasoline.

## 4.7 PETROLEUM COKE EXPORTS

Published forecasts of U.S. coke exports are not available; however, indicators suggest an increased demand for coke. Ongoing construction of cokers in regions other than SNWW is indicative of increased demand. Increasing volumes of high-sulphur crude oil also suggest increasing volumes of residual coke.

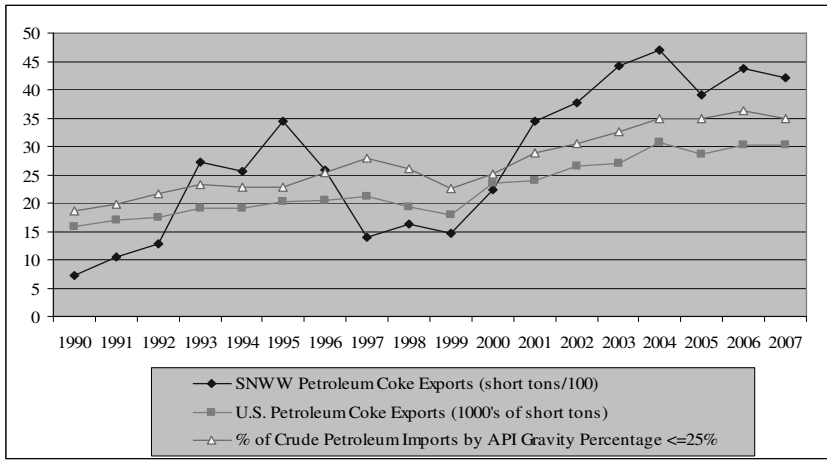
Figure 37 illustrates the change in API index of U.S. crude petroleum imports.[38] Subsequently, analysis of the relationship between U.S. and SNWW petroleum coke exports and API indices associated with heavy crude oil demonstrated that coke exports are well correlated increasing U.S. imports of high-sulfur crudes (Figure 38).

Figure 37
U.S. Crude Petroleum Imports by API Gravity Classification (%)




[38] The API (American Petroleum Institute) gravity measures the relative density of oils. It serves as a rough measure of the quality of crude oils. The higher the API gravity number, the higher the API gravity, the lighter the compound. Light crude oils generally exceed 38 degrees API.

Figure 38
SNWW and U.S. Petroleum Coke Exports and
% of U.S. Crude Petroleum Imports by API Gravity Classification (%)



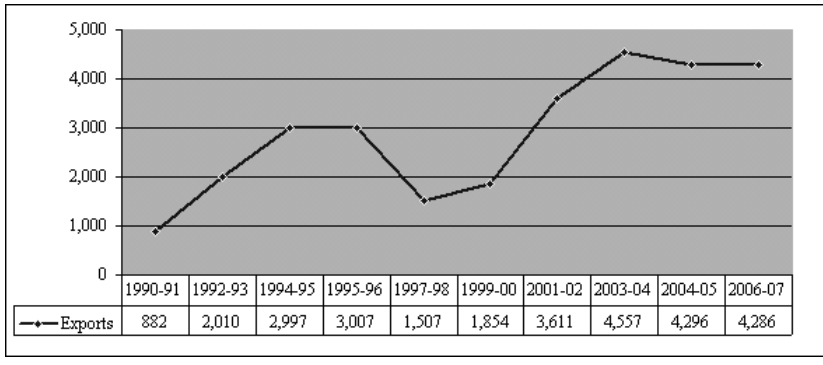

Analysis of the 1990–2007 relationship between U.S. petroleum coke exports and the percentage of crude petroleum imports with an API of 25 percent or less produced an adjusted R square of 0.94. The t value and F statistics associated with the equation is significant at the greater than 99.9 percent confidence levels. The relationship between SNWW petroleum coke exports and the API percentage produced an adjusted R square of 0.71, with a value of F statistic significant at the 99.99 confidence level.

Examination of 1990–2007 data showed that SNWW petroleum coke exports represents 14 percent of the U.S. waterborne exports, up from 4.6 percent in 1990. The U.S. is the world's largest supplier of petroleum coke. U.S. petroleum coke exports increased in 2008 by 3 percent over 2007 levels. The EIA shows refinery consumption and other domestic use of petroleum coke declining through 2030. At the same time, domestic production will increase based on the production of additional capacity and increased refinement of high-sulfur crude oil. Based on general indicators, including SNWW coker expansion, SNWW petroleum coke exports were assumed to follow SNWW and U.S. historical export trendlines. The refinement of high-sulfur crude oil, the processing of petroleum coke as a by-product, and the expansion of SNWW's coke-processing facilities supports this expectation. High-sulphur crudes are associated with both foreign imports of crude and Gulf of Mexico production.

Given the expectation of increased growth, a trendline using 1990–2005 SNWW exports as a function of time was used to represent the base forecast. Data for 2006–2007 were not originally available when the forecasts were prepared. Alternative forecasts using average annual growth rates were evaluated; however, the average annual growth exhibited variations. SNWW's 1990–1995 average annual growth rate is 36.5 percent, the 1995–2005 average annual growth rate is 1.3 percent, and the 2000–2005 average

annual rate is 11.8 percent. Growth rates based on 2-year point averages from 1990–2007 exports range from 3 and 10 percent. Figure 39 displays the 1990–2007 point averages.

Figure 39
SNWW Petroleum Coke Exports (1,000s of short tons)
1990–2007 Point Averages



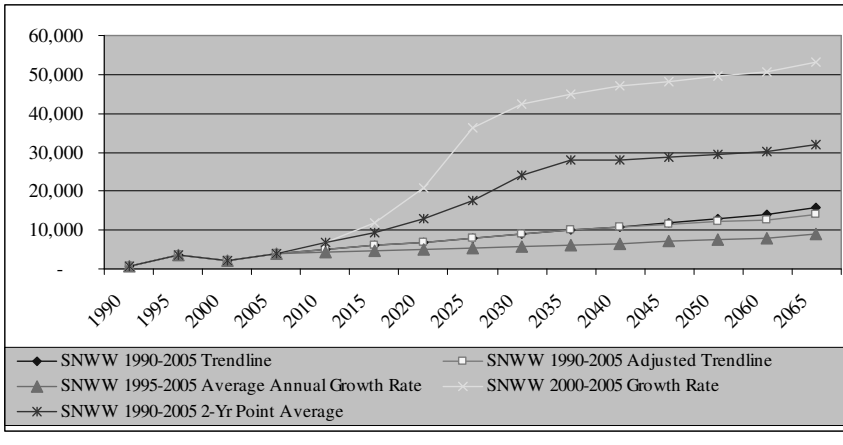

| | 1990-91 | 1992-93 | 1994-95 | 1995-96 | 1997-98 | 1999-00 | 2001-02 | 2003-04 | 2004-05 | 2006-07 |
|---|---|---|---|---|---|---|---|---|---|---|
| Exports | 882 | 2,010 | 2,997 | 3,007 | 1,507 | 1,854 | 3,611 | 4,557 | 4,296 | 4,286 |

Table 67 summarizes projections prepared using the 1990–2005 trendline, the 1995–2005 average annual growth rate of 1.3 percent, the 2000–2005 average annual growth rate of 11.8 percent, the 1990–2005 point averages of 3 and 10 percent, and the "no growth" forecast. SNWW transportations savings benefits were calculated using the forecast labeled "1990–2005 adjusted trendline." A 2039–2069 average annual growth rate of 1 percent was used for all of the forecasts except the "1990–2005 trendline" and the "no growth forecast." Figure 40 displays a comparison forecast trendlines shown in Table 66.

Table 67
SNWW Petroleum Coke Export Forecast Scenarios
(1,000s of Short Tons)

| Year | 1990–2005 Trendline | 1990–2005 Adjusted Trendline | 1995–2005 Growth Rate Application | 2000–2005 Growth Rate Application | 1990–2007 2–Year Point Average | No Growth After 2005–2007 Average |
|---|---|---|---|---|---|---|
| 1990 | 724 | 724 | 724 | 724 | 724 | 724 |
| 1995 | 2,558 | 2,558 | 2,558 | 2,558 | 2,558 | 2,558 |
| 2000 | 3,435 | 3,435 | 3,435 | 3,435 | 3,435 | 3,435 |
| 2005 | 3,903 | 3,903 | 3,903 | 3,903 | 3,903 | 3,903 |
| 2006 | 4,362 | 4,362 | 4,362 | 4,362 | 4,362 | 4,362 |
| 2007 | 4,210 | 4,210 | 4,210 | 4,210 | 4,210 | 4,210 |
| 2019 | 6,802 | 6,802 | 5,044 | 18,603 | 12,016 | 4,158 |
| 2029 | 8,768 | 8,768 | 5,740 | 38,073 | 22,555 | 4,158 |
| 2039 | 10,735 | 10,735 | 6,531 | 46,562 | 28,070 | 4,158 |
| 2049 | 12,701 | 11,955 | 7,432 | 47,968 | 28,694 | 4,158 |
| 2059 | 14,667 | 13,206 | 8,457 | 50,435 | 30,170 | 4,158 |
| 2069 | 16,633 | 14,588 | 9,509 | 54,336 | 32,503 | 4,158 |
| Average Annual Growth Rates | | | | | | |
| 2005–2019 | 4.0% | 4.0% | 1.8% | 11.8% | 8.4% | 0.5% |
| 2005–2069 | 2.3% | 2.1% | 1.4% | 4.2% | 3.4% | 0.1% |

Figure 40
SNWW Petroleum Coke Export Forecast Scenarios
(1,000s of Short Tons)



## 4.8 GASOLINE EXPORTS

SNWW gasoline exports steadily increased since the early 1990s. For the most recent 3-year period, exports averaged 1.8 million short tons. Figure 41 shows SNWW's 1990–2007 trendline of gasoline exports. SNWW gasoline exports compose approximately 18 percent of the U.S. total waterborne gasoline exports. As shown on Figure 41, regional gasoline exports growth is strong, with the regional growth continuing to increase through 2007 when U.S. and PADD III exports volumes dropped slightly. Figure 42 displays 1982–2007 U.S. and PADD III export volumes.

For the most recent 3-year period, approximately 75 percent of SNWW gasoline imports were shipped to Beaumont and the remaining 15 percent to Port Arthur. Port Arthur's share increased from zero in 1990 to 28 percent in 2006. Most of SNWW gasoline exports are shipped to Mexico. The study region's share is more constant than the U.S. share, which declined some over the most recent 10-year period. Over 2005–2007, nearly 75 percent of U.S. gasoline exports were also transported to Mexico. For 2002–2004, 83 percent of U.S. gasoline exports were transported to Mexico. Over 95 percent of SNWW gasoline exports for the most recent 5-year period were shipped to Mexico.

Figure 41
SNWW Gasoline Exports
1,000s of short tons

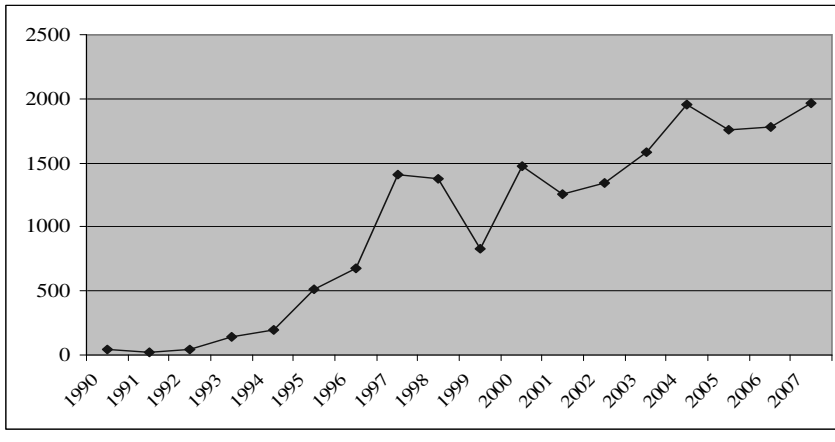
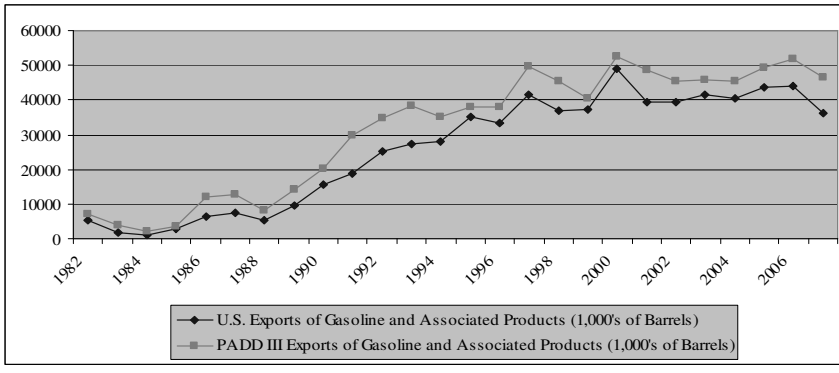


Figure 42
U.S. and PADD III Gasoline Exports, 1982–2007
1,000s of Barrels

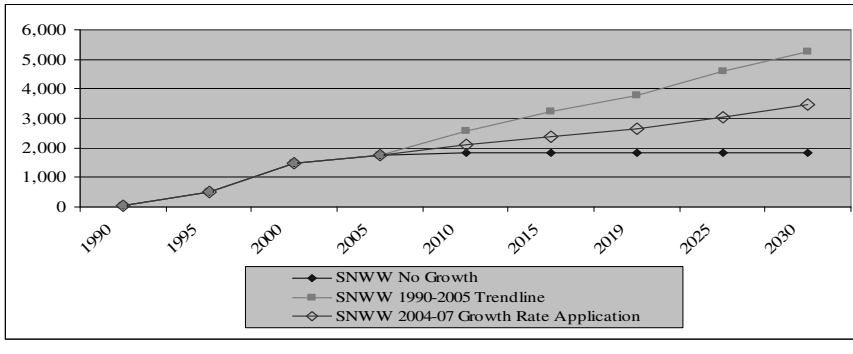



Comparison of U.S. and SNWW waterborne commerce records for gasoline exports showed a relatively strong level of correlation between the Nation and the region. The R square between 1990–2007 SNWW petroleum and U.S. gasoline exports is 0.71. PADD III gasoline exports produced an R square of 0.79. Published forecasts of gasoline exports are not available from the EIA or Global Insight. SNWW gasoline exports grew at an average annual rate of 27 percent from 1990 to 2007 and approximately 2.7 percent from 2004 to 2007. U.S. and PADD III 1990–2007 gasoline exports grew at an average annual rate of approximately 17 percent, with 2004–2007 U.S. and PADD III exports growing at rates comparable to the 1990–2007 rates. Trendline analysis of 1990–2007 SNWW gasoline exports as a function of time produced an adjusted R square of 0.92. Forecast of SNWW gasoline exports was evaluated based on comparison of the trendline and growth rate applications. Table 68 summarizes the gasoline export forecast applications evaluated for the SNWW study. SNWW's future gasoline exports were forecasted based on the 2004–2007 growth rate application (column 3, Table 68). Figure 43 displays a comparison of the forecasts evaluated.

Table 68
SNWW Gasoline Export Forecast Scenarios
(1,000s of Short Tons)

| Year | 1990–2005 Trendline | 2004–2007 Growth Rate Application | No Growth After 2005–2007 Average |
|---|---|---|---|
| | | 39 | 39 |
| 1990 | 39 | 9 | 9 |
| 1995 | 518 | 518 | 518 |
| 2000 | 1,474 | 1,474 | 1,474 |
| 2005 | 1,755 | 1,755 | 1,755 |
| 2006 | 1,778 | 1,778 | 1,778 |
| 2007 | 1,970 | 1,970 | 1,970 |
| 2010 | 2,575 | 2,096 | 1,834 |
| 2015 | 3,247 | 2,394 | 1,834 |
| 2019 | 3,785 | 2,664 | 1,834 |
| 2025 | 4,592 | 3,043 | 1,834 |
| 2030 | 5,264 | 3,480 | 1,834 |
| 2039 | 6,473 | 4,431 | 1,834 |
| 2049 | 7,818 | 5,641 | 1,834 |
| 2059 | 9,162 | 7,183 | 1,834 |
| 2069 | 10,506 | 9,145 | 1,834 |
| Average Annual Growth Rates | | | |
| 2005–2019 | 5.6% | 3.0% | 0.4% |
| 2005–2069 | 2.8% | 2.6% | 0.1% |

Figure 43
U.S. and PADD III Gasoline Exports
1,000s of Short Tons 1990–2030



## 4.9 DISTILLATE EXPORTS

U.S. distillate exports increased at an annual rate of 14 percent between 1990 and 1994 and declined from 1994 through 2002 before increasing to 1991 levels. PADD III exports also followed a similar pattern. In 2006 and 2007, SNWW exports were comparable to 1990–1991 levels. Figure 44 shows U.S. and PADD III 1990–2007 distillate exports. Distillate fuel oil represents approximately 7 percent of SNWW's 2004–2006 product exports. Approximately 80 percent of SNWW's distillate exports were shipped from Port Arthur, with the remaining 20 percent shipped from Beaumont. Figure 45 shows comparison of U.S. and SNWW waterborne distillate exports

As shown on Figure 45, U.S. distillate exports increased dramatically between 2004 and 2006. SNWW distillate exports remained relatively flat from 1990 through 1995 before increasing to over 600,000 short tons in 1997 and 1998. Exports then dropped to near zero in 2000 before steadily increasing through 2005, with volumes down in 2006 and 2007, and 2007 exports totaling 345,000 short tons. While distillate is exported to countries all around the world, the largest share of SNWW distillate exports is shipped to Mexico. Review of 2004–2006 vessel records showed that the largest vessels are associated with shipments to Mexico. Review of International Energy Administration world trade data for 2006–2008 show an increase in U.S. trade with Mexico between 2006 and 2008. Comparison of the EIA's first quarter 2008 product exports show an 18 percent increase over first quarter 2007. In its AEO2009 (SR/OIA/2009-03), the EIA shows U.S. petroleum product exports increasing at an average annual growth rate of 1 percent from 2006 through 2030. For forecasting purposes, SNWW's 2004–2006 average tonnage was used a base for the forecast application. In its December 2007 report to Congress, the GAO noted that petroleum product trade will continue to grow as global trends move towards increasing demand of lower sulfur fuel.

Figure 44
U.S. and PADD III Distillate Fuel Exports
1990–2007 Waterborne and Land Routes

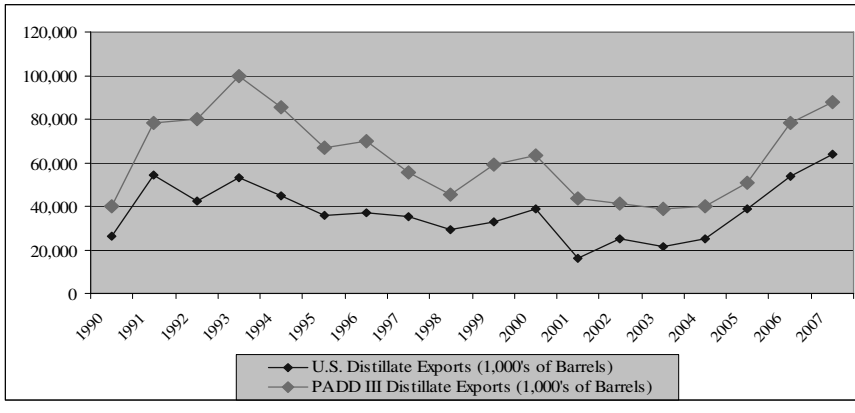
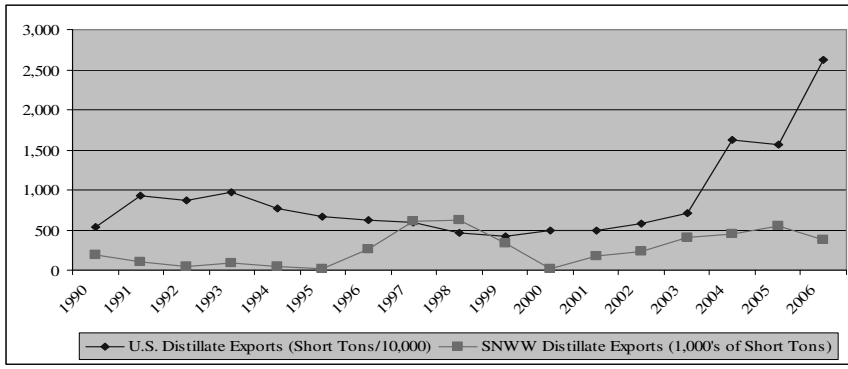


Figure 45
U.S. and SNWW Distillate Fuel Exports
1990–2006 Waterborne




The indication is that lower sulfur fuel will necessitate increased processing as it becomes increasingly scarce. The GAO noted that strong demand for certain petroleum products, particularly distillates, will increase competition for and facilitate global trade of petroleum products in particular distillates. Based on its position as a major refinery center, expectations are that SNWW product exports will increase at a greater rate than the Nation. All indications are that refining and export of petroleum products will increase. Based on these indicators, an average annual growth rate of 2.5 percent was used for SNWW 2006–2069 exports. Table 69 summarizes the gasoline export forecast applications evaluated for the SNWW study. The first column presents U.S. distillate exports and application of the AEO2009 (SR/OIA/2009-03) petroleum product export forecast. The next column summarizes application of the AEO growth rates to SNWW's 2004–2006 base. The AEO applications result in an average annual growth rate of 1 percent over 2004–2006 to 2029. The 2039–2069 volumes are based on continuation of a 1 percent growth rate. The third column summarizes application of a growth rate of 2.5 percent to the SNWW 2004–2006 base through 2039. The forecast in the last column is based on no growth beyond the 2004–2006 average. The forecast shown in column three was used for the benefit calculations. The 2039–2069 volumes for all growth forecasts are based on continuation of a 1 percent growth rate.

Table 69
SNWW Distillate Export Forecast Scenarios
(1,000s of Short Tons)

| Year | U.S. Distillate Exports AEO2009 Application | SNWW Distillate Exports Using AEO2009 | SNWW Distillate Exports Using a 2.5% Growth Rate | No Growth After 2004–2006 Average |
|---|---|---|---|---|
| 1990 | 5,349 | 192 | 192 | 192 |
| 1995 | 6,625 | 8 | 8 | 8 |
| 2004 | 16,202 | 449 | 449 | 449 |
| 2005 | 15,642 | 546 | 546 | 546 |
| 2006 | 26,249 | 371 | 371 | 371 |
| 2007 | 27,068 | 345 | 345 | 345 |
| 2010 | 20,037 | 471 | 515 | 455 |
| 2015 | 20,635 | 485 | 582 | 455 |
| 2019 | 21,832 | 513 | 643 | 455 |
| 2029 | 24,598 | 578 | 823 | 455 |
| 2039 | 26,984 | 634 | 1,053 | 455 |
| 2049 | 29,807 | 700 | 1,349 | 455 |
| 2059 | 32,926 | 774 | 1,726 | 455 |
| 2069 | 36,371 | 855 | 2,210 | 455 |
| Average Annual Growth Rates | | | | |
| 2004/2006–2019 | 0.9% | 0.9% | 1.2% | 0.4% |
| 2004/2006–2069 | 1.0% | 1.0% | 2.5% | 0.1% |

Source: USDOE, EIA, 2009 Annual Energy Outlook, SR/OIA/2009-03, March 2009.

## 4.10 COASTWISE PETROLEUM PRODUCTS

SNWW domestic coastwise movements primarily consist of gasoline. Examination of vessel characteristics and geographic routings suggested that 10 to 20 percent of outbound coastwise shipment tonnage would benefit from channel depths over 40 feet. The draft-restricted product carriers are generally between 60,000 and 70,000 DWT with design drafts in the 41- to 43-foot range. As shown on Figure 46, SNWW coastwise movements increased steadily since the mid-nineties. Movements prior to 1995 primarily consisted of crude petroleum. Current movements consist almost exclusively of gasoline shipments. The majority of shipments are to Florida and the U.S. Northeast. As with product exports, based on SNWW's position as a major refinery center, expectations are that coastwise shipments are expected to increase at an increasingly steady rate based on the region's position as a major refinery center. Table 70 summarizes the SNWW coastwise forecasts evaluated for the SNWW study.

Figure 46
SNWW Coastwise Shipments
1995–2007 Waterborne

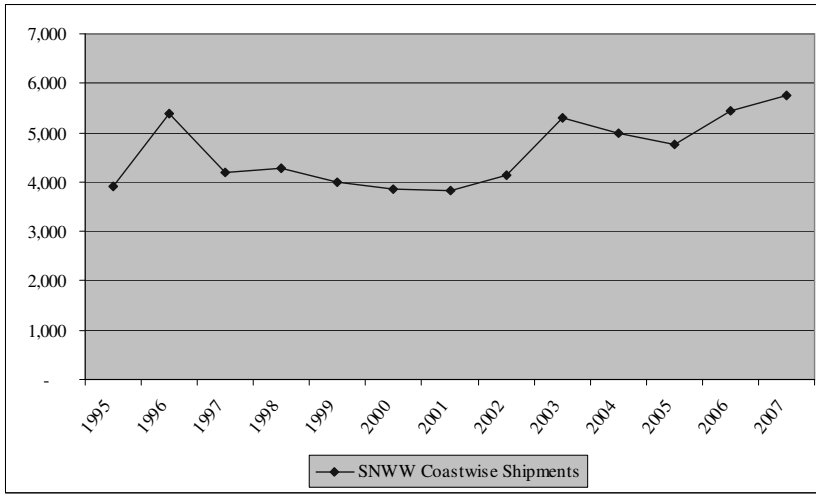


Table 70
SNWW Coastwise Movement Forecast Scenarios
(1,000s of Short Tons)

| Year | SNWW Coastwise Movements 1998–2007 Trendline | SNWW Coastwise Movements 1% Growth | SNWW No Growth Beyond 2005–2007 Average |
|---|---|---|---|
| 1990 | 8,906 | 8,906 | 8,906 |
| 1995 | 3,909 | 3,909 | 3,909 |
| 1996 | 5,386 | 5,386 | 5,386 |
| 1997 | 4,197 | 4,197 | 4,197 |
| 1998 | 4,284 | 4,284 | 4,284 |
| 1999 | 3,989 | 3,989 | 3,989 |
| 2000 | 3,863 | 3,863 | 3,863 |
| 2005 | 4,770 | 4,770 | 4,770 |
| 2006 | 5,438 | 5,438 | 5,438 |
| 2007 | 5,762 | 5,762 | 5,762 |
| 2010 | 6,121 | 5,595 | 5,323 |
| 2015 | 7,110 | 5,880 | 5,323 |
| 2019 | 7,901 | 6,119 | 5,323 |
| 2029 | 9,879 | 6,759 | 5,323 |
| 2039 | 11,857 | 7,466 | 5,323 |
| 2049 | 13,834 | 8,248 | 5,323 |
| 2059 | 15,812 | 9,110 | 5,323 |
| 2069 | 17,790 | 10,064 | 5,323 |
| Average Annual Growth Rates | | | |
| 2005–2019 | 2.9% | 1.0% | 0.0% |
| 2005–2069 | 1.8% | 1.0% | 0.0% |

While review of the historical vessel movements showed that nearly half of petroleum product shipments was shipped in vessels with design drafts over 40 feet, the combination of U.S. tanker availability, depths at trading ports, parcel size demand, and industry discussion suggests that the tonnage that would utilize channel depths over 40 feet would not exceed 10 percent. Channel deepening benefits were calculated based on 10 percent of 2019–2069 tonnage.

## 4.11 REMAINING PETROLEUM PRODUCT EXPORTS

SNWW's remaining product exports include lube oil and naphtha, with each representing approximately 1.5 percent of total petroleum product exports and totaling less than 100,000 short tons from 1995 through 2006. The 2004–2006 export volumes for lube oil and naphtha were assumed to grow at 1 percent annually in future years.

## 4.12 CHEMICAL IMPORTS

The largest volumes, and the highest growth rates, for SNWW imports are for alcohols and ammonia, with present imports of these inorganic chemicals up by over 4,000 percent from the previous 10-year period. In comparison, U.S. chemical imports are currently over 200 percent higher than in the early 1990s. Currently, U.S. alcohol imports are over 500 percent higher than in the early 1990s, and ammonia imports are up by over 200 percent. Figure 47 displays U.S. alcohol and ammonic imports for 1990–2007. For 2004–2007, Beaumont ammonia imports represented approximately 6 percent of the U.S. total, having increased from less than 5,000 short tons in the early 1990s to 460,000 short tons in 2006. The largest rates of growth for U.S. imports were for agricultural fertilizers. Fertilizers compose 33 percent of total chemical imports. While agricultural fertilizers are exported from SNWW, none are imported.

Figure 47
U.S. Alcohol and Ammonia Waterborne Imports 1990–2007
(1,000s of short tons)

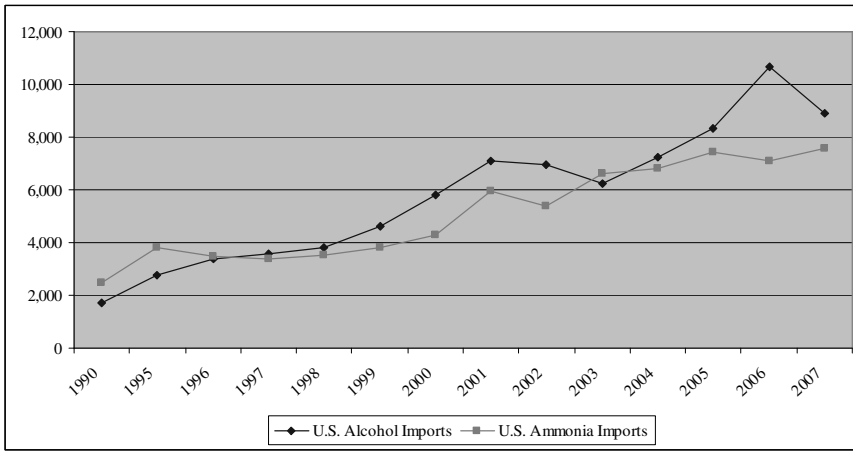



Figure 48 displays SNWW 1990–2007 alcohols and ammonia imports. Eighty-nine percent of SNWW methyl alcohol imports comes from Trinidad, 8 percent comes from Chile, and the remaining 3 percent from Venezuela. The Trinidad plant represents the world's largest methanol production plant and is capable of producing 5,000 tons per day. The plant located in Punta Arenas, Chile, plans to triple its methanol production capacity by the end of 2008. Additionally, the Economic Research Service of the USDA notes that new plants are planned in West Africa and the Middle East, with those locations presently serving markets other than the SNWW.

U.N. studies suggest that worldwide demand will grow at 5 percent but indicate that the higher growths are expected to be associated with emerging markets. Analysis of the SNWW and national total indicated a reasonable level of correlation between the study area and the Nation; however, SNWW tonnage was equally correlated with year. Analysis of the 1990–2007 relationship between U.S. and SNWW chemical imports showed strong statistical correlation, with a corresponding adjusted R square of 0.82. An adjusted R square of 0.78 was produced when "year" was used instead of "U.S. imports." The t value and F statistics associated with both of the equations are significant at the greater than 0.99 percent confidence levels. An average annual growth rate of 1 percent was used for SNWW 2006–2049 alcohol and ammonia imports. For forecasting purposes, SNWW's 2004–2006 average tonnage was used as a base for the forecast application. SNWW's alcohol and ammonia import forecast is displayed on Figure 49.

Figure 48
SNWW Alcohol and Ammonia Waterborne Imports 1990–2007
(1,000s of short tons)

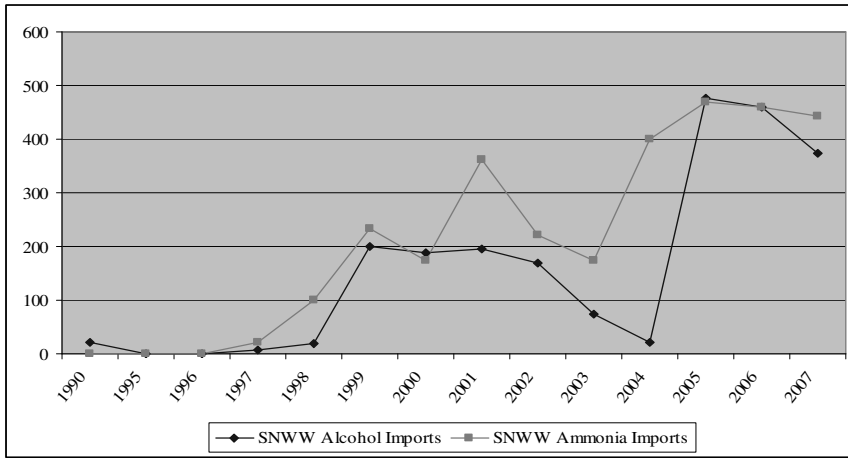
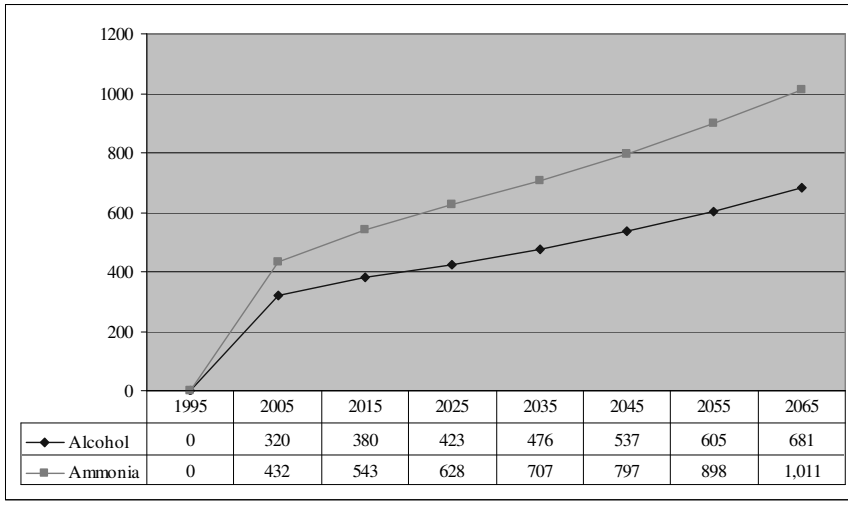


Figure 49
SNWW Alcohol and Ammonia Imports 1995–2065
Waterborne (1,000s of Short Tons)




| | 1995 | 2005 | 2015 | 2025 | 2035 | 2045 | 2055 | 2065 |
|---|---|---|---|---|---|---|---|---|
| Alcohol | 0 | 320 | 380 | 423 | 476 | 537 | 605 | 681 |
| Ammonia | 0 | 432 | 543 | 628 | 707 | 797 | 898 | 1,011 |

Future transition to larger and more fully loaded vessels for SNWW alcohol and ammonia imports was evaluated based on examination of vessel sizes and loaded drafts associated with other regional ports. These analyses showed that the loaded drafts associated with these commodities are generally less than 36 feet. The analyses also indicated that the use of vessel sizes constrained by the existing 40-foot channel depth is presently limited, with future transition being uncertain. While expectations concerning future chemical imports to SNWW are uncertain, larger and more deeply loaded carriers are presently being used.

## 4.13 CHEMICAL EXPORTS

Like imports, SNWW chemical exports grew at very fast rates. In 2006, SNWW exported 2.9 million short tons of chemicals, representing a record high. Review of 1990–2007 records show 1995–2007 exports had minimum exports of 724 thousand short tons in 1995. With few exceptions, SNWW exports steadily increased. In comparing SNWW's growth rates to U.S. rates, U.S. growth was slower but increased, with 2006 exports totaling 59 million short tons, up from 40 million in 1990.

SNWW's largest percentage increase was for fertilizer mixes, and the largest share of tonnage is associated with the organic compound and metallic salt commodity classifications (Table 17). U.S. exports of these commodities also increased. Figures 50 and 51 shows U.S. and SNWW metallic salts and organic compound exports for 1990–2006. For 2004–2006, SNWW exported 18 percent of the U.S. metallic salt waterborne total and 11 percent of the organic compound total. Based on these indicators, an

average annual growth rate of 2.5 percent was used for SNWW 2006–2039 metallic salts and organic compounds. A growth rate of 1 percent was used for 2039–2069. For forecasting purposes, SNWW's 2004–2006 average tonnage was used as a base for the forecast application. Ten percent of future tonnage was forecasted to use channel depths over 40 feet. The transition to larger and more fully loaded vessels for 10 percent of future tonnage was based on general indicators associated with chemical vessel fleet trends summarized in the fleet forecast section (see Table 44). SNWW's metallic salts and organic compound export forecast is displayed on Figure 52.

Figure 50
U.S. Metallic Salts and Organic Compound Exports
Waterborne (1,000s of Short Tons)

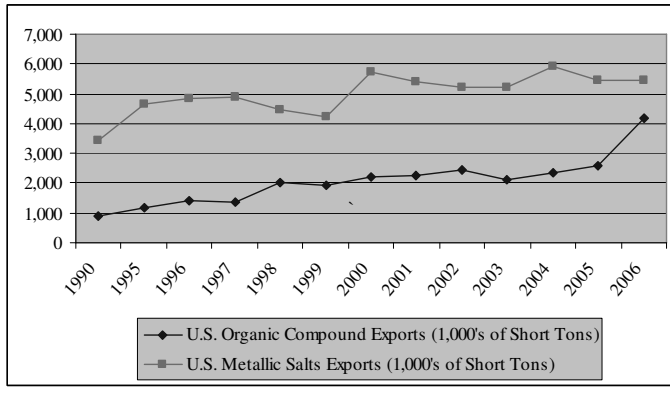


Figure 51
SNWW Metallic Salts and Organic Compound Exports

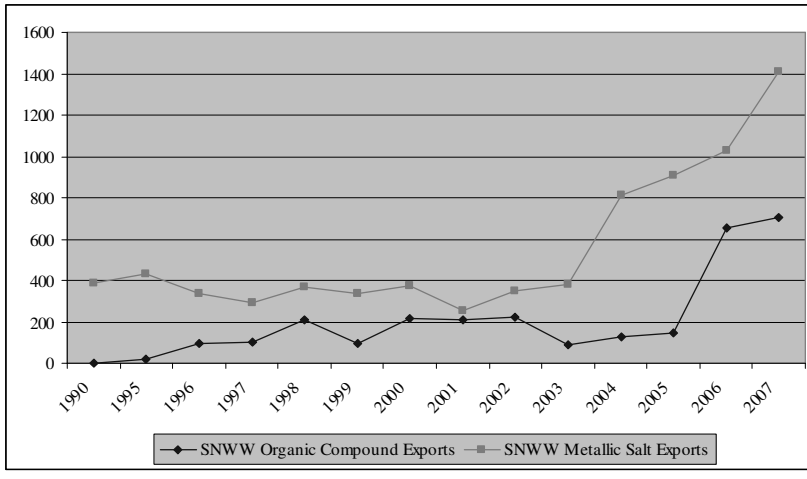
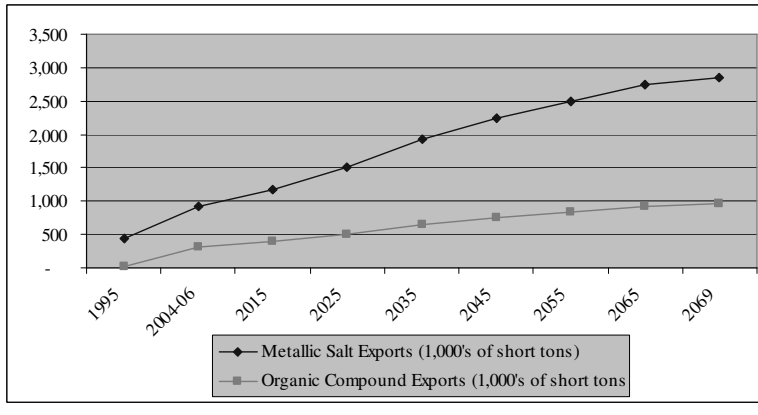



Figure 52
SNWW Metallic Salts and Organic Compound Exports 1995–2069
Waterborne



## 4.14 LIQUEFIED NATURAL GAS

LNG will play an increasingly important role in the natural gas industry and global energy markets in the next several years. Table 71 shows SNWW current and future capacity volumes for the SNWW facilities. Phase I of the Cheniere terminal is presently complete, and the first vessels arrived in April 2008. Phase 1 consists of 10.1 Bcf of LNG storage in three tanks, each with an LNG capacity of 160,000 cubic meters ($m^3$), and a maximum continuous regasification rate of 2.6 billion cubic feet per day (Bcf/d). Phase 2 will be built in stages. The first stage of Phase 2 will include the addition of fourth and fifth storage tanks, additional vaporizers that will bring the maximum continuous regasification rate up to 4.0 Bcf/d with a peak sendout capacity of 4.3 Bcf/d. In the future stages of Phase 2, a sixth storage tank may be added and related facilities will bring the total LNG storage volume to 20.2 Bcf.

Table 71
Distribution of Liquefied Natural Gas
Operational Capacity

| Facility | Full Operational Output (Bcf/d) | Annual Output (Bcf) |
|---|---|---|
| Sabine Pass | 3.360 | 1,226.40 |
| Golden Pass | 2.268 | 827.82 |
| Port Arthur | 2.520 | 919.80 |
| Total SNWW | 8.148 | 2,974.02 |

Construction of the Exxon Golden Pass LNG terminal is scheduled for completion by 2011. The Golden Pass facility, which is being constructed by ExxonMobil and Conoco Phillips, will consists of a dock and unloading facilities, 5 LNG storage tanks (≈17 Bcf), and vaporization capacity of 2.7 Bcf/d. The Port Arthur project consists of two ship berths, three to six storage tanks (160,000 $m^3$), and vaporization capacity of 1.5–3 Bcf/d. The LNG for the Golden Pass terminal is anticipated to be supplied primarily from the Ras Laffan 3 and the Qatargas 3 projects in Qatar, which will produce and process natural gas from Qatar's offshore North Field.

Construction of the Sempra terminal is anticipated after 2012. The Sempra LNG terminal will be capable of delivering between 1.5 and 3 Bcf per day of natural gas. The terminal will include two unloading docks for ships and three to six full containment storage tanks and associated equipment in order to transform the LNG back to its gaseous state. As noted, construction of this third facility is planned for after 2012. At full utilization, Sabine Pass and Golden Pass could handle 2.05 trillion cubic feet (Tcf) annually. The Sempra annual capacity increases regional capacity by 2.97 Tcf without pushing peak capacity.

There are about 40 LNG terminals that are either before the Federal Energy Regulatory Commission (FERC) or are being discussed by the LNG industry for North America. Six terminals are already operating on the East Coast, Puerto Rico, and Alaska. There are six onshore LNG terminals in the continental U.S., these are located in Everett, Massachusetts; Lake Charles, Louisiana; Elba Island, Georgia; Cove Point, Maryland; Cameron, Louisiana; Sabine, Texas; and Freeport, Texas. The Cameron,

Sabine, and Freeport terminals are new. In addition to these three terminals, the Northeast Gateway port offshore Massachusetts received its first supplies in 2008. With these four terminals now operational, U.S. capacity to receive LNG imports has increased from approximately 5.0 Bcf/d at the end of 2007 to about 9.1 Bcf/d as of the end of the year. The Sabine Pass facility adds 2.6 Bcf, or 29 percent to U.S. Bcf capacity.

In 2007, the U.S. imported an estimated 771 Bcf, or 21.2 million short tons, of LNG. Shipments to existing U.S. facilities in 2006–2008 came from Trinidad (64 percent), North Africa (22 percent), Western Africa (11 percent), Norway (2 percent), and the Middle East (1 percent). The EIA reported total LNG import shipments of 771 Bcf in 2007 to these terminals, with each importing similar volumes—each between 20 and 30 percent of the total. Imports in 2008 only reached 352 Bcf. Despite declines in 2008, the EIA expects U.S. LNG imports to increase to about 500 Bcf in 2009, up from 352 Bcf in 2008, and rise to about 740 Bcf in 2010. The 2008 fall in imported natural gas to the U.S. reflects the increased need for natural gas in other countries willing to compete for available global supplies. While U.S. imports increased in 2009 over 2008 levels, U.S. LNG import growth this year has been constrained because of increased LNG demand in Europe and delays and maintenance to new and existing LNG liquefaction capacity. With limited natural gas storage availability, recent data suggest that European inventory levels are now nearing capacity. The expectation is that LNG shipments may be redirected to U.S. ports in the coming months as prices in the European market become less attractive to LNG suppliers. A similar scenario may also occur in Canada, with natural gas pipeline imports increasing in the months ahead as Canadian storage facilities are topped off. The EIA notes that an increase in U.S. natural gas imports would likely be balanced by larger-than-expected declines in domestic natural gas production.

## 4.15 U.S. LNG IMPORT FORECAST

The EIA notes that annual U.S. LNG imports are projected to exceed 1 Tcf by 2015 but are expected to drop to 800 million cubic feet by 2030. Table 72 presents the LNG import forecasts outlined in the AEO2009. Short-term forecast revisions note that LNG imports are expected to increase to about 506 Bcf in 2009 from 352 Bcf in 2008, because of a combination of weak demand and growing supply in the global LNG market. Lower demand for LNG in Japan and South Korea has increased the amount of available LNG in the global market, leading to larger LNG purchases in China and Europe. However, with limited natural gas storage capacity in Asia and Europe, lower global demand is expected to increase available LNG cargoes for import by the United States.

The likelihood of a region's ability to capture a share of the LNG market is obviously subject to uncertainty; however, some sites, such as those on the SNWW, may have more-obvious advantages because of FERC approval, lack of public opposition, or locational advances (close access to international waters). The SNWW facilities have the advantage of FERC approval, relatively high levels of public and political support, and locational advances in terms of access to the U.S. Gulf. For the analysis, 20 percent of the U.S. waterborne LNG imports market was used for SNWW. Table 73 displays the expected distribution of imported by country of origin. The distribution was prepared based on industry input and

reflects a higher proportion of imports from Trinidad than the EIA forecast. The EIA is currently forecasting higher volumes from the Middle East than the distribution shown in Table 73.

Table 72
U.S. and SNWW Liquefied Natural Gas Imports, 2005–2030
Updated June 2009

| | U.S. Total LNG Imports | | SNWW |
|---|---|---|---|
| Year | Trillion Cubic Feet | Waterborne Short Tons | LNG Forecast Short Tons |
| 2005 | 0.5661 | 16,566,000 | - |
| 2006 | 0.5840 | 18,617,000 | - |
| 2007 | 0.7708 | 21,238,000 | - |
| 2015 | 1.1460 | 31,575,957 | 3,157,596 |
| 2019 | 1.4101 | 38,852,755 | 5,827,913 |
| 2020 | 1.3808 | 38,045,447 | 9,511,362 |
| 2025 | 1.1269 | 31,049,691 | 7,008,843 |
| 2029 | 0.8964 | 24,698,681 | 6,174,670 |
| 2030 | 0.8097 | 22,309,819 | 6,174,670 |
| 2039 | n/a | n/a | 6,174,670 |
| 2049 | n/a | n/a | 6,174,670 |
| 2059 | n/a | n/a | 6,174,670 |
| 2069 | n/a | n/a | 6,174,670 |

Source for U.S. Imports: USDOE, 2009 Annual Energy Outlook, March 2009.

Table 73
SNWW Liquefied Natural Gas Trade Route Forecast, 2019–2069
Short Tons

| Year | Middle East | Trinidad | Algeria | Total |
|---|---|---|---|---|
| 2019 | 1,946,522 | 1,940,695 | 1,940,695 | 5,827,913 |
| 2029 | 2,062,339 | 2,056,165 | 2,056,165 | 6,174,669 |
| 2039 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,670 |
| 2049 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,670 |
| 2059 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,670 |
| 2069 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,670 |

Note: SNWW 2015–2030 volumes are based on application of the EIA 2010–30 growth rates.

## 4.16 GRAIN EXPORT FORECAST

Grain is exported from the Beaumont elevator located just below the Port of Beaumont main turning basin. While exports have exceeded 1 million short tons since 2003, recent volumes remain less than half the 1993 peak volume of 3.5 million. While relatively low in comparison to the Pacific Northwest and the Lower Mississippi, Beaumont has maintained a 1.4 to 1.7 percent share of the U.S. waterborne bulk grain export market. Table 74 displays Beaumont's 1990–2007 bulk grain exports by major product. Wheat

presently comprises 100 percent of Beaumont's grain exports for the most recent 4-year period. Beaumont's 2007 wheat exports represented 4.4 percent of the U.S. wheat export total.

Table 74
Beaumont Bulk Grain Exports and Percentage by Grain Type

| | Wheat | | Corn | | Sorghum Grain | | |
|---|---|---|---|---|---|---|---|
| Year | 1,000s of Short Tons | % | 1,000s of Short Tons | % | 1,000s of Short Tons | % | Total Exports |
| 1990 | 1,957 | 94 | – | – | 132 | 6 | 2,089 |
| 1991 | 1,863 | 96 | – | – | 73 | 4 | 1,936 |
| 1992 | 2,796 | 87 | – | – | 431 | 13 | 3,227 |
| 1993 | 3,038 | 88 | – | – | 433 | 12 | 3,471 |
| 1994 | 2,143 | 93 | – | – | 160 | 7 | 2,303 |
| 1995 | 1,486 | 87 | – | – | 227 | 13 | 1,713 |
| 1996 | 796 | 77 | 3 | – | 238 | 23 | 1,037 |
| 1997 | 999 | 73 | 51 | 4 | 320 | 23 | 1,370 |
| 1998 | 648 | 72 | – | – | 251 | 28 | 899 |
| 1999 | 629 | 67 | – | – | 308 | 33 | 937 |
| 2000 | 753 | 84 | 56 | 6 | 85 | 10 | 894 |
| 2001 | 679 | 82 | 55 | 7 | 97 | 12 | 831 |
| 2002 | 742 | 89 | 70 | 8 | 23 | 3 | 835 |
| 2003 | 1,125 | 100 | – | – | – | – | 1,125 |
| 2004 | 1,329 | 100 | – | – | – | – | 1,329 |
| 2005 | 1,081 | 100 | – | – | – | – | 1,081 |
| 2006 | 1,214 | 100 | – | – | – | – | 1,214 |
| 2007 | 1,632 | 100 | – | – | – | – | 1,632 |

Source: USACE, Waterborne Commerce Database, 1990–2007.

Figure 53 shows wheat exports by U.S. geographic region for 2002–2007. Figure 54 shows Beaumont's share of the Texas Gulf Coast wheat exports for 2002–2007. Comparison of Beaumont wheat export volumes with other major U.S. grain export locations showed that Beaumont has maintained a consistent market share since 1996. Figure 55 displays 1990–2006 U.S. total wheat exports, U.S. production, and Beaumont wheat exports. While corn exports have historically been low, sorghum grain constituted 14 percent of Beaumont's bulk grain exports prior to 2003.

Figure 53
U.S. Wheat Exports by Region
(1,000s of Short Tons)

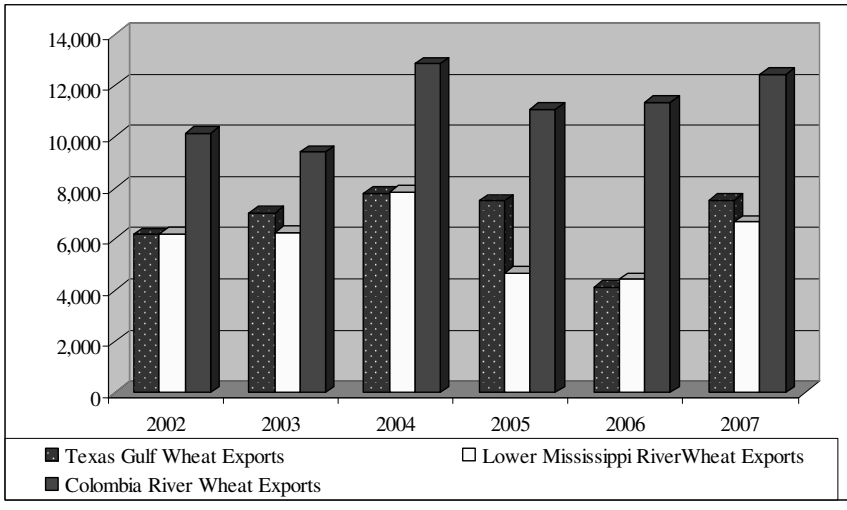



Figure 54
Beaumont Wheat Exports
(1,000s of Short Tons)

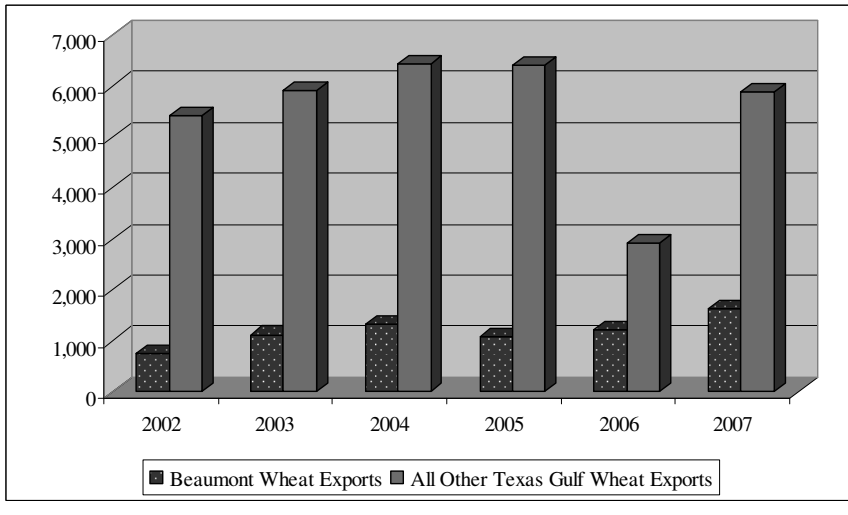
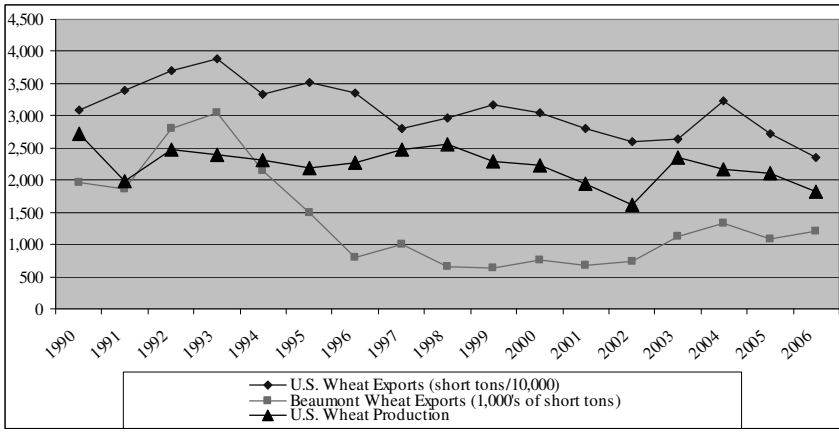


Figure 55
U.S. and Beaumont Wheat Exports and U.S. Wheat Production (short tons)




According to the U.S. Grains Council, the U.S. is currently positioned as the number two producer and number one exporter of sorghum on the world market. The U.S. share of the world sorghum trade has not dropped below 70 percent in more than a decade. World trade in sorghum is dominated by U.S. exports to Mexico. In the last 5 years, transportation of the commodities considered in this study (corn, sorghum, wheat, and soybeans) has shifted from maritime to overland.[39] Rail is the major overland transportation mode for all grains but sorghum. Sorghum is shipped by truck because of the proximity of the production areas in Texas's Rio Grande Valley to the border. Other importing countries and regions include Japan, Israel, South Africa, Spain, Morocco, and Eritrea.

Mexico is the world's third largest sorghum producer after Nigeria and the United States and the second largest world consumer after Nigeria. The United States is the only sorghum supplier to Mexico. Over the last 5 years, half of U.S. sorghum exports to Mexico were shipped by ocean through the U.S. Gulf, mostly from North Texas, South Texas, and the Mississippi River. The port of Veracruz is the major ocean point of entry. On average, trucks moved 30 percent and rail hauled 19 percent of sorghum shipped to Mexico. The top rail destinations for U.S. sorghum exports to Mexico in 2005 were Nuevo Leon, Veracruz, Estado de Mexico, Jalisco, and Guanajuato.[40] Texas (Laredo and El Paso) and Arizona (Santa Cruz) are the main rail entry points. The ports of Veracruz and Progreso are the major entry points by vessel. Half of the year's sorghum exports to Mexico occur between January and May, reaching a peak in April. The percentage of grain transported by oceangoing vessel declined from 60 percent in 2002 to 45 percent in 2006.

[39] USDA, U.S. Grain and Soybean Exports to Mexico – A Modal Share by Dalmy L. Salin, April 2008.

[40] Adcock, F. J, C. Parr Rosson III, and Alejandro Varela. 2007. Tracking U.S. Grain and Soybean Exports in Mexico. Center for North American Studies, Texas A&M University. http://cnas.tamu.edu/AMS%20Final%20Export%20Report.pdf

Analysis of Beaumont's grain exports does indicate reduction in shipments to Mexico and also shows that sorghum exports ceased after 2002. The specific reasons for Beaumont's drop in sorghum exports were not investigated; however, sorghum had composed a relative small share of Beaumont's grain. Analysis of Beaumont's 2004–2006 wheat exports by destination showed that the primary markets served are West Africa and the Middle East. Table 75 displays Beaumont's 1998–2006 wheat exports by destination.

Table 75
Beaumont Wheat Exports by Destination, 1998–2006
Short Tons

| Destination | 1998 | 2002 | 2004 | 2005 | 2006 | % |
|---|---|---|---|---|---|---|
| Brazil | – | 52,087 | – | – | – | 1 |
| Caribbean | 4,617 | 22,532 | 63,008 | 59,507 | 85,240 | 5 |
| Colombia | 17,218 | 170,807 | 58,426 | 65,438 | 43,799 | 7 |
| East Africa | – | – | – | 23,864 | – | 0 |
| Mexico | 25,266 | 71,888 | 84,881 | – | – | 4 |
| Middle East | 82,287 | – | 17,416 | 272,894 | 873,854 | 24 |
| Mediterranean and North Africa | 278,892 | 210,088 | 512,318 | 63,643 | – | 21 |
| South Africa | 17,505 | 94,114 | – | 26,467 | – | 3 |
| W South America | 67,461 | 89,375 | 89,739 | – | – | 5 |
| West Africa | 107,511 | 124,239 | 502,829 | 568,825 | 211,118 | 30 |
| Far East | 62,422 | – | – | – | – | 1 |
| Total | 663,179 | 835,130 | 1,328,617 | 1,080,639 | 1,214,010 | 100 |

Source: USACE, Navigation Data Center, detailed unpublished vessel records, 2004–2006.

Review of research conducted by Texas A&M University shows that the Gulf of Mexico ports are a major export outlet for U.S. wheat, in particular hard red winter wheat. Hard red winter wheat is railed from Kansas, Oklahoma, Texas, and Colorado for Texas export. Figure 56 displays the 1997–2006 relationship between wheat exports destination by state of origin and Beaumont's exports. The states of Kansas, Oklahoma, Texas, and Colorado originate virtually all of the 5 to 8 million tons of hard red winter wheat annually shipped to Texas Gulf ports. Transport of nearly all Texas Gulf grain exports is by unit train. The Burlington Northern Santa Fe, Missouri Pacific, Southern Pacific and Union Pacific railroads are used to transport wheat to export facilities in Brownsville, Corpus Christi, Galveston, and Houston.

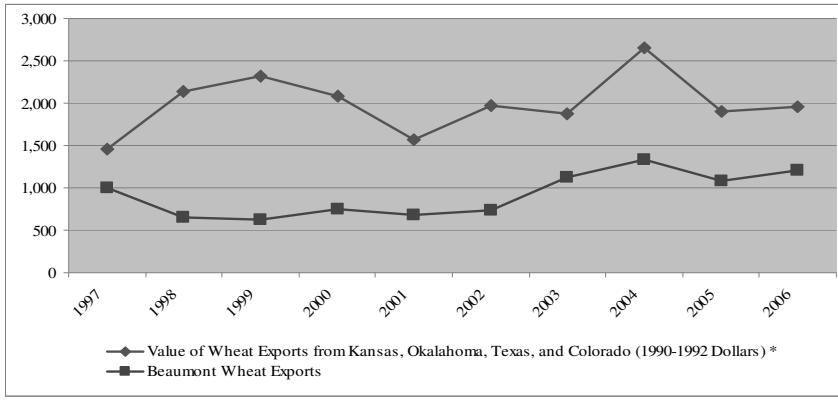
The relative locations of the grain production areas to either rail lines or to the Mississippi River is the major determinant in the distribution of grain exports between the Texas Gulf Coast ports and the Lower Mississippi River.[41] The U.S. Grains Council notes that while infrequent corn will move from Nebraska and Iowa to Texas ports during periods of Mississippi River low flow or of excess demand, red winter wheat from Louisiana, Mississippi, Arkansas, Missouri, Illinois, Indiana and other states in the Illinois and Ohio River basins tends to move via barge and rail through the Mississippi River ports.[42] The Pacific Northwest is noted to have a freight advantage over the other U.S. Gulf for Asian destinations. The

[41] Besslerand, David and Stephen W. Fuller, Transportation Research: Part E: Logistics and Transportation Review, Volume 36, Number 1: "Railroad Wheat Transportation Markets in the Central Plains: Modeling with Error Correction and Directed graphs", Department of Agricultural Economics, Texas A&M University.
[42] U.S. Grains Council – Importer Manual, August 2004, Chapter 5, p. 64.

shorter distance from the Pacific Northwest to Asian destinations is mentioned as contributing to the willingness to pay a substantially higher price for feed grains delivered from that coast. While having an ocean freight advantage, the Pacific Northwest is noted as being relatively far from feed grains production areas.

Figure 56

Wheat Exports by State and Beaumont Exports, 1997–2006




*Constant 1990–1992 dollars. ftp://ftp-fc.sc.egov.usda.gov/Economics/priceindexes/Data/PPPI_CPI_CCI.xls.

Beaumont's tonnage forecast is based on application of the USDA's Baseline Projections Report February 2009 forecast. The forecast shown in Table 76 is based on Beaumont capturing between 4.4 percent and 7.8 percent of U.S. wheat exports, with 7.8 percent representing the 1990–2006 maximum and 4.4 percent representing the 2004–2006 average. The baseline forecast used for the transportation cost calculations is based on Beaumont capturing a 6.6 percent share of the U.S. export market. The transportation savings benefits are based on 30 percent of tonnage would load to drafts over 40 feet.

Table 76
Beaumont Wheat Export Forecast (2004–2069)

| | U.S. Wheat Exports | | Beaumont Wheat Exports | |
|---|---|---|---|---|
| Year | Bushels | Short Tons | Total Exports | Volume Used for Benefit Calculations |
| 2004 | 1,066,000 | 31,980,000 | 1,208,333 | – |
| 2005 | 1,002,000 | 30,060,000 | 1,081,000 | – |
| 2006 | 909,000 | 27,270,000 | 1,214,000 | – |
| 2007 | 1,264,000 | 34,400,000 | 1,632,000 | – |
| 2019 | 1,075,000 | 29,300,000 | 2,128,500 | 638,550 |
| 2029 | – | – | 2,351,188 | 705,356 |
| 2039 | – | – | 2,597,175 | 779,152 |
| 2049 | – | – | 2,868,896 | 860,669 |
| 2059 | – | – | 3,169,046 | 950,714 |
| 2069 | – | – | 3,500,599 | 1,050,180 |

The USDA is presently showing modest growth in wheat exports between 2006 and 2018/2019.[43] U.S. 2006–2018/2019 exports are forecasted to increase from approximately 990 million bushels in 2006 to 1,075 million bushels by 2014/2015 and remain constant at that level through the end of the forecast period in 2018/2019. Egypt maintains its position as the world's biggest importer of wheat, as imports climb slowly to nearly 9 million tons. Imports by developing countries in Sub-Saharan Africa, North Africa, and the Middle East rise to nearly 12 million tons and account for 45 percent of the total increase in world wheat trade. While the shares of the world wheat market held by Canada and the U.S. are noted to decline slightly and be offset by increases in the European Union, Ukraine, Russia, Australia, and Argentina, total U.S. wheat exports increase slightly. The USDA also notes that changing consumption patterns will boost wheat imports by some major importing countries. In Indonesia, strong economic growth and diversification of diets are projected to increase per capita wheat consumption. The USDA notes that for most developing countries there is little change in per capita wheat consumption but imports expand modestly because of population growth. Table 77 displays major destination ports for SNWW grain exports that can accommodate large bulk carriers.

An average of nearly 30 percent of Beaumont's 2000–2007 grain export tonnage was shipped in vessels with design drafts over 40 feet (Table 78). The maximum DWT presently used for grain exports is in the 60,000 to 70,000 DWT range. The vessels have design drafts between 42 and 43 feet. Until the early 1990s, grain carriers in excess of 100,000 DWT were used for the Texas bulk grain exports. The larger vessels were associated with the former Soviet Union and Northern Europe grain shipments. Currently, the maximum parcel sizes are in the 50,000 to 60,000 short tons range.

[43] USDA, Economic Research Service, USDA Wheat Baseline to 2018/2019, Wheat Trade Projections (Table 35), February 2009.

Table 77
Beaumont Bulk Grain Exports
to Ports with Channel Depths Over 40 Feet

| | Trade Partners for Draft-Restricted Tonnage | | | | | | |
|---|---|---|---|---|---|---|---|
| Destination | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| Damietta, Egypt | 65,571 | 66,612 | 184,374 | 57,417 | 64,403 | 63,643 | 53,998 |
| Aqaba, Jordon | 110,802 | 57,292 | 0 | 43,070 | 111,903 | 0 | 0 |
| Durban, South Africa | 0 | 55,186 | 0 | 0 | 0 | 0 | 0 |
| Haifa, Israel | 0 | 35,834 | 0 | 0 | 0 | 0 | 0 |
| Constanta, Romania | 0 | 0 | 0 | 59,061 | 59,341 | 0 | 0 |
| Khor al Zubair, Iraq | 0 | 0 | 0 | 0 | 0 | 104,905 | 724,461 |
| Djibouti, Djibouti | 0 | 0 | 0 | 0 | 0 | 191,853 | 43,276 |
| Exports to Ports with Depths Over 40 feet | 176,373 | 214,923 | 184,374 | 159,548 | 235,647 | 360,401 | 821,735 |
| Total Bulk Grain Exports | 894,000 | 858,000 | 835,000 | 1,125,000 | 1,329,000 | 1,082,000 | 1,214,000 |
| % of Total Grain Exports | 19.7 | 25.0 | 22.1 | 14.2 | 17.7 | 33.3 | 67.7 |

Source: Compiled from the USACE, NDC detailed records.

Table 78
Importers of Wheat (USDA Forecast), 2004/2005 to 2015/2016 a/

| % Distribution | 2004/2005 | 2005/2006 | 2006/2007 | 2007/2008 | 2008/2009 | 2009/2010 | 2010/2011 | 2015/2016 |
|---|---|---|---|---|---|---|---|---|
| Brazil | 4.9 | 5.1 | 5.4 | 5.7 | 5.7 | 5.9 | 5.9 | 5.8 |
| Europe and Mediterranean | 32.0 | 32.5 | 32.4 | 32.7 | 32.8 | 32.9 | 32.8 | 44.2 |
| Africa (non- Mediterranean) | 11.2 | 11.5 | 11.3 | 11.1 | 11.1 | 11.0 | 11.0 | 0.0 |
| Far East | 29.2 | 26.5 | 26.1 | 25.8 | 26.0 | 26.0 | 26.0 | 26.0 |
| Former Soviet Union | 4.2 | 3.6 | 4.2 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 |
| India/Bangladesh | 3.1 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.3 | 2.4 |
| Mexico, South and Central America | 11.7 | 12.2 | 12.2 | 12.1 | 12.1 | 12.2 | 12.1 | 11.9 |
| Mideast | 2.9 | 3.7 | 3.8 | 3.6 | 3.5 | 3.4 | 3.4 | 3.5 |
| Other | 0.7 | 2.3 | 2.1 | 2.1 | 2.1 | 2.0 | 2.0 | 1.8 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: USDA, Economic Research Service, February 2006.

a/ February 2006, an updated trade route distribution was released but not presented (February 2009). Beaumont's wheat exports were assumed to continue Europe and the Mediterranean and expand to other markets as demand arises.

Note: Totals may not add due to rounding.

## 4.17 BREAKBULK IMPORT FORECAST

Analysis of the vessel fleets and utilization, and existing and future constraints associated with imports of aggregate products, such as iron ore, steel slab, limestone, and sand and gravel, and discussion with industry personnel suggested that 50 percent of limestone and sand and gravel, iron ore, and steel slab would be transported in vessels with loaded drafts over 40 feet (sections 3.9 and 3.10). Limestone and rock are classified as crude materials by WCSC. Iron ore and steel slab are classified as manufactured goods by WCSC. In addition to these classifications, crude materials are exported. SNWW's crude materials, primarily dry sulfur, clay, and refractory materials, are exported from SNWW. Table 79 displays SNWW's breakbulk tonnage forecast.

Table 79
SNWW Bulk Commodities Forecast, 2019–2069
2001–2007 Historical Data, Short Tons

| | Crude Materials Imports Historical | | Crude Materials Exports Historical | | Manufactured Goods Imports Historical | |
|---|---|---|---|---|---|---|
| Year | Beaumont | Port Arthur | Beaumont | Port Arthur | Beaumont | Port Arthur |
| 2001 | 622,000 | 131,000 | 165,000 | 0 | 103,000 | 665,000 |
| 2002 | 394,000 | 919,000 | 14,000 | 2,000 | 204,000 | 641,000 |
| 2003 | 583,000 | 481,000 | 73,000 | 20,000 | 115,000 | 557,000 |
| 2004 | 559,000 | 531,000 | 104,000 | 41,000 | 420,000 | 564,000 |
| 2005 | 624,000 | 558,000 | 106,000 | 14,000 | 471,000 | 710,000 |
| 2006 | 550,000 | 566,000 | 243,000 | 54,000 | 364,000 | 542,000 |
| 2007 | 617,000 | 513,000 | 421,000 | 64,000 | 173,000 | 122,000 |
| | Crude Materials Import Forecast | | Crude Materials Export Forecast | | Manufactured Goods Import Forecast | |
| Year | Beaumont | Port Arthur | Beaumont | Port Arthur | Beaumont | Port Arthur |
| 2019 | 760,862 | 712,739 | 344,873 | 38,319 | 428,221 | 523,626 |
| 2029 | 884,920 | 828,951 | 400,240 | 44,471 | 498,041 | 607,630 |
| 2039 | 1,029,206 | 964,110 | 465,498 | 51,722 | 579,247 | 705,110 |
| 2049 | 1,197,017 | 1,121,308 | 541,397 | 60,155 | 673,692 | 818,228 |
| 2059 | 1,392,189 | 1,304,136 | 629,672 | 69,964 | 783,537 | 949,493 |
| 2069 | 1,619,184 | 1,516,661 | 732,339 | 81,371 | 911,292 | 1,101,817 |

## 5.0 FORECAST OF TOTAL OCEANGOING TONNAGE

Tables 80 and 81 summarize the forecasts for the major commodity groups evaluated for channel deepening. The Port Arthur forecast is shown in Table 80 and Beaumont's forecast in Table 81. Discussions of each of the tonnage forecasts major groups are provided in the sections that follow.

Table 80
Port Arthur Tonnage Evaluated for Channel Deepening*
(1,000s of short tons)

| | | Petrochemicals | | | | | Breakbulk | | Liquefied |
|---|---|---|---|---|---|---|---|---|---|
| | Crude | Petroleum Products | | Chemical Products | | Coastwise a/ | Crude | Primary Manuf. | Natural Gas |
| Year | Petroleum Imports | Imports | Exports | Imports | Exports | Products | Materials | Goods | Imports |
| 2001 | 11,064 | 641 | 2,327 | 25 | 136 | 1,043 | 131 | 665 | 0 |
| 2002 | 9,013 | 997 | 3,143 | 89 | 176 | 1,422 | 921 | 641 | 0 |
| 2003 | 11,987 | 1,152 | 3,734 | 60 | 210 | 2,577 | 501 | 557 | 0 |
| 2004 | 10,015 | 2,150 | 4,255 | 225 | 889 | 1,804 | 572 | 564 | 0 |
| 2005 | 9,320 | 2,205 | 3,858 | 194 | 998 | 1,803 | 572 | 710 | 0 |
| 2006 | 10,627 | 1,144 | 4,391 | 111 | 1,330 | 2,323 | 620 | 542 | 0 |
| 2007 | 10,334 | 772 | 3,978 | 97 | 1,525 | 3,330 | 577 | 122 | 0 |
| Port Arthur Tonnage Forecast* | | | | | | | | | |
| 2019 | 12,248 | 1,811 | 6,879 | 223 | 1,462 | 3,002 | 751 | 524 | 5,828 |
| 2029 | 13,663 | 2,027 | 9,013 | 246 | 1,872 | 3,754 | 873 | 608 | 6,175 |
| 2039 | 14,509 | 2,312 | 10,255 | 272 | 2,396 | 4,506 | 1,016 | 705 | 6,175 |
| 2040 | 14,800 | 2,589 | 11,619 | 301 | 2,647 | 4,977 | 1,181 | 818 | 6,175 |
| 2059 | 15,100 | 2,901 | 13,124 | 332 | 2,924 | 5,498 | 1,374 | 949 | 6,175 |
| 2069 | 15,469 | 3,250 | 14,850 | 367 | 3,229 | 6,073 | 1,598 | 1,102 | 6,175 |

a/ Includes coastwise crude petroleum shipments and receipts.
*Deepening Benefits were calculated for a percentage of the tonnage presented in this table. Discussion of the commodity-specific percentages is contained in the previous and following sections.

Table 81
Beaumont Tonnage for Major Commodity Groups *
1,000s of short tons

| | | Petrochemicals | | | | | | Breakbulk | |
|---|---|---|---|---|---|---|---|---|---|
| | Crude Petroleum | Petroleum Products | | Chemical Products | | Coastwise a/ | Grain | Crude | Primary Manuf. |
| Year | Imports | Imports | Exports | Imports | Exports | Products | Exports | Materials | Goods |
| 2001 | 53,162 | 2,093 | 2,793 | 729 | 1,160 | 2,793 | 858 | 787 | 103 |
| 2002 | 57,370 | 4,031 | 2,492 | 594 | 1,411 | 2,712 | 835 | 408 | 204 |
| 2003 | 58,171 | 4,035 | 2,839 | 374 | 1,345 | 2,732 | 1,125 | 656 | 115 |
| 2004 | 59,860 | 3,852 | 2,897 | 431 | 1,215 | 3,191 | 1,329 | 663 | 420 |
| 2005 | 50,371 | 3,144 | 2,496 | 890 | 893 | 2,967 | 1,082 | 703 | 471 |
| 2006 | 46.988 | 2,676 | 2,432 | 1,133 | 1,574 | 3,115 | 1,214 | 793 | 364 |
| 2007 | 47,776 | 2,948 | 2,713 | 858 | 1,644 | 3,261 | 1,632 | 1,632 | 173 |
| Beaumont Tonnage Forecast * | | | | | | | | | |
| 2019 | 81,980 | 3,362 | 4,586 | 967 | 1,787 | 4,899 | 2,129 | 1,106 | 428 |
| 2029 | 91,463 | 3,765 | 6,008 | 1,068 | 2,288 | 6,125 | 2,351 | 1,285 | 498 |
| 2039 | 97,152 | 4,293 | 7,458 | 1,180 | 2,928 | 7,351 | 2,597 | 1,495 | 579 |
| 2049 | 99,136 | 4,809 | 8,450 | 1,303 | 3,235 | 8,120 | 2,869 | 1,738 | 674 |
| 2059 | 101,149 | 5,387 | 10,738 | 1,439 | 3,573 | 8,970 | 3,169 | 2,022 | 784 |
| 2069 | 103,189 | 6,036 | 12,150 | 1,590 | 3,947 | 9,908 | 3,501 | 2,352 | 911 |

a/ Includes coastwise crude petroleum shipments and receipts.

* Deepening Benefits were calculated for a percentage of the tonnage presented in this table.

Discussion of the commodity-specific percentages is contained in the previous and following sections.

# 6.0 TRANSPORTATION SAVINGS BENEFITS

This section presents the transportation savings benefits. Transportation savings benefits were calculated for channel widening and deepening.

## 6.1 VESSEL OPERATING COSTS

The vessel operating costs are shown in tables 82 to 84. Table 82 displays the hourly operating costs for tankers. The hourly operating costs include fuel, labor, and maintenance. The costs used were obtained from deep-draft vessel operating cost EGM December 2008 update. The tanker costs were used for the crude petroleum, petroleum product, and chemical product transportation cost calculations. The maximum-sized vessels using the channel to Beaumont on a regular basis are in the 150,000 DWT class. The maximum size using the Taylor Bayou Port Arthur facilities are in the 110,000 to 116,000 DWT range. As previously noted, the Port Arthur fleet is smaller, in terms of DWT, because the existing width at the mouth of Taylor Bayou limits the allowable vessel size. The U.S. flag tanker costs contained in Table 82 were used for calculating the transportation costs for U.S. coastwise product movements. Table 83 displays the foreign flag bulk carrier operating costs which were used for the grain exports and imports of iron ore, metal products, limestone and rock. Table 84 displays the LNG vessel operating costs. The LNG costs were estimated in consultation with the Institute of Water Resources (IWR).

Table 82
Tanker Characteristics and Hourly Operating Cost
Double-Hull Tankers, December 2008 IWR Release

| Vessel DWT | Design Draft (feet) | Immersion Factor | Hourly Cost ($) Foreign-Flag At Sea | Foreign-Flag In Port | U.S. Flag At Sea | U.S. Flag In Port |
|---|---|---|---|---|---|---|
| 20,000 | 32.3 | 78.7 | 659 | 403 | 1,470 | 1,214 |
| 25,000 | 33.4 | 90.8 | 696 | 430 | 1,565 | 1,300 |
| 35,000 | 35.6 | 112.6 | 766 | 481 | 1,747 | 1,463 |
| 50,000 | 38.7 | 141.4 | 865 | 554 | 2,005 | 1,693 |
| 60,000 | 40.7 | 158.9 | 952 | 622 | 2,239 | 1,909 |
| 70,000 | 42.6 | 175.4 | 1,001 | 653 | 2,354 | 2,007 |
| 80,000 | 44.6 | 191.0 | 1,058 | 692 | 2,496 | 2,130 |
| 90,000 | 46.4 | 205.9 | 1,107 | 724 | 2,610 | 2,226 |
| 110,000 | 50.0 | 234.1 | 1,192 | 772 | 2,793 | 2,374 |
| 150,000 | 56.4 | 285.4 | 1,369 | 878 | 3,190 | 2,700 |
| 165,000 | 58.6 | 303.4 | 1,439 | 922 | 3,350 | 2,833 |
| 175,000 | 70.3 | 410.7 | 1,485 | 951 | 4,400 | 3,707 |
| 265,000 | 73.2 | 444.5 | 1,900 | 1,207 | 4,764 | 4,010 |
| 320,000 | 74.5 | 463.3 | 2,061 | 1,306 | 4,971 | 4,182 |

Source: Application of USACE, December 2008 Foreign Flag Tanker Costs presented in Economic Guidance Memorandum #08-04, Deep-Draft Vessel Operating Cost FY 2008, December 2007.

Table 83
Dry Bulk Carrier Characteristics and Hourly Operating Cost
Foreign Flag Dry Bulk Carriers, December 2008 IWR Release

| Vessel DWT | Design Draft (feet) | Immersion Factor | Hourly Cost ($) At Sea | Hourly Cost ($) In Port |
|---|---|---|---|---|
| 60,000 | 41.6 | 153.5 | 807 | 552 |
| 70,000 | 43.6 | 168.6 | 847 | 578 |
| 80,000 | 45.6 | 183.7 | 886 | 603 |
| 90,000 | 47.5 | 197.4 | 940 | 643 |
| 100,000 | 49.4 | 211.1 | 994 | 683 |
| 120,000 | 52.0 | 236.5 | 1,092 | 754 |
| 135,000 | 55.9 | 271.8 | 1,236 | 857 |
| 150,000 | 55.9 | 271.8 | 1,236 | 857 |
| 175,000 | 58.7 | 299.2 | 1,355 | 942 |

Source: USACE, December 2008 unpublished update of Economic Guidance Memorandum #08-04, Deep-Draft Vessel Operating Cost FY 2008, December 2008.

Table 84
Liquefied Natural Gas Carriers
Characteristics and Hourly Operating Cost (December 2008 Vessel Costs)

| Vessel DWT | Design Draft (feet) | Cubic Meters Capacity | Immersion Factor | Hourly Cost ($) At Sea | Hourly Cost ($) At Sea |
|---|---|---|---|---|---|
| 76,500 | 37 | 145,000 | 248.7 | 1,773 | 1,506 |
| 100,000 | 39 | 210,000 | 315.2 | 2,073 | 1,753 |
| 125,000 | 40 | 250,000 | 358.1 | 2,302 | 1,937 |
| 125,000 | 40 | 265,000 | 372.4 | 2,423 | 2,039 |

Source: Application of USACE, December 2008 Foreign Flag Tanker Costs presented in Economic Guidance Memorandum #08-04, Deep-Draft Vessel Operating Cost FY 2008, December 2008.

The LNG design vessel used by ERDC for the ship simulations consisted of a 140,000-$m^3$ spherical-tank-type vessel 920 feet long, 142 feet wide, and 37.4 feet in draft, and a proposed 250,000-$m^3$ membrane-type tanker 1,126 feet long, 177 feet wide, and 39.4 feet in draft. The LNG facilities are in the Sabine Pass Channel and Port Arthur reaches. The project design vessel for crude petroleum tankers using the entrance channel and going to Beaumont is 899 feet long and 164 feet wide. These dimensions correspond to a 158,000 DWT crude petroleum tanker.

## 6.2 UNDERKEEL CLEARANCE

Underkeel clearance is defined as the minimum clearance available between the deepest point on the vessel and the channel bottom, in still water. The SNWW project depth allows vessels to transit with a maximum draft of 40 foot fresh water subject to the most recent USACE's hydrographic report, prevailing weather, and tidal conditions.[44] Galveston District's dredging practice also provides 2 feet of

[44] http://www.sabinepilots.com/index.html.

advance maintenance and 2 feet of overdepth to the existing project depth of 40 feet mean low tide. The availability of advance maintenance and overdepth can provide an extra 4 feet of underkeel clearance. As the dredging cycle transpires, the stated project depth of 40 feet mean low tide and the range of underkeel clearance available on a period basis obviously varies and generally diminishes. Given these circumstances, it is also recognized that the dredging cycle is established with the goal of maintaining a minimum available project depth of 40 feet mean low tide. As indicated, the subsequent effect of the dredging cycle interval may result in a greater concentration of vessels loaded to 39 to 40 feet for the period closer to the completion of maintenance dredging. While the current analysis contained in this portion of the report does not include an investigation of the dredging history in relationship to vessel trips by loaded draft, the annual distributions of trips by draft from the pilots and USACE NDC were evaluated. Specifically, the pilots' policy was evaluated in relationship to the USACE and the pilot records of trips by loaded draft as a means of understanding existing underkeel clearance practices.

Data associated with the number of vessel trips by loaded draft was presented in Table 23 as part of the vessel utilization presentation (Section 3.3). Interpretation of the pilots' policy suggests that loaded drafts in excess of 40 feet should be rare, Table 23 shows this to be true, with few loaded drafts over 40 feet. Based on analysis of the Corps data and the pilots' records, vessels are loaded to a maximum draft of 40 feet.

While the pilots emphasize 3 feet of underkeel clearance, review of the waterborne commerce data shows some sailing drafts exceed 40 feet. The pilot emphasis of 3 feet of underkeel for liquid cargoes and review of the WCSC-WCUS data, which show a high number of vessels with loaded drafts over 37 feet, revealed discrepancies that showed uncertainty. Based on these findings, the transportation cost calculations were made based on 1 foot of underkeel clearance used for all vessels except LNG. Based on industry input a 4- to 6-foot underkeel clearance was used for LNG vessels. The indication from pilot discussion was that an absolute minimum of 4 feet underkeel clearance would be required and the preference was for 6 feet. The effects of varying underkeel clearance are addressed in detail in the Sensitivity section of this appendix (Section 8).

## 6.3 CHANNEL WIDENING BENEFITS

Reduction in delay benefits were calculated for channel widening and for holding area alternatives. The benefit estimates are based on comparison of transit times between project alternatives. Transportation costs for existing conditions, the without-project condition, and the project alternatives were calculated using 2004 SNWW traffic base. Pilot records for 2001 and 2004–2005 were obtained from the SPA. Vessel characteristics and related details were obtained from the USACE NDC detailed records.

In terms of channel width, there are three main traffic rules presently affecting vessel traffic. The traffic rules, which affect movements in the 400- and 500-foot project reaches, are instituted by the SPA for the purpose of helping to ensure safe navigation (Section 1, Table 3). The results of these rules provide for a safe channel and a relatively low accident rate; however, the rules affect a significant portion of traffic in the form of vessel delays. The traffic first rule is that vessels with combined beam widths equaling or

exceeding 50 percent of the channel width cannot meet each other. The second main rule is that vessels of 85,000 DWT or more will not meet vessels of 30,000 or more or with loaded drafts of 30 feet or more above buoys 29 and 30. The third rule is that vessels of 48,000 DWT or more with a loaded draft of 30 feet or more will not meet above buoys 29 and 30. Vessels going to existing port facilities in Port Arthur, Beaumont, and terminals in between are all affected by these traffic rules. The effect of the pilot rules in the existing 400- and 500-foot reaches is that inbound crude petroleum tankers that characteristically are in the 90,000 to 150,000 DWT range with beam widths between 135 and 145 feet and inbound loaded over drafts of 35 feet cannot meet an outbound tanker of a comparable size at a lesser or a blast draft nor can it meet a 106-foot-beam outbound chemical or product tanker.

The HarborSym model was used in evaluation of the Entrance Channel widening and the Neches River turning basin and anchorage features. The outputs from HarborSym were aggregated into Excel spreadsheets and are summarized in this section of the report. HarborSym is a planning-level model developed by the IWR to assist in economic analyses of channel widening improvements. HarborSym is an event-driven simulation model and includes data from user-specified transit rules that the model processes with each vessel call in order to calculate delays within the system. While not yet certified, the model is scheduled for review under the USACE certification system. The model is presently in the model certification process. The model is presently being used by several USACE district offices for channel-widening studies, and these outputs have undergone Agency Technical Review and USACE headquarters review.

As noted, channel widening was considered for the channel reaches from the Sabine Pass Channel inland through the Neches River Channel during the initial screening. The channel-widening alternatives evaluated include widening of the existing 500-foot Sabine Pass Channel and Port Arthur Canal and the 400-foot Sabine-Neches Canal and Neches River Channel. Table 85 presents the mileage from the offshore Entrance Channel to the jetty where the Sabine Pass Channel starts. The pilots board at either the Sabine Bar (SB) Buoy or the Sea Buoy. As shown from the mileage points in Table 85, the SB Buoy is farther seaward than buoys 29 and 30. Under present conditions, the pilots steer vessels from the SB Buoy or from buoys 29 and 30. Under present conditions, vessels with loaded drafts of 28 feet or more are piloted to and from SB Buoy, and vessels with lighter drafts are piloted from buoys 29 and 30. The effect of widening the Sabine Pass Channel to 500 feet will provide a continuous series of reaches for the inbound and outbound convoys to meet.

Table 85
SNWW Mileage Points

| Location | Approximate Mileage Point |
|---|---|
| Sabine Bar (SB) Buoy | 0.0 |
| Sea Buoy (Markers #29 and 30) | 14.0 |
| East Jetty Light | 16.3 |
| LNG Facilities Sabine Pass | 21.6 |
| LNG Facility Port Arthur Canal | 24.5 |
| Texas Island (Junction to Taylor Bayou) | 30.2 |
| Taylor Bayou Crude Oil and Product Facilities | 31.5 |
| Martin Luther King Bridge | 32.2 |
| Port of Port Arthur Bulk Materials | 32.6 |
| Mouth of Neches River Channel to Beaumont | 40.0 |
| Rainbow Bridge | 41.5 |
| Crude Petroleum and Product Facilities, Lower Neches | 41.7 |
| Port Neches Crude Petroleum and Product Facilities | 44.8 |
| Crude Petroleum Terminal | 46.1 |
| Crude Petroleum Terminal | 47.6 |
| Crude Petroleum Terminal | 50.9 |
| Petroleum Coke Terminal | 54.8 |
| Crude Petroleum Terminal | 55.2 |
| Municipal Docks Bulk Materials | 56.1 |
| Trinity Industries | 57.2 |

In addition to channel widening, the proposed Neches River turning basin anchorages were identified based on user input as a less costly alternative to channel widening. These proposed features would be used to facilitate vessel passing. The turning basin and anchorages would all be located above mile 40 shown in Table 86. Current and future use of the existing turning basins and new holding and turning sites is outlined in Table 86. The table shows the cross-section stations and approximate mile, from the Sabine Bank to the turning basin anchorages.

Under existing and without-project future conditions, there are four federally maintained turning basins on the Neches River. These are TBA 1, TBA 4, TB 6, and the Beaumont Maneuvering Area. TBA 1, TBA 4, and TB 6 are used to turn Suezmax vessels. The maximum-sized vessels using the Beaumont Maneuvering Area are light Aframax vessels. The Beaumont Maneuvering Area is not currently designed for Suezmax vessels nor will it be under the with-project future. Under existing conditions, Suezmax vessels partially use the maneuvering area but also rely on the open channel in order to turn. This condition will continue under the with-project condition. In addition to the four federally maintained turning basins, light Aframax vessels presently use TBA 2, a privately maintained basin, for turning and anchorage.

Table 86
Neches River Turning Basin and Anchorage Features

| | | | | | CURRENT USE Maximum Vessel Size and Federal Authority (Y/N) | | | | PROPOSED USE Maximum Vessel Size and Federal Authority (Y/N) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TURNING Maximum Vessel Size | | ANCHORAGE Maximum Vessel Size | | TURNING Maximum Vessel Size | | ANCHORAGE Maximum Vessel Size | |
| Title | Location | Description | Station Number | Estimated Miles from Sea Buoy | FEDERAL (Y/N) | | | | FEDERAL (Y/N) | | | |
| TBA 1 | Lower Fina | Turning Basin Anchorage 1 | 210+00 | 43.4 | Suezmax | Y | None a/ | N | Suezmax | Y | Suezmax | Y |
| TBA 2 | Upper Fina | Turning Basin Anchorage 2 | 275+00 | 44.6 | Suezmax a/ | N | None a/ | N | Suezmax | Y | Suezmax | Y |
| TB 3 | Port Neches | Turning Basin 3 | 370+00 | 46.4 | None | N | None | N | Suezmax | Y | None | N |
| TBA 4 | Lower Sun | Turning Basin Anchorage 4 | 510+00 | 49.1 | Suezmax | Y | None a/ | N | Suezmax | Y | Suezmax | Y |
| TB 5 | Upper Sun | Turning Basin 5 | 570+00 | 50.2 | Shallow-Draft Barges b/ | N | Shallow-Draft Barges b/ | N | Suezmax | Y | None | N |
| TB 6 | Oil Tanking | Turning Basin 6 | 700+00 | 52.7 | Suezmax | Y | None | N | Suezmax | Y | None | N |
| AB 7 | PA 25 | Anchorage Basin 7 | 750+00 | 53.6 | None | N | None | N | None | N | Suezmax c/ | Y |
| AB 8 | Below Exxon | Anchorage Basin 8 | 850+00 | 56.5 | None | N | None | N | None | N | Suezmax c/ | Y |
| None | Beaumont | Beaumont Maneuvering Area | 975+00 | 58.8 | Suezmax | Y | None | N | Suezmax | Y | None | N |

a/ Light vessels under emergency conditions.

b/ Under existing conditions, TB 5 is private and used by shallow-draft barges. A new turning basin is proposed immediately north of existing TB 5. This basin would be designed for loaded Suezmax tankers.

c/ For the "with-project future," anchorage basins 7 and 8 are designed for anchorage; however, the pilots intend to use anchorage basins 7 and 8 for both the anchorage and turning of Suezmax vessels.

While official publications note that there are no Federal anchorage areas on the Neches River Channel and that only emergency anchorage is permitted[45], analysis of the pilots' records showed that several sites are routinely used for temporary anchorage of light vessels. Table 87 displays the 2005 distribution of inbound vessels by docks and anchorage basins and suggests that the anchorages are used on more than emergency basis by light vessels. The pilots verified that the anchorages are used by light vessels (TBA 1, TBA 2, and TBA 4). The data shown in Table 87 indicate that 11 percent of vessels presently use unofficial anchorages. Of the total of 1,404 shown in Table 87, 161 vessels used the unofficial anchorages under existing conditions.

Seven federally maintained turning basins, including the Beaumont Maneuvering Area, and five anchorages are proposed under the with-project condition. TB 2, TB 3, and TB 5 would become Federal turning basins under the with-project condition. TB 1, TB 4, TB 6, and the Beaumont Maneuvering Area are existing Federal features, and they would be enlarged under the with-project condition. All of the anchorage basin components represent new Federal features (TBA 1, TBA 2, TBA 4, AB 7, and AB 8). Three of the basins (TBA 1, TBA 2, and TBA 4) are used for anchorage under existing conditions to a limited extent, but the limited anchorage component is not presently part of the Federal project. The pilots noted that under present conditions, the vessels are wedged in at those locations. Depth availability is limited to light-loaded or ballasted vessels. Additionally, while TBA 1, TBA 2, and TBA 4 currently provide anchorage function; they cannot serve as turning basins while vessels are anchored in them. The with-project condition would provide for concurrent use of TBA 1, TBA 2, and TBA 4 for both turning and anchorage of individual vessels.

As the titles indicate, some of the individual features will include a turning basin and an anchorage (TBAs 1, 2, and 4), and some just a turning basin (TB 3, TB 5, and TB 6) or an anchorage (AB 7 and AB 8). The SPA noted that the turning basin and anchorages, such as TBA 1, TBA 2, TBA 4, TBA 7, and AB 8 will be designed to enable a 48-foot loaded Suezmax tanker to use the inner portion of the feature as an anchorage and also allow a 48-foot loaded Suezmax tanker to turn in the turning basin section. While some of the features listed in Table 87 would be developed from existing basins (TBA 1, TBA 4, and TB 6) or are new basins (TBA 2, TB 3, TB 5, AB 7, and AB 8); the anchorage components of the features are essentially new and the proposed dimensions represent new dredging.

[45] NDC, Ports of Port Arthur, Beaumont, and Orange, Texas, NDC-01-P-5, Port Series, No. 22, Revised 2001.

Table 87
Neches River Inbound Vessels by Destination
Existing Base

| Destination | Annual CY 2005 Inbound Vessels a/ | Maximum Vessel Beam (feet) in CY2005 a/ | Channel Depth (feet) b/ | Maximum Vessel Length (feet) b/ | Closest Existing or Future Anchorage Basin |
|---|---|---|---|---|---|
| Fina Anchorage (Lower) | 112 | 158 | - | - | TBA 1-2 |
| Fina Anchorage (Upper) | 49 | 144 | - | - | TBA 1-2 |
| Sun Anchorage Lower | 20 | 158 | - | - | TBA 4 |
| **Suezmax and Aframax Size Docks** | | | | | |
| Total Petrochemicals #2 | 130 | 158 | 40 | 900 | TBA 1 |
| Motiva, Port Neches #1 | 127 | 139 | 40 | 950 | TBA 2 |
| Unocal #5 | 64 | 138 | 40 | 1,170 | TBA 4 |
| Unocal #2 | 100 | 151 | 40 | 1,020 | TBA 4 |
| Sun Terminal #1 | 48 | 138 | 38 | 875 | TBA 4 |
| Sun Terminal #2 | 67 | 164 | 40 | 1,000 | TBA 4 |
| Sun Terminal #3 | 86 | 164 | 40 | 1,000 | TBA 4 |
| Sun Terminal #4 | 99 | 158 | 40 | 1,000 | TBA 4 |
| Sun Terminal #5 | 63 | 146 | 40 | 1,000 | TBA 4 |
| Oil tanking (North) | 141 | 158 | 40 | 900 | TBA 4 |
| Exxon Mobil #5 | 212 | 139 | 40 | 850 | AB 7–8 |
| Subtotal | 1,137 | | | | |
| % of Total | 81 | | | | |
| **Panamax Size Docks** | | | | | |
| Total Petrochemicals #1 | 1 | 106 | ≤40 | ≤800 | TBA 1 |
| Huntsman East | 13 | 106 | ≤40 | ≤800 | TBA 2 |
| Huntsman West | 1 | 68 | ≤40 | ≤800 | TBA 2 |
| Transit Mix | 4 | 106 | ≤40 | ≤800 | TBA 2 |
| Unocal #1 Main Dock | 28 | 106 | ≤40 | ≤800 | TBA 4 |
| Martin Gas/Sulphur Basin | 11 | 106 | ≤40 | ≤800 | TBA 4 |
| Oil tanking (South) | 40 | 106 | ≤40 | ≤800 | TBA 4 |
| Exxon Mobil #2 | 25 | 106 | ≤40 | ≤800 | AB 7–8 |
| Exxon Mobil #4 | 42 | 106 | ≤40 | ≤800 | AB 7–8 |
| Neches River Terminal | 15 | 106 | ≤40 | ≤800 | AB 8 |
| Port of Beaumont | 26 | 106 | ≤40 | ≤800 | AB 8 |
| Grain Elevator | 24 | 106 | ≤40 | ≤800 | AB 8 |
| Carrol St., Beaumont Bulk | 36 | 106 | ≤40 | ≤800 | AB 8 |
| Bean's West Fleet | 1 | 60 | ≤40 | ≤800 | AB 8 |
| Subtotal | 267 | | | | |
| % of Total | 19 | | | | |
| Total Number of Inbound Vessels | 1,404 | | | | |

a/ Sabine Pilots Association, 2007.
b/ USACE, NDC, Ports of Port Arthur, Beaumont, and Orange, Texas, NDC-01-P-5, Port Series, No. 22, Revised 2001.

The HarborSym model was used to evaluate widening of the Sabine Pass Channel and Port Arthur Canal and the turning basin and anchorage features. The HarborSym model results are for the baseline benefit calculations. Sensitivity analysis of the turning basin and anchorages was made using pilot interview data. Pilot interview data, including vessel log information and estimate of transit times, were crucial parts of building the SNWW HarborSym application. Model calibration is additionally crucial, and concerns about the ability of HarborSym to capture and model the pilots' anticipated behavior as it relates to the Neches River turning basin anchorage features were not resolved. There is a greater level of uncertainty associated with the Neches River anchorages than with the widening of the Sabine Pass Channel and Port Arthur Canal reaches. In reviewing the model outputs with the pilots, they found that the effects on transit times and vessel throughput associated with Sabine Pass Channel and Port Arthur Canal outputs were within their expectations. The time savings associated with the HarborSym Neches River turning basin and anchorage features runs are much lower than anticipated.

### 6.3.1 HarborSym Model

The HarborSym model is designed to create an event-driven simulation based on data stored in a database, instead of customization within a simulation environment. Included in these data are the user-specified transit rules that the model processes with each vessel call in order to calculate delays within the system. Users can define alternative sets of channel dimensions or rules reflecting harbor improvements to determine potential transportation cost savings resulting from reduced delays.

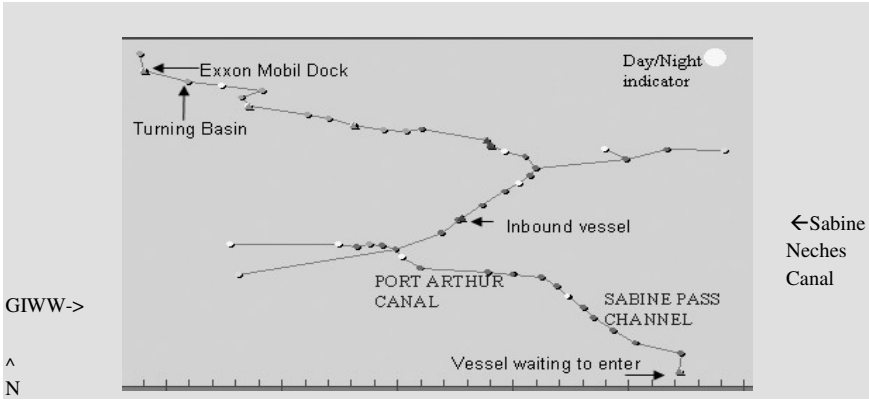
HarborSym outputs were crucial for aggregation and understanding of base condition delays. Pilot interviews were used to identify a wide range of information, including delay times. Vessel-class-specific delay times were obtained from the model output, with these inputs having been defined using pilot logs and extensive pilot interviews. A basic schematic of the SNWW from within the jetty starting at the Sabine Pass Channel is displayed on Figure 57. The key element in modeling the harbor system was replicating transit rules as listed in Table 3 of Section 1.

Inland waterway barge traffic was not included in HarborSym. Barge traffic moves through the Sabine-Neches Canal section of the SNWW. The Sabine-Neches Canal reach presently has a deep-draft project width of 400 feet, and deep-draft vessels do not meet other deep-draft vessels or tows in that reach. The project reach proposed for widening is the Sabine Pass Channel and the Port Arthur Canal, which is approximately 15 miles long and south of the Sabine-Neches Canal. Vessel-to-barge communication and the recently active VTM will help ensure that tow-barge and vessel transits do not overlap. Presently, every effort is made to avoid overlap of tow-barge and vessel transits.

Vessel-to-tow communication has greatly improved since the beginning of the study process. Additionally, the VTM is operational and very effective in planning vessel transits. Discussions with the tow industry, the VTM, and the deep-draft vessel pilots indicated that the relative impacts to tow-barge traffic are anticipated to be similar between the without- and with-project future due to vessel management. The with-project condition of channel deepening will provide the advantage of fewer oceangoing vessel trips for a given volume of traffic and, therefore, result in a net reduction in overall

congestion between the without- and with-project future conditions. The decision to forgo the barge shelf was made by the tow industry due to reconsideration of how vessels and barges would interact. The concern that was raised, but not physically modeled, was that the tow-barges could get pulled under or out into the channel as it either meets a deep-draft vessel or "held-up or idled" in the barge shelf. The tow operators originally thought that they wanted the shelf in case radio and/or other communication failed and a tow-barge could not clear the channel as a deep-draft vessel began its transit through the reach. An additional variable in deciding against the barge shelf was the activation of the VTM.

Figure 57
SNWW HarborSym Network




#### 6.3.1.1 Model Input Overview

HarborSym requires inputs associated with vessel traffic, channel dimensions, docks, reach length, entrance and exits, and topographic nodes. The point of entrance is the Gulf of Mexico. From the "entrance point," the channel moves inward through a series of topographic nodes along the Sabine Pass Jetty Channel to the Sabine Pass Channel and then to the Port Arthur Canal and onward. Most topographic nodes are situated at the end of one channel reach and the start of another, such as the nodes on either end of the Sabine Pass Channel and the Port Arthur Canal. Some are at the junction of the Sabine-Neches Canal at the Neches River Channel and the junction of the Port Arthur Canal and Taylor Bayou. The Port Arthur Canal and Taylor Bayou junction is just north of the Port Arthur Canal junction with the GIWW. The topographic nodes generally reflect traffic rule changes.

For modeling purposes, docks are generally aggregated as a group. Moving in from the offshore entrance channel, the first dock destination on the Sabine Pass Channel is for Cheniere LNG and Offshore Marine. Moving into the next reach, the Golden Pass LNG, which is presently under construction, and the proposed Sempra terminal are contained in the next dock cluster located on the Port Arthur Canal. Within Taylor Bayou there are two major dock points with other docks within Taylor Bayou being grouped under

one of the two majors. At the lower end of the Neches River, several petroleum terminals are tied to a central dock destination. The Neches River Channel includes six center dock destinations.

Ten vessel types were defined and two or more classes per vessel type were defined. The vessel types are general cargo/RoRo, oil tanker, chemical tanker, LPG tanker, LNG tanker, bulk carrier, oceangoing tank/barge, tugboat, miscellaneous/other, and tug/barge. The vessel classes are based on vessel dimensions. Table 88 lists most of the major vessel classes and their associated DWT, beam width, and vessel operating costs. Additional variables, such as vessel length and load draft, were necessary inputs but are not shown in the table. Vessel loaded draft was tied to the "vessel call list," which is another major level. The model structure contained several first level components and vessel characteristics and associated operating costs are included under the "vessel type heading." Port traffic is a level one heading and it includes the vessel call list. Table 89 displays the general framework used for SNWW and shows most of the major line items. For nearly all of the items listed, additional levels of definitions and details are inputted. For example, under the reach heading, 48 reaches are defined. The general framework shown in Table 90 would be similar for other port studies.

#### 6.3.1.2 Vessel Traffic Input

Vessel trip estimates were prepared for the 2000–2004-period base and for 2030–2040 average trips. The vessel classes were established based on the HarborSym vessel structure. The coding sheet corresponding to the vessel classes is presented in Table 14. The 2000–2004 period tonnage and the 2000–2004 fleet are presented in tables 91 and 92.

Table 88
SNWW HarborSym Model Vessel Classes

| Vessel | DWT Range | | Beam Range (feet) | | Hourly Operating Cost ($) | | Port Shifting |
|---|---|---|---|---|---|---|---|
| Type a/ | Min | Max | Min | Max | at Sea | In Port | Cost ($) |
| OIL5 | 133,000 | 170,000 | 142 | 160 | 1,585 | 953 | 737 |
| OIL1 | 8,000 | 56,000 | 60 | 104 | 825 | 475 | 358 |
| OIL2 | 45,000 | 73,000 | 104 | 107 | 1,011 | 607 | 385 |
| OIL3 | 67,000 | 97,000 | 115 | 127 | 1,174 | 712 | 449 |
| OIL4 | 80,000 | 113,000 | 127 | 150 | 1,399 | 846 | 509 |
| TNKB1 | – | 25,000 | 0 | 76 | 654 | 530 | 358 |
| TNKB2 | 25,000 | 50,000 | 0 | 76 | 654 | 530 | 358 |
| TUG1 | – | 25,000 | 0 | 76 | 463 | 350 | 358 |
| TUG2 | 25,000 | 50,000 | 76 | 100 | 976 | 719 | 358 |
| MISC1 | – | 50,000 | 0 | 76 | 463 | 350 | 358 |
| MISC2 | 50,000 | 70,000 | 106 | 131 | 976 | 719 | 379 |
| BLKC1 | – | 25,000 | 0 | 76 | 634 | 311 | 358 |
| BLKC2 | 25,000 | 53,000 | 76 | 106 | 799 | 424 | 358 |
| BLKC3 | 34,000 | 78,000 | 105 | 107 | 957 | 523 | 396 |
| CHEM1 | – | 25,000 | 0 | 76 | 759 | 420 | 358 |
| CHEM2 | 25,001 | 44,000 | 76 | 104.9 | 887 | 522 | 358 |
| CHEM3 | 33,000 | 49,000 | 105 | 107 | 1,015 | 610 | 358 |
| CHEM4 | 85,000 | 105,000 | 130 | 138 | 1,337 | 810 | 503 |
| LPG1 | – | 25,000 | 0 | 76 | 654 | 520 | 358 |
| LPG2 | 25,000 | 56,000 | 76 | 107 | 729 | 574 | 358 |
| LPG3 | 60,000 | 70,000 | 115 | 120 | 857 | 669 | 379 |
| LPG4 | 157,000 | 167,000 | 140 | 150 | 995 | 774 | 780 |
| GCRR1 | – | 25,000 | 0 | 76 | 657 | 352 | 358 |
| GCRR2 | 25,000 | 50,000 | 76 | 104 | 1,081 | 632 | 358 |
| GCRR3 | 42,000 | 69,000 | 104 | 107 | 1,469 | 930 | 377 |
| GCRR4 | 75,000 | 95,000 | 120 | 160 | 2,337 | 1,661 | 462 |

a/ This column contains the abbreviations for each of vessel classes. The abbreviations are shown for presentation purposes of how the inputs were defined.

Table 89
SNWW HarborSym Model Framework

| Description of Inputs | Model Layer |
|---|---|
| Existing Condition | Level 1 |
| Vessel Info | Level 2 |
| Vessel Types | Level 3 |
| General Cargo/RoRo | Level 4 |
| Oil Tanker | Level 4 |
| Chemical Tanker | Level 4 |
| Bulk Carrier | Level 4 |
| LNG Tanker | Level 4 |
| Commodity Info | Level 2 |
| Crude | Level 3 |
| Petroleum Products | Level 3 |
| Grain | Level 3 |
| Chemicals | Level 3 |
| Wood | Level 3 |
| Stone | Level 3 |
| etc. | Level 3 |
| Port Structures | Level 2 |
| Reaches | Level 3 |
| Anchorage | Level 3 |
| Entry/Exit | Level 2 |
| Turning Basins | Level 2 |
| Anchorage | Level 2 |
| Docks | Level 2 |
| Reaches | Level 2 |
| Outer Bar | Level 3 |
| Jetty Channel | Level 3 |
| etc. | Level 3 |
| Port Traffic | Level 3 |
| New Project Alternative | Level 1 |
| Vessel Info | Level 2 |
| Commodity Info | Level 2 |
| Port Structures | Level 2 |
| Entry/Exit | Level 2 |
| Turning Basins | Level 2 |
| Anchorage | Level 2 |
| Docks | Level 2 |
| Reaches | Level 2 |
| Port Traffic | Level 2 |
| Run Model | |

Table 90
HarborSym Vessel Classes

| | | Class 1 | Class 2 | Class 3 | Class 4 | Class 5 | Class 6 | Total Calls |
|---|---|---|---|---|---|---|---|---|
| Bulk | Min Beam | 0 | 76.1 | 105 | | | | |
| | Max Beam | 76 | 104.9 | 107 | | | | |
| | # calls | 46 | 143 | 59 | | | | 248 |
| | Min Capacity | 0 | 25,001 | 34,000 | | | | |
| | Max Capacity | 25000 | 53000 | 78,000 | | | | |
| Chemical Tanker | Min Beam | 0 | 76.1 | 105 | 130 | | | |
| | Max Beam | 76 | 104.9 | 107 | 138 | | | |
| | # calls | 102 | 76 | 131 | 1 | | | 310 |
| | Min Capacity | 0 | 25001 | 33000 | 85,000 | | | |
| | Max Capacity | 25000 | 44000 | 49000 | 105,000 | | | |
| General Cargo | Min Beam | 0 | 76.1 | 104 | 120 | | | |
| | Max Beam | 76 | 103.9 | 107 | 142 | | | |
| | # calls | 125 | 58 | 16 | 3 | | | 202 |
| | Min Capacity | 0 | 25,001 | 42,000 | 75,000 | | | |
| | Max Capacity | 25,000 | 50,000 | 69,000 | 95,000 | | | |
| LPG | Min Beam | 0 | 76.1 | 115 | 140 | | | |
| | Max Beam | 76 | 107 | 120 | 150 | | | |
| | # calls | 15 | 16 | 1 | 1 | | | 33 |
| | Min Capacity | 0 | 25,001 | 60,000 | 157,000 | | | |
| | Max Capacity | 25,000 | 56,000 | 70,000 | 167,000 | | | |
| MISC | Min Beam | 0 | 106 | | | | | |
| | Max Beam | 76 | 131 | | | | | |
| | # calls | 3 | 2 | | | | | 5 |
| | Min Capacity | 0 | 50,000 | | | | | |
| | Max Capacity | 25,000 | 70,000 | | | | | |
| Oil Tanker | Min Beam | 60 | 104.1 | 115 | 127.1 | 142 | | |
| | Max Beam | 104 | 107 | 127 | 150 | 160 | | |
| | # calls | 49 | 96 | 153 | 657 | 15 | | 970 |
| | Min Capacity | 8,000 | 45,000 | 67,000 | 80,000 | 133,000 | | |
| | Max Capacity | 56,000 | 73,000 | 97,000 | 113000 | 170,000 | | |
| Tank Barge | Min Beam | 0 | 76.1 | | | | | |
| | Max Beam | 76 | 107 | | | | | |
| | # calls | 92 | 11 | | | | | 103 |
| | Min Capacity | 0 | 25,001 | | | | | |
| | Max Capacity | 25,000 | 50,000 | | | | | |
| Tug | Min Beam | 0 | 76.1 | | | | | |
| | Max Beam | 76 | 100 | | | | | |
| | # calls | 55 | 12 | | | | | 67 |
| | Min Capacity | 0 | 25,001 | | | | | |
| | Max Capacity | 25,000 | 50,000 | | | | | |
| Total Calls | # calls | 487 | 414 | 360 | 662 | 15 | | 1,938 |
| | | 25.1% | 21.4% | 18.6% | 34.2% | 0.8% | | 100.0% |

Table 91
SNWW 2000/2004 Tonnage (1,000s of Short Tons) a/

| Type/Class Code | 1,000s Tonnage by Vessel Class, 2000/2004 Base | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Total |
| Bulk | 544.6 | 3,964.1 | 2,596.2 | 0.0 | 0.0 | 7,105.0 |
| Chem | 733.9 | 1,583.9 | 2,950.9 | 96.7 | | 5,365.5 |
| GenCargo | 705.3 | 418.6 | 190.6 | 24.1 | | 1,338.7 |
| LPG | 147.3 | 235.0 | 1.7 | 2.9 | | 386.9 |
| Misc | 0.0 | 0.3 | | | | 0.4 |
| Oil Tanker | 2,915.0 | 4,344.8 | 9,595.6 | 52,542.6 | 1,170.0 | 70,568.1 |
| Tank Barge | 1,306.3 | 138.6 | | | | 1,444.9 |
| Tug | 17.6 | 153.1 | | | | 170.7 |
| LNG | | | | | 5,777.0 | 5,770.0 |
| Total | 6,370.0 | 10,838.6 | 15,335.4 | 52,666.3 | 6,947.0 | 95,150.1 |

a/ LNG tonnage and vessels were included in the 2000/2004 HarborSym traffic analysis.

Table 92
Sabine-Neches Waterway 2000/2004 Trips a/

| Type /Class Code | Estimated Number of Vessel Calls by Vessel Class at Existing Depth | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Total |
| Bulk | 46 | 143 | 59 | 0 | 0 | 248 |
| Chem | 102 | 76 | 131 | 1 | 0 | 310 |
| GenCargo | 125 | 58 | 16 | 3 | 0 | 202 |
| LPG | 15 | 16 | 1 | 1 | 0 | 33 |
| Misc | 3 | 2 | 0 | 0 | 0 | 5 |
| Oil Tanker | 49 | 96 | 153 | 657 | 15 | 970 |
| Tank Barge | 92 | 11 | 0 | 0 | 0 | 103 |
| Tug | 55 | 12 | 0 | 0 | 0 | 67 |
| LNG | 0 | 0 | 0 | 0 | 119 | 119 |
| Total | 487 | 414 | 360 | 662 | 134 | 2,057 |

a/ LNG tonnage and vessels were included in the 2000/2004 HarborSym traffic analysis.

Tables 93 through 95 present the 2030–2040 period tonnage and trip data. A "widening and deepening alternative" would generate greater savings than widening. In regard to the pilot rules (see Table 3), rule 1 would change if the channel was widened and deepened. Rule 1 says that vessels with combined beam widths that equal or exceed one-half of the channel width are not permitted to meet day or night. If the channel was just widened, rules 3 and 4 would be relaxed as well. The effect of deepening and widening will likely be to result in vessels with loaded drafts of less than 40 feet being able to meet; however, vessels with loaded drafts over 40 feet would be much more restricted. While the vessel pilots indicated that the effect of deepening would mean a loss of some of the gains in terms of relaxing rules 3 and 4, a widening-only alternative would produce a lower number of vessels and could result in higher savings. The effects of deepening and widening on total transportation costs are discussed in the sensitivity section (Section 8).

Table 93
SNWW 2030/2040 Tonnage (1,000s of Short Tons)

| | 1000s Tonnage by Vessel Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Type /Class Code | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Bulk | 835 | 6,079 | 3,982 | – | – | – | 10,896 |
| Chem | 1,231 | 2,656 | 4,949 | 162 | – | – | 8,998 |
| GenCargo | 1,155 | 685 | 312 | 40 | – | – | 2,191 |
| LPG | 235 | 376 | 3 | 5 | – | – | 618 |
| Misc | – | – | – | – | – | – | – |
| Oil Tanker | 4,497 | 6,703 | 14,804 | 81,064 | 1,805 | – | 108,875 |
| Tank Barge | 2,284 | 270 | – | – | – | – | 2,553 |
| Tug | 0 | 0 | – | – | – | – | 1 |
| LNG | – | – | – | – | 5,777 | – | 5,777 |
| Total | 10,237 | 16,770 | 24,049 | 81,271 | 7,582 | – | 139,909 |

Table 94
SNWW 2030/2040 Vessel Trips Without Deepening

| | Estimated Number of Vessel Trips by Vessel Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Type/Class | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Bulk | 71 | 219 | 90 | 0 | 0 | 0 | 380 |
| Chem | 171 | 127 | 220 | 2 | 0 | 0 | 520 |
| GenCargo | 205 | 95 | 26 | 5 | 0 | 0 | 331 |
| LPG | 24 | 26 | 2 | 2 | 0 | 0 | 53 |
| Misc | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| Oil Tanker | 76 | 148 | 236 | 1,014 | 23 | 0 | 1,497 |
| Tank Barge | 145 | 17 | 0 | 0 | 0 | 0 | 163 |
| Tug | 87 | 19 | 0 | 0 | 0 | 0 | 105 |
| LNG | 0 | 0 | 0 | 0 | 119 | 0 | 119 |
| Total | 780 | 652 | 574 | 1,023 | 142 | 0 | 3,170 |

Table 95
SNWW 2030/2040 Vessel Trips With Deepening

| | Vessel Trips by Vessel Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Type/Class | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Bulk | 71 | 138 | 112 | – | – | – | 321 |
| Chem | 171 | 80 | 210 | 6 | – | – | 467 |
| GenCargo | 205 | 60 | 41 | 7 | – | – | 312 |
| LPG | 24 | 14 | 7 | 3 | – | – | 48 |
| Misc | 1 | 1 | – | – | – | – | 2 |
| Oil Tanker | 236 | 86 | 61 | 579 | 315 | – | 1,277 |
| Tank Barge | 145 | 17 | – | – | – | – | 162 |
| Tug | 87 | 19 | – | – | – | – | 105 |
| LNG | – | – | – | – | 119 | – | 119 |
| Total | 940 | 415 | 431 | 595 | 434 | 0 | 2,815 |

#### 6.3.1.3 Evaluation of Project Alternatives

The HarborSym model was run for existing conditions and each of the project alternatives. The widening alternatives included widening of the Sabine Pass Channel and Port Arthur Canal channel from 500 to 700 feet. Evaluation of widths less than 700 feet was also conducted. Widening of the Sabine Pass Channel and Port Arthur Canal reaches were evaluated with and without the Neches River turning basin and anchorage alternatives, and the turning basin anchorage features were evaluated on an incremental basis. The transportation cost savings associated with widening of the Sabine Pass Channel and Port Arthur Canal reaches and Neches River turning basin and anchorage features were evaluated based on a 40-foot channel depth.

An anticipated effect of widening the Sabine Pass Channel and Port Arthur Canal to 700 feet would be to allow a higher percentage of vessels in the proposed 700-foot reach. The effect of widening on rule 1 would be that a larger number of vessels with wider beam would be able to meet. Rule 2 would not change with widening as it applies to the Sabine-Neches Canal, which is shared by GIWW barge traffic. Widening of the Sabine-Neches Canal reach was evaluated during the early formulation stages; however, cargo docks are located on the west side of canal in the lower end of the reach, and the Port Arthur Hurricane Protection Levee, also on the west side, is located in the following section of this reach.

Anticipated costs associated with channel widening due to the Hurricane Protection Levee in the Sabine-Neches Canal and docks along the Sabine-Neches Canal and Neches River Channel reaches limited the extent of structural alternatives that were carried into detailed analysis. As part of plan formulation, the Neches River anchorage basins were introduced as a less costly alternative to widening of the Neches River Channel to Beaumont. The anchorages would be used to facilitate vessel passing. During the initial screening, extensive but intermittent widening was evaluated for the channel reaches from Sabine Pass Channel, inland through the Neches River Channel. This and the other alternatives were screened based on comparison of anticipated reductions in vessel delay costs and initial project construction cost estimates and the outputs of the ERDC ship simulation modeling. Widening of the Neches River reach

was found not be a cost effective alternative due to costly dock relocations and extensive dredging. Additionally, intermittent widening of the Neches River Channel did not perform well during ERDC ship simulation modeling. In comparison, the Neches River anchorages and Sabine Pass Channel and Port Arthur Canal widening features performed favorably. The results of the ERDC modeling showed that a minimum width of 700 feet through the Sabine Pass Channel and Port Arthur Canal would be necessary for the Suezmax and Aframax vessels to meet smaller vessels in the Sabine Pass Channel and Port Arthur Canal. The project design vessel is 899 feet long and 164 feet wide. These dimensions correspond to a 158,000 DWT Suezmax crude petroleum tanker. A loaded and a ballast design vessel could not successfully meet in the ERDC test of the 600-foot channel nor could the design vessel and a smaller 110,000 DWT Aframax tanker meet. Aframax tankers characteristically range from 90,000 to 120,000 DWT, and the Suezmax tankers characteristically range from 120,000 to 175,000 DWT.

#### 6.3.1.4 Entrance Channel Widening Benefits

Evaluation of widening of the entrance channel to 700 feet through the Sabine Pass Channel and Port Arthur Canal showed that, using 2000–2004 traffic levels, vessels would save an average of 1.5 hours per round trip voyage, with an annual savings of $3,487,322. Summary output from the HarborSym model associated with widening the Sabine Pass Channel and Port Arthur Canal to 700 feet is displayed in Table 96. The benefits of widening only through the Sabine Pass Channel totaled approximately $2,269,264. Evaluation of Port Arthur by itself resulted in annual savings of approximately $2,579,760. The widening benefits shown in Table 96 are for the existing 40-foot channel depth and 2000–2004 period traffic. The effect of reductions in total vessel movements resulting from channel deepening is evaluated in the sensitivity section of this appendix.

Examination of the output data shows that for the without-project condition, which reflects the inclusion of LNG carriers, vessels are in the system for 78.2 hours. The output also shows that expansion of the Entrance Channel will reduce the time in system to 76.7 hours. In reviewing the changes in delay times, it was found that there are large variances in throughput times. The minimum time for the without-project condition was on average 11.9 hours, and the minimum time for the with-project condition also averaged 11.9 hours. The larger crude oil tankers showed throughput savings for the with-project condition. For instance, Suezmax vessels took an average of 86.7 hours under the without-project condition and an average of 83.1 hours with the widened entrance channel. The addition of the LNG vessels will result in longer waiting times for several vessel classes. Without the LNG vessels, the average number of hours in the system was 66.4. The effect of introducing the LNG vessels increases total delay times but reduces average times because the LNG vessels represent a large increase in vessels that travel shorter distances than the existing tanker fleet going to the Neches River and, therefore, will not be subject to delays.

Table 96
SNWW HarborSym Output Annual Savings by Vessel Class (2004-Period Traffic), Widening Only

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| OIL5 | System | 45.971 | 44.472 | 1.499 | | | | |
| 133,000 to | Waiting | 11.835 | 10.332 | 1.503 | | | | |
| 170,000 DWT | Reaches | 12.531 | 12.527 | 0.004 | 1,585 | 6 | 54 | 342 |
| | Loading | 19.194 | 19.2 | –0.006 | 953 | –6 | 54 | –309 |
| | TB | 0.311 | 0.311 | 0 | 1,585 | 0 | 54 | 0 |
| | Docking | 1.5 | 1.5 | 0 | 1,585 | 0 | 54 | 0 |
| | Undocking | 0.6 | 0.601 | –0.001 | 1,585 | –2 | 54 | –86 |
| | Wait Entry | 7.53 | 5.026 | 2.504 | 1,585 | 3,969 | 54 | 214,317 |
| | Wait Dock | 4.305 | 5.306 | –1.001 | 953 | –954 | 54 | –51,513 |
| | Waiting TB | 0 | 0 | 0 | 953 | 0 | 54 | 0 |
| | Waiting FN | 0 | 0 | 0 | 953 | 0 | 54 | 0 |
| | | | | | | Subtotal | | 162,752 |
| Oceangoing | System | 61.703 | 61.67 | 0.033 | | | | |
| Tank Barge | Waiting | 1.424 | 1.391 | 0.033 | | | | |
| Up to 25,000 | Reaches | 8.078 | 8.078 | 0 | 654 | 0 | 76 | 0 |
| DWT | Loading | 49.518 | 49.518 | 0 | 520 | 0 | 76 | 0 |
| | TB | 0.306 | 0.306 | 0 | 654 | 0 | 76 | 0 |
| | Docking | 1.699 | 1.698 | 0.001 | 654 | 1 | 76 | 50 |
| | Undocking | 0.679 | 0.679 | 0 | 654 | 0 | 76 | 0 |
| | Wait Entry | 0.423 | 0.331 | 0.092 | 654 | 60 | 76 | 4,573 |
| | Wait Dock | 0.95 | 1.025 | –0.075 | 520 | –39 | 76 | –2,964 |
| | Waiting TB | 0 | 0 | 0 | 520 | 0 | 76 | 0 |
| | Waiting FN | 0.051 | 0.034 | 0.017 | 520 | 9 | 76 | 672 |
| | | | | | | Subtotal | | 2,330 |

Continued next page

Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| Oceangoing | System | 49.192 | 48.8 | 0.392 | | | | |
| Tank Barge | Waiting | 1.824 | 1.43 | 0.394 | | | | |
| 25,000 to 50,000 | Reaches | 9.2 | 9.2 | 0 | 995 | 0 | 11 | 0 |
| DWT | Loading | 35.344 | 35.344 | 0 | 774 | 0 | 11 | 0 |
| | TB | 0.338 | 0.338 | 0 | 995 | 0 | 11 | 0 |
| | Docking | 1.779 | 1.78 | –0.001 | 995 | –1 | 11 | –11 |
| | Undocking | 0.707 | 0.708 | –0.001 | 995 | –1 | 11 | –11 |
| | Wait Entry | 0.918 | 0.375 | 0.543 | 995 | 540 | 11 | 5,943 |
| | Wait Dock | 0.838 | 1.026 | –0.188 | 774 | –146 | 11 | –1,601 |
| | Waiting TB | 0 | 0 | 0 | 774 | 0 | 11 | 0 |
| | Waiting FN | 0.068 | 0.029 | 0.039 | 774 | 30 | 11 | 332 |
| | | | | | | Subtotal | | 4,653 |
| MISC1 | System | 10.448 | 9.759 | 0.689 | | | | |
| <50,000 DWT | Waiting | 1.563 | 0.874 | 0.689 | | | | |
| | Reaches | 6.395 | 6.395 | 0 | 463 | 0 | 1 | 0 |
| | Loading | 0.062 | 0.062 | 0 | 350 | 0 | 1 | 0 |
| | TB | 0.316 | 0.316 | 0 | 463 | 0 | 1 | 0 |
| | Docking | 1.508 | 1.508 | 0 | 463 | 0 | 1 | 0 |
| | Undocking | 0.604 | 0.604 | 0 | 463 | 0 | 1 | 0 |
| | Wait Entry | 0.333 | 0.181 | 0.152 | 463 | 70 | 1 | 70 |
| | Wait Dock | 1.23 | 0.693 | 0.537 | 350 | 188 | 1 | 188 |
| | Waiting TB | 0 | 0 | 0 | 350 | 0 | 1 | 0 |
| | Waiting FN | 0 | 0 | 0 | 350 | 0 | 1 | 0 |
| | | | | | | Subtotal | | 258 |

Continued next page

Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| MISC2 | System | 12.132 | 10.405 | 1.727 | | | | |
| >50,000 DWT | Waiting | 2.859 | 1.139 | 1.72 | | | | |
| | Reaches | 6.648 | 6.648 | 0 | 976 | 0 | 2 | 0 |
| | Loading | 0.216 | 0.216 | 0 | 719 | 0 | 2 | 0 |
| | TB | 0.306 | 0.306 | 0 | 976 | 0 | 2 | 0 |
| | Docking | 1.499 | 1.497 | 0.002 | 976 | 2 | 2 | 4 |
| | Undocking | 0.605 | 0.6 | 0.005 | 976 | 5 | 2 | 10 |
| | Wait Entry | 1.465 | 0.276 | 1.189 | 976 | 1,160 | 2 | 2,321 |
| | Wait Dock | 1.394 | 0.863 | 0.531 | 719 | 382 | 2 | 764 |
| | Waiting TB | 0 | 0 | 0 | 719 | 0 | 2 | 0 |
| | Waiting FN | 0 | 0 | 0 | 719 | 0 | 2 | 0 |
| | | | | | | Subtotal | | 3,098 |
| Oceangoing | System | 17.61 | 17.395 | 0.215 | | | | |
| Tug Type1 | Waiting | 0.222 | 0.007 | 0.215 | | | | |
| | Reaches | 4.517 | 4.517 | 0 | 463 | 0 | 1 | 0 |
| | Loading | 10.452 | 10.452 | 0 | 350 | 0 | 1 | 0 |
| | TB | 0.309 | 0.309 | 0 | 463 | 0 | 1 | 0 |
| | Docking | 1.494 | 1.494 | 0 | 463 | 0 | 1 | 0 |
| | Undocking | 0.616 | 0.616 | 0 | 463 | 0 | 1 | 0 |
| | Wait Entry | 0.215 | 0 | 0.215 | 463 | 100 | 1 | 100 |
| | Wait Dock | 0 | 0 | 0 | 350 | 0 | 1 | 0 |
| | Waiting TB | 0 | 0 | 0 | 350 | 0 | 1 | 0 |
| | Waiting FN | 0.007 | 0.007 | 0 | 350 | 0 | 1 | 0 |
| | System | 17.61 | 17.395 | 0.215 | | Subtotal | | 100 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| Oceangoing | System | 27.813 | 27.568 | 0.245 | | | | |
| Tug Type2 | Waiting | 0.765 | 0.518 | 0.247 | | | | |
| | Reaches | 5.119 | 5.119 | 0 | 976 | 0 | 6 | 0 |
| | Loading | 19.51 | 19.51 | 0 | 719 | 0 | 6 | 0 |
| | TB | 0.314 | 0.314 | 0 | 976 | 0 | 6 | 0 |
| | Docking | 1.501 | 1.503 | –0.002 | 976 | –2 | 6 | –12 |
| | Undocking | 0.602 | 0.603 | –0.001 | 976 | –1 | 6 | –6 |
| | Wait Entry | 0.361 | 0.255 | 0.106 | 976 | 103 | 6 | 621 |
| | Wait Dock | 0.304 | 0.238 | 0.066 | 719 | 47 | 6 | 285 |
| | Waiting TB | 0 | 0 | 0 | 719 | 0 | 6 | 0 |
| | Waiting FN | 0.101 | 0.025 | 0.076 | 719 | 55 | 6 | 328 |
| | | | | | | Subtotal | | 1,216 |
| LNG | System | 100.565 | 100.565 | 0 | | | | |
| Small | Waiting | 0.041 | 0.041 | 0 | | | | |
| | Reaches | 1.832 | 1.832 | 0 | 1,773 | 0 | 107 | 0 |
| | Loading | 96.606 | 96.606 | 0 | 1,506 | 0 | 107 | 0 |
| | TB | 0 | 0 | 0 | 1,773 | 0 | 107 | 0 |
| | Docking | 1.501 | 1.501 | 0 | 1,773 | 0 | 107 | 0 |
| | Undocking | 0.601 | 0.601 | 0 | 1,773 | 0 | 107 | 0 |
| | Wait Entry | 0.026 | 0.026 | 0 | 1,773 | 0 | 107 | 0 |
| | Wait Dock | 0.015 | 0.015 | 0 | 1,506 | 0 | 107 | 0 |
| | Waiting TB | 0 | 0 | 0 | 1,506 | 0 | 107 | 0 |
| | Waiting FN | 0 | 0 | 0 | 1,506 | 0 | 107 | 0 |
| | | | | | | Subtotal | | 0 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| LNG | System | 118.402 | 118.402 | 0 | | | | |
| Large | Waiting | 0.028 | 0.028 | 0 | | | | |
| | Reaches | 4.421 | 4.421 | 0 | 2,423 | 0 | 200 | 0 |
| | Loading | 111.715 | 111.715 | 0 | 2,039 | 0 | 200 | 0 |
| | TB | 0.152 | 0.152 | 0 | 2,423 | 0 | 200 | 0 |
| | Docking | 1.5 | 1.5 | 0 | 2,423 | 0 | 200 | 0 |
| | Undocking | 0.601 | 0.601 | 0 | 2,423 | 0 | 200 | 0 |
| | Wait Entry | 0.013 | 0.013 | 0 | 2,423 | 0 | 200 | 0 |
| | Wait Dock | 0.015 | 0.015 | 0 | 2,039 | 0 | 200 | 0 |
| | Waiting TB | 0 | 0 | 0 | 2,039 | 0 | 200 | 0 |
| | Waiting FN | 0 | 0 | 0 | 2,039 | 0 | 200 | 0 |
| | | | | | | Subtotal | | 0 |
| Bulk Carrier1 | System | 38.117 | 37.972 | 0.145 | | | | |
| | Waiting | 1.204 | 1.061 | 0.143 | | | | |
| | Reaches | 6.754 | 6.754 | 0 | 634 | 0 | 53 | 0 |
| | Loading | 27.749 | 27.749 | 0 | 311 | 0 | 53 | 0 |
| | TB | 0.31 | 0.31 | 0 | 634 | 0 | 53 | 0 |
| | Docking | 1.5 | 1.499 | 0.001 | 634 | 1 | 53 | 34 |
| | Undocking | 0.6 | 0.599 | 0.001 | 634 | 1 | 53 | 34 |
| | Wait Entry | 0.392 | 0.325 | 0.067 | 634 | 42 | 53 | 2,251 |
| | Wait Dock | 0.711 | 0.692 | 0.019 | 311 | 6 | 53 | 313 |
| | Waiting TB | 0 | 0 | 0 | 311 | 0 | 53 | 0 |
| | Waiting FN | 0.101 | 0.044 | 0.057 | 311 | 18 | 53 | 940 |
| | | | | | | Subtotal | | 3,571 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| Bulk Carrier2 | System | 55.117 | 54.713 | 0.404 | | | | |
| | Waiting | 1.259 | 0.856 | 0.403 | | | | |
| | Reaches | 6.11 | 6.11 | 0 | 799 | 0 | 134 | 0 |
| | Loading | 45.337 | 45.337 | 0 | 424 | 0 | 134 | 0 |
| | TB | 0.31 | 0.31 | 0 | 799 | 0 | 134 | 0 |
| | Docking | 1.501 | 1.5 | 0.001 | 799 | 1 | 134 | 107 |
| | Undocking | 0.6 | 0.6 | 0 | 799 | 0 | 134 | 0 |
| | Wait Entry | 0.544 | 0.264 | 0.28 | 799 | 224 | 134 | 29,978 |
| | Wait Dock | 0.623 | 0.559 | 0.064 | 424 | 27 | 134 | 3,636 |
| | Waiting TB | 0 | 0 | 0 | 424 | 0 | 134 | 0 |
| | Waiting FN | 0.093 | 0.033 | 0.06 | 424 | 25 | 134 | 3,409 |
| | | | | | | Subtotal | | 37,131 |
| Bulk Carrier3 | System | 76.241 | 75.503 | 0.738 | | | | |
| | Waiting | 1.851 | 1.113 | 0.738 | | | | |
| | Reaches | 7.559 | 7.559 | 0 | 957 | 0 | 61 | 0 |
| | Loading | 64.42 | 64.42 | 0 | 523 | 0 | 61 | 0 |
| | TB | 0.311 | 0.311 | 0 | 957 | 0 | 61 | 0 |
| | Docking | 1.501 | 1.501 | 0 | 957 | 0 | 61 | 0 |
| | Undocking | 0.599 | 0.6 | –0.001 | 957 | –1 | 61 | –58 |
| | Wait Entry | 0.898 | 0.238 | 0.66 | 957 | 632 | 61 | 38,529 |
| | Wait Dock | 0.808 | 0.836 | –0.028 | 523 | –15 | 61 | –893 |
| | Waiting TB | 0 | 0 | 0 | 523 | 0 | 61 | 0 |
| | Waiting FN | 0.146 | 0.039 | 0.107 | 523 | 56 | 61 | 3,414 |
| | | | | | | Subtotal | | 40,991 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| Chem1 | System | 36.364 | 36.088 | 0.276 | | | | |
| | Waiting | 1.329 | 1.05 | 0.279 | | | | |
| | Reaches | 6.491 | 6.491 | 0 | 759 | 0 | 120 | 0 |
| | Loading | 26.099 | 26.099 | 0 | 420 | 0 | 120 | 0 |
| | TB | 0.311 | 0.311 | 0 | 759 | 0 | 120 | 0 |
| | Docking | 1.525 | 1.526 | –0.001 | 759 | –1 | 120 | –91 |
| | Undocking | 0.609 | 0.61 | –0.001 | 759 | –1 | 120 | –91 |
| | Wait Entry | 0.526 | 0.301 | 0.225 | 759 | 171 | 120 | 20,493 |
| | Wait Dock | 0.724 | 0.724 | 0 | 420 | 0 | 120 | 0 |
| | Waiting TB | 0 | 0 | 0 | 420 | 0 | 120 | 0 |
| | Waiting FN | 0.079 | 0.025 | 0.054 | 420 | 23 | 120 | 2,722 |
| | | | | | | Subtotal | | 23,032 |
| Chem2 | System | 52.078 | 51.696 | 0.382 | | | | |
| | Waiting | 1.58 | 1.196 | 0.384 | | | | |
| | Reaches | 7.109 | 7.109 | 0 | 887 | 0 | 75 | 0 |
| | Loading | 40.388 | 40.388 | 0 | 522 | 0 | 75 | 0 |
| | TB | 0.369 | 0.369 | 0 | 887 | 0 | 75 | 0 |
| | Docking | 1.881 | 1.88 | 0.001 | 887 | 1 | 75 | 67 |
| | Undocking | 0.752 | 0.754 | –0.002 | 887 | –2 | 75 | –133 |
| | Wait Entry | 0.745 | 0.372 | 0.373 | 887 | 331 | 75 | 24,814 |
| | Wait Dock | 0.696 | 0.739 | –0.043 | 522 | –22 | 75 | –1,683 |
| | Waiting TB | 0 | 0 | 0 | 522 | 0 | 75 | 0 |
| | Waiting FN | 0.139 | 0.085 | 0.054 | 522 | 28 | 75 | 2,114 |
| | | | | | | Subtotal | | 25,178 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| Chem3 | System | 54.421 | 53.758 | 0.663 | | | | |
| | Waiting | 2.12 | 1.457 | 0.663 | | | | |
| | Reaches | 8.132 | 8.132 | 0 | 1,015 | 0 | 104 | 0 |
| | Loading | 41.672 | 41.672 | 0 | 610 | 0 | 104 | 0 |
| | TB | 0.314 | 0.314 | 0 | 1,015 | 0 | 104 | 0 |
| | Docking | 1.558 | 1.559 | –0.001 | 1,015 | –1 | 104 | –106 |
| | Undocking | 0.624 | 0.624 | 0 | 1,015 | 0 | 104 | 0 |
| | Wait Entry | 1 | 0.37 | 0.63 | 1,015 | 639 | 104 | 66,503 |
| | Wait Dock | 1.1 | 1.082 | 0.018 | 610 | 11 | 104 | 1,142 |
| | Waiting TB | 0 | 0 | 0 | 610 | 0 | 104 | 0 |
| | Waiting FN | 0.02 | 0.005 | 0.015 | 610 | 9 | 104 | 952 |
| | | | | | | Subtotal | | 68,491 |
| Chem4 | System | 152.792 | 150.139 | 2.653 | | | | |
| | Waiting | 19.552 | 16.904 | 2.648 | | | | |
| | Reaches | 7.865 | 7.865 | 0 | 1,337 | 0 | 1 | 0 |
| | Loading | 120.861 | 120.861 | 0 | 810 | 0 | 1 | 0 |
| | TB | 0.309 | 0.309 | 0 | 1,337 | 0 | 1 | 0 |
| | Docking | 3.003 | 2.991 | 0.012 | 1,337 | 16 | 1 | 16 |
| | Undocking | 1.202 | 1.209 | –0.007 | 1,337 | –9 | 1 | –9 |
| | Wait Entry | 4.789 | 2.919 | 1.87 | 1,337 | 2,500 | 1 | 2,500 |
| | Wait Dock | 14.763 | 13.985 | 0.778 | 810 | 630 | 1 | 630 |
| | Waiting TB | 0 | 0 | 0 | 810 | 0 | 1 | 0 |
| | Waiting FN | 0 | 0 | 0 | 810 | 0 | 1 | 0 |
| | | | | | | Subtotal | | 3,137 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| LPGT1 | System | 31.893 | 31.816 | 0.077 | | | | |
| | Waiting | 1.172 | 1.095 | 0.077 | | | | |
| | Reaches | 7.02 | 7.02 | 0 | 654 | 0 | 13 | 0 |
| | Loading | 21.294 | 21.294 | 0 | 520 | 0 | 13 | 0 |
| | TB | 0.309 | 0.309 | 0 | 654 | 0 | 13 | 0 |
| | Docking | 1.5 | 1.501 | –0.001 | 654 | –1 | 13 | –9 |
| | Undocking | 0.599 | 0.597 | 0.002 | 654 | 1 | 13 | 17 |
| | Wait Entry | 0.41 | 0.336 | 0.074 | 654 | 48 | 13 | 629 |
| | Wait Dock | 0.762 | 0.759 | 0.003 | 520 | 2 | 13 | 20 |
| | Waiting TB | 0 | 0 | 0 | 520 | 0 | 13 | 0 |
| | Waiting FN | 0 | 0 | 0 | 520 | 0 | 13 | 0 |
| | | | | | | Subtotal | | 658 |
| LPGT2 | System | 65.482 | 65.154 | 0.328 | | | | |
| | Waiting | 1.49 | 1.163 | 0.327 | | | | |
| | Reaches | 7.055 | 7.055 | 0 | 729 | 0 | 18 | 0 |
| | Loading | 54.523 | 54.523 | 0 | 574 | 0 | 18 | 0 |
| | TB | 0.312 | 0.312 | 0 | 729 | 0 | 18 | 0 |
| | Docking | 1.502 | 1.502 | 0 | 729 | 0 | 18 | 0 |
| | Undocking | 0.6 | 0.599 | 0.001 | 729 | 1 | 18 | 13 |
| | Wait Entry | 0.608 | 0.351 | 0.257 | 729 | 187 | 18 | 3,372 |
| | Wait Dock | 0.882 | 0.812 | 0.07 | 574 | 40 | 18 | 723 |
| | Waiting TB | 0 | 0 | 0 | 574 | 0 | 18 | 0 |
| | Waiting FN | 0 | 0 | 0 | 574 | 0 | 18 | 0 |
| | | | | | | Subtotal | | 4,109 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| LPGT3 | System | 15.49 | 14.966 | 0.524 | | | | |
| | Waiting | 1.315 | 0.811 | 0.504 | | | | |
| | Reaches | 5.878 | 5.878 | 0 | 857 | 0 | 1 | 0 |
| | Loading | 5.886 | 5.886 | 0 | 669 | 0 | 1 | 0 |
| | TB | 0.313 | 0.313 | 0 | 857 | 0 | 1 | 0 |
| | Docking | 1.502 | 1.489 | 0.013 | 857 | 11 | 1 | 11 |
| | Undocking | 0.595 | 0.588 | 0.007 | 857 | 6 | 1 | 6 |
| | Wait Entry | 0.526 | 0.104 | 0.422 | 857 | 362 | 1 | 362 |
| | Wait Dock | 0.789 | 0.707 | 0.082 | 669 | 55 | 1 | 55 |
| | Waiting TB | 0 | 0 | 0 | 669 | 0 | 1 | 0 |
| | Waiting FN | 0 | 0 | 0 | 669 | 0 | 1 | 0 |
| | | | | | | Subtotal | | 434 |
| LPGT4 | System | 40.871 | 36.812 | 4.059 | | | | |
| | Waiting | 22.644 | 18.585 | 4.059 | | | | |
| | Reaches | 6.873 | 6.873 | 0 | 995 | 0 | 1 | 0 |
| | Loading | 8.927 | 8.927 | 0 | 774 | 0 | 1 | 0 |
| | TB | 0.319 | 0.319 | 0 | 995 | 0 | 1 | 0 |
| | Docking | 1.516 | 1.516 | 0 | 995 | 0 | 1 | 0 |
| | Undocking | 0.593 | 0.593 | 0 | 995 | 0 | 1 | 0 |
| | Wait Entry | 9.485 | 7.019 | 2.466 | 995 | 2,454 | 1 | 2,454 |
| | Wait Dock | 13.159 | 11.567 | 1.592 | 774 | 1,232 | 1 | 1,232 |
| | Waiting TB | 0 | 0 | 0 | 774 | 0 | 1 | 0 |
| | Waiting FN | 0 | 0 | 0 | 774 | 0 | 1 | 0 |
| | | | | | | Subtotal | | 3,686 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| GCRR1 | System | 29.632 | 29.489 | 0.143 | | | | |
| | Waiting | 0.879 | 0.736 | 0.143 | | | | |
| | Reaches | 5.556 | 5.556 | 0 | 657 | 0 | 133 | 0 |
| | Loading | 20.771 | 20.771 | 0 | 352 | 0 | 133 | 0 |
| | TB | 0.311 | 0.311 | 0 | 657 | 0 | 133 | 0 |
| | Docking | 1.512 | 1.511 | 0.001 | 657 | 1 | 133 | 87 |
| | Undocking | 0.605 | 0.605 | 0 | 657 | 0 | 133 | 0 |
| | Wait Entry | 0.263 | 0.191 | 0.072 | 657 | 47 | 133 | 6,291 |
| | Wait Dock | 0.572 | 0.524 | 0.048 | 352 | 17 | 133 | 2,247 |
| | Waiting TB | 0 | 0 | 0 | 352 | 0 | 133 | 0 |
| | Waiting FN | 0.044 | 0.021 | 0.023 | 352 | 8 | 133 | 1,077 |
| | | | | | | Subtotal | | 9,703 |
| GCRR2 | System | 47.611 | 47.221 | 0.39 | | | | |
| | Waiting | 1.422 | 1.032 | 0.39 | | | | |
| | Reaches | 7.085 | 7.085 | 0 | 1,081 | 0 | 57 | 0 |
| | Loading | 36.693 | 36.693 | 0 | 632 | 0 | 57 | 0 |
| | TB | 0.311 | 0.311 | 0 | 1,081 | 0 | 57 | 0 |
| | Docking | 1.499 | 1.499 | 0 | 1,081 | 0 | 57 | 0 |
| | Undocking | 0.601 | 0.6 | 0.001 | 1,081 | 1 | 57 | 62 |
| | Wait Entry | 0.625 | 0.303 | 0.322 | 1,081 | 348 | 57 | 19,841 |
| | Wait Dock | 0.786 | 0.722 | 0.064 | 632 | 40 | 57 | 2,306 |
| | Waiting TB | 0 | 0 | 0 | 632 | 0 | 57 | 0 |
| | Waiting FN | 0.011 | 0.007 | 0.004 | 632 | 3 | 57 | 144 |
| | | | | | | Subtotal | | 22,352 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| GCRR3 | System | 124.117 | 123.908 | 0.209 | | | | |
| | Waiting | 0.977 | 0.769 | 0.208 | | | | |
| | Reaches | 5.581 | 5.581 | 0 | 1,469 | 0 | 10 | 0 |
| | Loading | 115.176 | 115.176 | 0 | 930 | 0 | 10 | 0 |
| | TB | 0.281 | 0.281 | 0 | 1,469 | 0 | 10 | 0 |
| | Docking | 1.503 | 1.502 | 0.001 | 1,469 | 1 | 10 | 15 |
| | Undocking | 0.599 | 0.6 | –0.001 | 1,469 | –1 | 10 | –15 |
| | Wait Entry | 0.401 | 0.19 | 0.211 | 1,469 | 310 | 10 | 3,100 |
| | Wait Dock | 0.557 | 0.571 | –0.014 | 930 | –13 | 10 | –130 |
| | Waiting TB | 0 | 0 | 0 | 930 | 0 | 10 | 0 |
| | Waiting FN | 0.019 | 0.007 | 0.012 | 930 | 11 | 10 | 112 |
| | | | | | | Subtotal | | 3,081 |
| OIL1 | System | 43.474 | 42.898 | 0.576 | | | | |
| | Waiting | 1.453 | 0.878 | 0.575 | | | | |
| | Reaches | 8.037 | 8.037 | 0 | 825 | 0 | 33 | 0 |
| | Loading | 31.512 | 31.512 | 0 | 475 | 0 | 33 | 0 |
| | TB | 0.31 | 0.31 | 0 | 825 | 0 | 33 | 0 |
| | Docking | 1.543 | 1.544 | –0.001 | 825 | –1 | 33 | –27 |
| | Undocking | 0.618 | 0.617 | 0.001 | 825 | 1 | 33 | 27 |
| | Wait Entry | 0.733 | 0.259 | 0.474 | 825 | 391 | 33 | 12,905 |
| | Wait Dock | 0.581 | 0.569 | 0.012 | 475 | 6 | 33 | 188 |
| | Waiting TB | 0 | 0 | 0 | 475 | 0 | 33 | 0 |
| | Waiting FN | 0.139 | 0.051 | 0.088 | 475 | 42 | 33 | 1,379 |
| | | | | | | Subtotal | | 14,472 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| OIL2 | System | 47.631 | 46.767 | 0.864 | | | | |
| | Waiting | 1.592 | 0.729 | 0.863 | | | | |
| | Reaches | 5.664 | 5.664 | 0 | 1,011 | 0 | 85 | 0 |
| | Loading | 37.974 | 37.974 | 0 | 607 | 0 | 85 | 0 |
| | TB | 0.3 | 0.3 | 0 | 1,011 | 0 | 85 | 0 |
| | Docking | 1.5 | 1.499 | 0.001 | 1,011 | 1 | 85 | 86 |
| | Undocking | 0.601 | 0.601 | 0 | 1,011 | 0 | 85 | 0 |
| | Wait Entry | 0.918 | 0.189 | 0.729 | 1,011 | 737 | 85 | 62,647 |
| | Wait Dock | 0.459 | 0.454 | 0.005 | 607 | 3 | 85 | 258 |
| | Waiting TB | 0 | 0 | 0 | 607 | 0 | 85 | 0 |
| | Waiting FN | 0.215 | 0.086 | 0.129 | 607 | 78 | 85 | 6,656 |
| | | | | | | Subtotal | | 69,646 |
| OIL3 | System | 42.648 | 40.676 | 1.972 | | | | |
| | Waiting | 6.343 | 4.364 | 1.979 | | | | |
| | Reaches | 6.939 | 6.936 | 0.003 | 1,174 | 4 | 100 | 352 |
| | Loading | 26.962 | 26.97 | –0.008 | 712 | –6 | 100 | –570 |
| | TB | 0.305 | 0.305 | 0 | 1,174 | 0 | 100 | 0 |
| | Docking | 1.499 | 1.5 | –0.001 | 1,174 | –1 | 100 | –117 |
| | Undocking | 0.6 | 0.6 | 0 | 1,174 | 0 | 100 | 0 |
| | Wait Entry | 4.034 | 2.088 | 1.946 | 1,174 | 2,285 | 100 | 228,460 |
| | Wait Dock | 2.145 | 2.23 | –0.085 | 712 | –61 | 100 | –6,052 |
| | Waiting TB | 0 | 0 | 0 | 712 | 0 | 100 | 0 |
| | Waiting FN | 0.164 | 0.047 | 0.117 | 712 | 83 | 100 | 8,330 |
| | | | | | | Subtotal | | 230,404 |

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Table 96 (Cont'd)

| Vessel Type | Average Time | Existing Condition (hrs) | SPC/PAC Widening (hrs) | Difference | Hourly Operating Cost ($) | Change Cost/Vessel ($) | # of vessels | Savings ($) |
|---|---|---|---|---|---|---|---|---|
| OIL4 | System | 47.201 | 44.533 | 2.668 | | | | |
| | Waiting | 13.789 | 11.118 | 2.671 | | | | |
| | Reaches | 10.653 | 10.649 | 0.004 | 1,399 | 6 | 695 | $3,889 |
| | Loading | 20.377 | 20.385 | –0.008 | 846 | –7 | 695 | –$4,704 |
| | TB | 0.278 | 0.278 | 0 | 1,399 | 0 | 695 | $0 |
| | Docking | 1.502 | 1.502 | 0 | 1,399 | 0 | 695 | $0 |
| | Undocking | 0.601 | 0.601 | 0 | 1,399 | 0 | 695 | $0 |
| | Wait Entry | 8.514 | 5.437 | 3.077 | 1,399 | 4,305 | 695 | $2,991,782 |
| | Wait Dock | 5.254 | 5.675 | –0.421 | 846 | –356 | 695 | –$247,535 |
| | Waiting TB | 0 | 0 | 0 | 846 | 0 | 695 | $0 |
| | Waiting FN | 0.022 | 0.006 | 0.016 | 846 | 14 | 695 | $9,408 |
| | | | | | | Subtotal | | $2,752,840 |
| | | | | | Total Savings (all vessels) | | | 3,487,322 |

The benefits shown in Table 96 are based on widening only and are based on 2004-period traffic levels. Table 97 summarizes the average annual benefits for 2019–2069 for widening of the Sabine Pass Channel and the Port Arthur Canal. Table 98 displays the incremental economic summary data associated with the widening of the Sabine Pass Channel and the Port Arthur Canal. The results of the benefit-cost analysis indicated that widening was not an incremental justified feature.

Table 97
Sabine Pass Channel and Port Arthur Canal Widening Only
Average Annual Benefits (2008 Dollars at 4.375%)

| Year | Sabine Pass Channel | Port Arthur Canal | Sabine Pass Channel and Port Arthur Canal |
|---|---|---|---|
| 2004 | 2,269,264 | 2,579,760 | 3,487,322 |
| 2019 | 2,922,548 | 3,431,103 | 4,335,553 |
| 2029 | 3,738,979 | 4,431,691 | 5,486,406 |
| 2039 | 4,691,482 | 5,599,044 | 6,829,067 |
| 2049 | 5,262,983 | 6,299,456 | 7,634,664 |
| 2059 | 6,215,486 | 7,466,809 | 8,977,326 |
| 2069 | 7,548,990 | 9,101,103 | 10,857,052 |
| | | Average Annual Benefits (4.375%) | 6,379,579 |

Table 98
Sabine Pass Channel and Port Arthur Canal Widening Only
Economic Summary Data (2008 Dollars at 4.375%)

| Item | Sabine Pass Channel and Port Arthur Canal |
|---|---|
| First Cost | 78,448,000 |
| Mitigation Cost | 48,484,500 |
| Interest During Construction | 36,282,311 |
| Total First Cost | 163,214,811 |
| Average Annual Construction Cost | 8,091,727 |
| Incremental Average Annual Operations and Maintenance (O&M) Cost | 9,587,005 |
| Total Average Annual Cost | 17,678,733 |
| Average Annual Benefits | 6,338,991 |
| Benefit to Cost Ratio | 0.4 |

The benefit calculations are based on 2004-period historical and 2030-2040 projected traffic. The future traffic levels do not account for channel deepening. The effect on the reduction in total vessel movements resulting from channel deepening is evaluated in the sensitivity section of this appendix. For the sensitivity, HarborSym widening model was run based on the reduction in vessel trips as a result of channel deepening The purpose of the sensitivity was to determine changes in the annual delays in relationship to widening and deepening of the Sabine Pass Channel and Port Arthur Canal. The change in vessel trips due to channel deepening was estimated based on the decrease in the number of trips

necessary to transport future tonnage. The model results show that the reduction in the number of vessel trips resulting from channel deepening has a significant effect on the net difference in the duration of vessel delays between the without- and with-project conditions. Further analyses based on various ranges of fleet forecasts indicate that the increase in benefits from scenarios that included either "deepening and widening" or "deepening and the turning basins" were primarily attributable to the reduction in trips due to channel deepening. These savings result from the reduction in trips based on vessels carrying additional cargo or the redistribution of vessel sizes based on the availability of a deeper channel and do vary significantly from the "widening only" benefits shown in Table 98. The effect of adding these savings to the project benefits is outlined in the sensitivity section (Section 8).

#### 6.3.1.5 Neches River Holding Areas

Determination of the number of turning basins, turning basin anchorage combinations, and anchorages was initially made based on pilot interviews. The turning basins and turning basin anchorage combinations are used for both turning and for vessels to wait while others pass. The TBAs allow loaded vessels to await berths at the dock and will save the time that they originally would have spent "inbounding" when the berth became clear. With the TBAs, instead vessels only have to shift from one of these sites to a dock rather than awaiting an outbound ship to sail and to start in accordance with the traffic rules. The pilots said that they would trade vessels out between the Neches River "holding areas" and "docks," thus violating established rules. According to ER 1105-2-100 and the Policy Digest, features such as turning basins can be in the Federal interest if they facilitate safe and efficient vessel navigation; this is clearly the case for the Neches River turning basins. In regards to incremental justification review concerns, there was considerably reluctance to allow anything less than the six turning basins; however, the pilots indicated that if priorities had to be placed on TBA construction, the priorities would be 1, 4, and 7. Next noted grouping was 1, 4, 5, and 7. It was emphasized that the priority was for all turning basin improvements. Current and without-project future use of the existing turning basins and new holding and turning sites is summarized in Table 99.

The pilots noted that the number of hours saved depends on the dock facility and that the benefits will be primarily for the crude oil tankers and some product carriers; however, all traffic would realize some savings. Pilot expectation is that the crude oil carriers would save about 7 hours. It also noted that the Panamax-size product carriers that load at ExxonMobil will save about 7 hours. The pilots noted that they did not expect a difference between the Aframax and Suezmax savings. The number of hours saved for vessels in the lower end of the Neches River Channel would be less.

Table 99
Neches River Proposed Turning Basin Anchorages

| | Description | Approximate Miles from Sabine Bank | | Current Use |
|---|---|---|---|---|
| | | Station | SB Buoy | |
| TBA 1 | Turning Basin Anchorage 1 | 210+00 | 43.4 | Limited with no anchorage |
| TBA 2 | Turning Basin Anchorage 2 | 275+00 | 44.6 | None |
| TB 3 | Turning Basin 3 | 370+00 | 46.4 | None |
| TBA 4 | Turning Basin Anchorage 4 | 510+00 | 49.1 | Limited with no anchorage |
| TB 5 | Turning Basin 5 | 570+00 | 50.2 | None |
| TB 6 | Turning Basin 6 | 700+00 | 52.7 | Turning Basin |
| TBA 7 | Anchorage Basin 7 | 750+00 | 53.6 | None |
| TBA 8 | Anchorage Basin 8 | 850+00 | 56.5 | None |
| | Beaumont Maneuvering Area | 975+00 | 58.8 | Maneuvering Area |

Pilot meetings conducted during the initial screening and during the HarborSym model building continued to show that the model was accurately calibrating existing conditions for the Entrance Channel reaches. In addition, the transit times were accurate for vessel throughput times. Discussion with the pilots after the runs were completed and review of the transit costs helped reconfirm that the model outputs for the Entrance Channel behavior were reasonably accurate for existing conditions as were expectations for the with-project condition; however, it was found that the model did not validate current or future use of the Neches River turning basins. The model results indicated a transfer in vessel delays from the present offshore location to the proposed siding locations. Detailed discussions with the vessel pilots initially revealed that the model was not set-up to account for pilots anticipated behavior of switching vessels between docks and holding areas. For this reason, HarborSym was not initially used for the Neches River turning basin analysis. In 2007–2008, modifications were made to the model in order to better capture the pilots anticipated behavior. The results of these modifications resulted in an increase in savings; however, the increase in savings is still significantly less than the pilots anticipated.

The model input is based on the assumption that the major difference in the Neches River without- and with-project conditions would be that, “as holding areas,” the “with project condition” would enable two vessels to be stored in TBA 1, TBA 2, TB 5, TBA 7, and TBA 8, instead of one small vessel in each. An additional item revealed at the meetings was that the maximum vessel size using the turning basins was the same for the without- and with-project conditions. Additionally, the model assumptions were based on “no change in Neches River transit rules” for the with-project condition. At the meeting, the pilots said that they would, in fact, trade vessels out between the Neches River “holding areas” and “docks” despite night rules and beam and depth restrictions. The indication was that “trading places” would be orchestrated to minimize the dangerous effects of violating established rules.

As an example of how the turning basins would be used, an inbound convoy would arrive on the Neches River Channel with the vessels going to docks on the upper end of the Neches leading the convoy. Each vessel would proceed to their respective dock and head into the berth (for the SNWW vessels turn after finishing at the dock). It takes about 1.5 hours to tie up at the docks, and loading or unloading takes about 18 hours, depending largely on cargo load. While the goal is for the vessel to get in and away from the dock within 24 hours, it is difficult to meet that goal, and vessel dock time frequently exceeds 30 hours. The goal of working to minimize unloading time or synchronizing it based on the other vessels in the convoy is an important consideration as the goal of completing dock time can be particularly crucial if another offshore convoy is set-up to come in. Under present conditions, the dockside convoy will leave its respective docks and head down the Neches River Channel. A vessel normally takes 2 hours to get from Exxon near the Beaumont Turning Basin at Neches River Station 990 to the lower end of the Neches River Channel (Station 240+00), a distance of about 14 miles. It was noted that outbound convoys often include one to two additional vessels. Under present condition, the vessels move down the Neches River Channel out to Buoy 29 and 30 in the Entrance Channel and into the 800-foot channel reach before they can meet single vessels with comparable dimensions or likewise an inbound convoy. Vessel meetings between inbound vessels and the outbound convoy are very restricted due to the combined beam and loaded-draft restrictions.

The pilots emphasized that the seven holding area improvements would allow loaded vessels to await berths and would save time that they originally would have spent in an inbound transit mode while the berth became clear. With the holding areas, vessels would only have to shift from the anchorage instead of awaiting the ship to sail and to start in accordance with the traffic rules. The pilots noted that the number of hours saved depends on the dock facility and that the benefits will be primarily for the crude oil tankers and some product carriers; however, all traffic would realize some savings. Pilot expectation is that the crude oil carriers would save about 7 hours. It also noted that the Panamax-sized product carriers that load at ExxonMobil will save about 7 hours. The pilots noted that they did not expect a difference between the Aframax and Suezmax savings. The number of hours saved for vessels in the lower end of the Neches River Channel would be lower.

The pilots noted that with the anchorages, future inbound convoys will include additional ships to await berths. Under present conditions, the size of an inbound convoy is limited due to berth space. When the berths are available, the vessels will switch from the holding area to a berth. They noted that it is quicker to put a vessel in an anchorage (approximately 20 minutes) than to dock (approximately 1 hour). Similarly, it is quicker to depart from anchorage than to undock and turn. The net result is that the convoys will move faster and include additional vessels.

The benefits of the turning basin features were evaluated based on pilot input and examination of the HarborSym output data associated with waiting times and other related variables. The initial focus of the discussions with the pilots was to understand present use of the turning basins and obtain clarification on the DWT, loaded drafts, beam, length, and number of vessels associated with each of the turning basins. Presently, the turning basins are used for vessel turning and holding of light vessels (i.e., loaded drafts less than 29 feet). Some turning basins are also used for holding light Aframax tankers, again with drafts

loaded to less than 29 feet. It was noted that Aframax tankers can be pushed into a turning basin; however, lack of maintenance dredging makes this practice less frequent and more difficult, but it will occur if a vessel, communication, or other breakdown situation requires.

The vessel arrivals and departures from the Neches River Channel are planned and/or orchestrated rather than random. Under present conditions, a new Neches River inbound fleet cannot come in until the outbound Neches River fleet has traveled down the Neches and has cleared the Jetty Channel and is in the Outer Bar Channel. Under the without-project condition, the vessels wait offshore. Under the with-project condition, they will also wait offshore; however, the sidings will allow a vessel to move to the dock and start unloading when, under the without-project condition, it would be waiting for an outbound convoy to clear the jetty channel. By widening the Entrance Channel through the Sabine Pass Channel, the inbound and outbound convoys have a longer reach in which to meet. By building the Neches River sidings, an inbound convoy can save a significant portion of the inbound transit time by being in the sidings and ready to move to the docks as the outbound convoy leaves. The convoy behavior will not change between the without- and with-project conditions. Table 100 presents the HarborSym output associated with the Neches River anchorages. Discussion with the pilots indicated uncertainty concerning shifting charges; therefore, the effect of their inclusion was evaluated. The benefits were calculation based on shifting costs being levied 50 percent of the time. Tables 101 and 102 summarize the average annual savings in comparison to the average construction cost. Table 101 is similar to Table 102 and presents the same combinations but differs in that the annual benefits reflect inclusion of “pilot shifting costs” for 100 percent of the time. The annual benefits presented in tables 101 and 102 do not reflect future growth and are based on 2004-period traffic levels. Analysis of the data presented in tables 101 and 102 shows that the combination of basins that include alternatives 1, 4, and 8 produce the highest net excess benefits among the alternatives evaluated.

Table 100
Neches River Anchorage Basins (2004-Period Savings)

| Feature | No Shifting Cost ($) | With Shifting Cost ($) | Shifting Cost 50% of the Time ($) |
|---|---|---|---|
| Alt 1 | 1,011,421 | 212,798 | 612,110 |
| Alt 2 | 1,085,993 | 287,370 | 686,682 |
| Alt 3 | 5,045 | 1,335 | 3,190 |
| Alt 4 | 711,087 | 0 | 355,544 |
| Alt 5 | 3,304 | 0 | 1,652 |
| Alt 7 | 367,215 | 0 | 183,608 |
| Alt 8 | 278,304 | 0 | 139,152 |
| Alt 1, 2 | 1,590,026 | 791,403 | 1,190,715 |
| Alt 1, 3 | 1,012,551 | 213,928 | 613,240 |
| Alt 1, 4 | 1,598,751 | 800,128 | 1,199,440 |
| Alt 1, 5 | 1,012,551 | 213,928 | 613,240 |
| Alt 1, 7 | 1,328,837 | 530,215 | 929,526 |
| Alt 1, 8 | 1,263,380 | 464,758 | 864,069 |
| Alt 2, 4 | 1,598,187 | 799,565 | 1,198,876 |
| Alt 2, 7 | 1,413,856 | 615,233 | 1,014,545 |
| Alt 2, 8 | 1,344,211 | 0 | 672,106 |
| Alt 4, 7 | 1,178,793 | 380,170 | 779,482 |
| Alt 4, 8 | 1,103,461 | 304,838 | 704,150 |
| Alt 1, 2, 3 | 1,592,519 | 793,896 | 1,193,208 |
| Alt 1, 2, 4 | 1,897,906 | 1,099,283 | 1,498,595 |
| Alt 1, 2, 5 | 1,208,613 | 297,153 | 752,883 |
| Alt 1, 2, 7 | 1,824,395 | 1,025,773 | 1,425,084 |
| Alt 1, 2, 8 | 1,750,352 | 951,730 | 1,351,041 |
| Alt 1, 3, 4 | 1,601,048 | 802,425 | 1,201,737 |
| Alt 1, 3, 5 | 1,012,551 | 213,928 | 613,240 |
| Alt 1, 3, 7 | 1,334,789 | 536,166 | 935,478 |
| Alt 1, 3, 8 | 1,334,789 | 536,166 | 935,478 |
| Alt 1, 4, 5 | 1,601,048 | 802,425 | 1,201,737 |
| Alt 1, 4, 7 | 1,697,713 | 898,950 | 1,298,332 |
| Alt 1, 4, 8 | 1,761,501 | 962,878 | 1,362,190 |
| Alt 2, 4, 7 | 1,796,902 | 0 | 898,451 |
| Alt 2, 4, 8 | 1,750,548 | 0 | 875,274 |
| Alt 2, 7, 8 | 1,370,980 | 998,280 | 1,184,630 |
| Alt 4, 7, 8 | 1,259,138 | 460,516 | 859,827 |
| Alt 1, 2, 3, 4 | 1,902,467 | 1,103,845 | 1,503,156 |
| Alt 1, 2, 4, 7 | 2,100,114 | 1,301,491 | 1,700,803 |
| Alt 1, 2, 4, 8 | 2,062,240 | 1,263,618 | 1,662,929 |
| Alt 1, 2, 7, 8 | 1,879,960 | 1,081,337 | 1,480,649 |
| Alt 1, 4, 7, 8 | 1,850,392 | 1,051,629 | 1,451,011 |
| Alt 2, 3, 4, 5 | 1,797,233 | 998,610 | 1,397,922 |
| Alt 2, 4, 7, 8 | 1,707,628 | 909,005 | 1,308,317 |
| Alt 1, 2, 4, 7, 8 | 1,982,703 | 1,184,081 | 1,583,392 |
| Alt 2, 3, 4, 5, 7 | 1,797,233 | 998,610 | 1,397,922 |
| Alt 2, 4, 5, 7, 8 | 1,838,302 | 1,039,679 | 1,438,991 |
| Alt 3, 4, 5, 7, 8 | 1,261,556 | 462,934 | 862,245 |

Table 101
Average Annual Cost, Transportation Savings Benefits, Net Excess Benefits (4.375%), and Benefit to Cost Ratios (No Shifting Charges)

| Feature | Average Annual Cost ($) | Benefits Based on 2004-Period Traffic ($) | Net Excess Benefits ($) | Benefit to Cost Ratio |
|---|---|---|---|---|
| Alt 1 | 317,880 | 1,011,421 | 693,541 | 3.2 |
| Alt 2 | 393,568 | 1,085,993 | 692,424 | 2.8 |
| Alt 3 | 120,157 | 5,045 | –115,112 | 0.0 |
| Alt 4 | 192,390 | 711,087 | 518,697 | 3.7 |
| Alt 5 | 351,101 | 3,304 | –347,797 | 0.0 |
| Alt 7 | 144,821 | 367,215 | 222,393 | 2.5 |
| Alt 8 | 132,768 | 278,304 | 145,536 | 2.1 |
| Alt 1, 2 | 711,448 | 1,590,026 | 878,578 | 2.2 |
| Alt 1, 3 | 438,037 | 1,012,551 | 574,514 | 2.3 |
| Alt 1, 4 | 510,270 | 1,598,751 | 1,088,481 | 3.1 |
| Alt 1, 5 | 462,701 | 1,012,551 | 549,849 | 2.2 |
| Alt 1, 7 | 450,648 | 1,328,837 | 878,189 | 2.9 |
| Alt 1, 8 | 317,880 | 1,263,380 | 945,501 | 4.0 |
| Alt 2, 4 | 585,958 | 1,598,187 | 1,012,229 | 2.7 |
| Alt 2, 7 | 538,390 | 1,413,856 | 875,466 | 2.6 |
| Alt 2, 8 | 526,337 | 1,344,211 | 817,874 | 2.6 |
| Alt 4, 7 | 337,211 | 1,178,793 | 841,582 | 3.5 |
| Alt 4, 8 | 325,158 | 1,103,461 | 778,303 | 3.4 |
| Alt 1, 2, 3 | 831,605 | 1,592,519 | 760,914 | 1.9 |
| Alt 1, 2, 4 | 903,838 | 1,897,906 | 994,068 | 2.1 |
| Alt 1, 2, 5 | 1,062,549 | 1,208,613 | 146,064 | 1.1 |
| Alt 1, 2, 7 | 856,269 | 1,824,395 | 968,126 | 2.1 |
| Alt 1, 2, 8 | 844,216 | 1,750,352 | 906,136 | 2.1 |
| Alt 1, 3, 4 | 630,427 | 1,601,048 | 970,621 | 2.5 |
| Alt 1, 3, 5 | 789,138 | 1,012,551 | 223,413 | 1.3 |
| Alt 1, 3, 7 | 582,858 | 1,334,789 | 751,930 | 2.3 |
| Alt 1, 3, 8 | 570,805 | 1,334,789 | 763,983 | 2.3 |
| Alt 1, 4, 5 | 861,371 | 1,601,048 | 739,677 | 1.9 |
| Alt 1, 4, 7 | 655,091 | 1,697,713 | 1,042,622 | 2.6 |
| Alt 1, 4, 8 | 643,038 | 1,761,501 | 1,118,463 | 2.7 |

Continued next page

Table 101 (Cont'd)

| Feature | Average Annual Cost ($) | Benefits Based on 2004-Period Traffic ($) | Net Excess Benefits ($) | Benefit to Cost Ratio |
|---|---|---|---|---|
| Alt 2, 4, 7 | 730,780 | 1,796,902 | 1,066,123 | 2.5 |
| Alt 2, 4, 8 | 889,491 | 1,750,548 | 861,057 | 2.0 |
| Alt 2, 7, 8 | 683,211 | 1,370,980 | 687,769 | 2.0 |
| Alt 4, 7, 8 | 469,980 | 1,259,138 | 789,159 | 2.7 |
| Alt 1, 2, 3, 4 | 1,023,995 | 1,902,467 | 878,472 | 1.9 |
| Alt 1, 2, 4, 7 | 1,048,659 | 2,100,114 | 1,051,455 | 2.0 |
| Alt 1, 2, 4, 8 | 1,036,606 | 2,062,240 | 1,025,634 | 2.0 |
| Alt 1, 2, 7, 8 | 989,038 | 1,879,960 | 890,922 | 1.9 |
| Alt 1, 4, 7, 8 | 787,859 | 1,850,392 | 1,062,533 | 2.3 |
| Alt 2, 3, 4, 5 | 1,057,216 | 1,797,233 | 740,017 | 1.7 |
| Alt 2, 4, 7, 8 | 863,548 | 1,707,628 | 844,080 | 2.0 |
| Alt 1, 2, 4, 7, 8 | 1,181,428 | 1,982,703 | 801,276 | 1.7 |
| Alt 2, 3, 4, 5, 7 | 1,202,038 | 1,797,233 | 595,195 | 1.5 |
| Alt 2, 4, 5, 7, 8 | 1,189,985 | 1,838,302 | 648,317 | 1.5 |
| Alt 3, 4, 5, 7, 8 | 941,238 | 1,261,556 | 320,318 | 1.3 |

Table 102
Average Annual Cost, Transportation Savings Benefits, Net Excess Benefits (4.375%), and Benefit to Cost Ratios (Shifting Charges 100% of the Time)

| Feature | Average Annual Cost ($) | Benefits Based on 2004-Period Traffic ($) | Net Excess Benefits ($) | Benefit to Cost Ratio |
|---|---|---|---|---|
| Alt 1 | 317,880 | 212,798 | –105,082 | 0.7 |
| Alt 2 | 393,568 | 287,370 | –106,198 | 0.7 |
| Alt 4 | 192,390 | 0 | –192,390 | 0.0 |
| Alt 7 | 144,821 | 0 | –144,821 | 0.0 |
| Alt 8 | 132,768 | 0 | –132,768 | 0.0 |
| Alt 1, 2 | 711,448 | 791,403 | 79,955 | 1.1 |
| Alt 1, 3 | 438,037 | 213,928 | –224,109 | 0.5 |
| Alt 1, 4 | 510,270 | 800,128 | 289,859 | 1.6 |
| Alt 1, 5 | 462,701 | 213,928 | –248,773 | 0.5 |
| Alt 1, 7 | 450,648 | 530,215 | 79,567 | 1.2 |
| Alt 1, 8 | 317,880 | 464,758 | 146,878 | 1.5 |
| Alt 2, 4 | 585,958 | 799,565 | 213,607 | 1.4 |
| Alt 2, 7 | 538,390 | 615,233 | 76,843 | 1.1 |

Continued next page

Table 102 (Cont'd)

| Feature | Average Annual Cost ($) | Benefits Based on 2004-Period Traffic ($) | Net Excess Benefits ($) | Benefit to Cost Ratio |
|---|---|---|---|---|
| Alt 2, 8 | 526,337 | 0 | –526,337 | 0.0 |
| Alt 4, 7 | 337,211 | 380,170 | 42,959 | 1.1 |
| Alt 4, 8 | 325,158 | 304,838 | –20,320 | 0.9 |
| Alt 1, 2, 3 | 831,605 | 793,896 | –37,709 | 1.0 |
| Alt 1, 2, 4 | 903,838 | 1,099,283 | 195,446 | 1.2 |
| Alt 1, 2, 5 | 1,062,549 | 297,153 | –765,396 | 0.3 |
| Alt 1, 2, 7 | 856,269 | 1,025,773 | 169,503 | 1.2 |
| Alt 1, 2, 8 | 844,216 | 951,730 | 107,513 | 1.1 |
| Alt 1, 3, 4 | 630,427 | 802,425 | 171,998 | 1.3 |
| Alt 1, 3, 5 | 789,138 | 213,928 | –575,210 | 0.3 |
| Alt 1, 3, 7 | 582,858 | 536,166 | –46,692 | 0.9 |
| Alt 1, 3, 8 | 570,805 | 536,166 | –34,639 | 0.9 |
| Alt 1, 4, 5 | 861,371 | 802,425 | –58,946 | 0.9 |
| Alt 1, 4, 7 | 655,091 | 898,950 | 243,859 | 1.4 |
| Alt 1, 4, 8 | 643,038 | 962,878 | 319,840 | 1.5 |
| Alt 2, 4, 7 | 730,780 | 0 | –730,780 | 0.0 |
| Alt 2, 4, 8 | 889,491 | 0 | –889,491 | 0.0 |
| Alt 2, 7, 8 | 683,211 | 998,280 | 315,068 | 1.5 |
| Alt 4, 7, 8 | 469,980 | 460,516 | –9,464 | 1.0 |
| Alt 1, 2, 3, 4 | 1,023,995 | 1,103,845 | 79,850 | 1.1 |
| Alt 1, 2, 4, 7 | 1,048,659 | 1,301,491 | 252,832 | 1.2 |
| Alt 1, 2, 4, 8 | 1,036,606 | 1,263,618 | 227,012 | 1.2 |
| Alt 1, 2, 7, 8 | 989,038 | 1,081,337 | 92,299 | 1.1 |
| Alt 1, 4, 7, 8 | 787,859 | 1,051,629 | 263,770 | 1.3 |
| Alt 2, 3, 4, 5 | 1,057,216 | 998,610 | –58,606 | 0.9 |
| Alt 2, 4, 7, 8 | 863,548 | 909,005 | 45,457 | 1.1 |
| Alt 1, 2, 4, 7, 8 | 1,181,428 | 1,184,081 | 2,653 | 1.0 |
| Alt 2, 3, 4, 5, 7 | 1,202,038 | 998,610 | –203,427 | 0.8 |
| Alt 2, 4, 5, 7, 8 | 1,189,985 | 1,039,679 | –150,306 | 0.9 |
| Alt 3, 4, 5, 7, 8 | 941,238 | 462,934 | –478,304 | 0.5 |

Table 103 summarizes the project cost and benefits associated with the combination of 1, 4, and 8. The annual benefits presented in Table 104 are average annual numbers and reflect future growth based on 2019–2069 traffic levels. The benefit calculations are based on a project condition without deepening. The project construction cost is based on a project depth of 48 feet.

Table 103
SNWW Neches River Anchorage Analysis
Basins 1, 4, and 8
Economic Summary Data
October 2008 Dollars

| | |
|---|---|
| First Cost of Construction | 9,452,214 |
| Interest During Construction | 190,786 |
| Total Investment | 9,643,000 |
| Average Annual Construction Cost | 478,073 |
| Average Annual O&M | 190,106 |
| Total Annual Cost | 668,179 |

Average Annual Benefits at 4.375%
Incorporates Traffic Growth (2019–2069)
Based on Pilot Shifting Cost Scenarios

| Benefit Component | Based on No Pilot Shifting Cost | Based on Pilot Shifting Cost 100% of the Time | Based on Pilot Shifting Cost 50% of the Time |
|---|---|---|---|
| Average Annual Benefits | 2,784,668 | 1,522,166 | 2,153,417 |
| Net Excess Benefits | 2,116,489 | 853,987 | 1,485,238 |
| Benefit to Cost Ratios | 4.2 | 2.3 | 3.2 |

## 6.4 CHANNEL DEEPENING BENEFITS

The transportation costs and the savings associated with the proposed project depth increase were calculated using commodity-specific vessel class and trade route distributions. Transportation costs were calculated based on the channel depth alternatives and variables associated with vessel design drafts, maximum feet of light-loading, underkeel clearance, mileage traveled, and the number of hours to load and unload. Maximum vessel cargo capacities for crude oil and petroleum products were estimated based on review of the range of load factors obtained based on review from IWR Report 91-R-13, *National Economic Development Procedures Manual Deep Draft Navigation* (1991) and consultation with SNWW industry and the SPA. The IWR (1991) cargo capacity factors published in the deep-draft manual for dry bulk carriers and tankers are shown in Table 104. Consultation with industry and the pilots revealed that these estimates are reasonable. Table 105 presents representative round-trip mileage for the trade routes or junction points used for the transportation savings computations.

Table 104
Adjustments for Estimating Actual Vessel Capacity

| Vessel DWT | Dry Bulk | Tanker |
|---|---|---|
| <20,000 | 0.90 | 0.90 |
| 20,000–70,000 | 0.92 | 0.92 |
| 70,000–120,000 | 0.95 | 0.95 |
| >120,000 | 0.97 | 0.97 |

Table 105
Representative Round-Trip Mileage to SNWW

| Location | Total Miles |
|---|---|
| Coatzacoalcos, Mexico | 1,376 |
| U.S. Gulf Coast Lightering/Lightening Zone | 160 |
| Venezuela | 3,612 |
| Panama Canal | 3,120 |
| Brazil (Maceio/Sao Paulo weighted average) | 9,422 |
| Rotterdam, Netherlands | 10,040 |
| Sture, Norway | 10,528 |
| North Africa, Algiers | 10,294 |
| West Africa (Nigeria and Angola) | 12,500 |
| Persian Gulf and Indian Subcontinent via Suez Canal | 19,704 |
| Persian Gulf and Indian Subcontinent via Cape of Good Hope | 25,112 |
| Singapore via Panama Canal | 24,248 |
| Singapore via Cape of Good Hope | 26,304 |

### 6.4.1 Transportation Savings Benefits for Channel Deepening

Transportation savings benefits from reductions in the vessel operating costs were calculated based on the relative difference in transportation costs between the without-project and with-project conditions. Transportation costs and savings were calculated for vessels that minimize transportation costs given trade route constraints. As previously noted, long-term fleet selection will continue to reflect goals of minimizing vessel operating costs. The basic procedure used to calculate transportation costs using 110,000 and 150,000 DWT foreign flag tankers as an example is illustrated in Table 106. Similar computations were made for appropriate distances and vessel sizes for each of the channel depth alternatives. The resulting costs-per-ton computations were calculated over the relevant range of vessels projected for each channel depth improvement, and the associated savings per ton were measured using the net differences in costs between the existing 40-foot channel and the depth alternative. Unless otherwise noted, the 2019–2069 tonnage forecasts used for the benefit calculations are shown in tables 81 and 82 summarizing the transportation savings benefits. Table 107 lists the terminal locations by channel and mileage point for the commodities included in the deepening analysis.

Table 106
Transportation Cost Calculation (South America to SNWW)

| Channel Depth | 40 feet | 45 feet | 50 feet | 40 feet | 45 feet | 50 feet |
|---|---|---|---|---|---|---|
| Vessel Deadweight Tons | 110,000 | 110,000 | 110,000 | 150,000 | 150,000 | 150,000 |
| Design Draft (feet) | 50.0 | 50.0 | 50.0 | 56.4 | 56.4 | 56.4 |
| Cargo Capacity (%) a/ | 95 | 95 | 95 | 97 | 97 | 97 |
| Cargo Capacity (short tons) a/ | 104,500 | 104,500 | 104,500 | 145,500 | 145,500 | 145,500 |
| Immersion Factor (tons per inch) | 234.1 | 234.1 | 234.1 | 285.4 | 285.4 | 285.4 |
| Hourly Cost at Sea (from EGM) | 1,192 | 1,192 | 1,192 | 1,369 | 1,369 | 1,369 |
| Underkeel Clearance (feet) b/ | 1 | 1 | 1 | 1 | 1 | 1 |
| Hourly Cost in Port (from EGM) | $772 | $772 | $772 | $878 | $878 | $878 |
| Round Trip Mileage from South America b/ | 5,627 | 5,627 | 5,627 | 5,627 | 5,627 | 5,627 |
| Speed (Knots) | 15 | 15 | 15 | 15 | 15 | 15 |
| Total Voyage Cost | 447,127 | 447,127 | 447,127 | 513,521 | 513,521 | 513,521 |
| Other Components (Loading and Unloading and Port Time) | | | | | | |
| Maximum Load at Channel Dept | 73,599 | 87,645 | 101,691 | 85,908 | 103,032 | 120,156 |
| Cost per Ton for Sea Voyage | 6.08 | 5.10 | 4.40 | 5.98 | 4.98 | 4.27 |
| Loading/Unloading Rate (short tons/hour) | 5,250 | 5,250 | 5,250 | 5,250 | 5,250 | 5,250 |
| Hours in Port | 24 | 24 | 24 | 24 | 24 | 24 |
| Total Loading Cost at Foreign Port | 18,528 | 18,528 | 18,528 | 21,072 | 21,072 | 21,072 |
| Total Unloading Cost SNWW | 18,528 | 18,528 | 18,528 | 21,072 | 21,072 | 21,072 |
| Pilot and Tug Costs | 45,501 | 48,624 | 51,031 | 56,923 | 60,331 | 62,908 |
| Total Loading, Unloading, and Port Costs | 82,557 | 85,680 | 88,087 | 99,067 | 102,475 | 105,052 |
| Total Cost Sum | 529,684 | 532,808 | 535,214 | 612,588 | 615,996 | 618,573 |
| Total Cost Per Ton | 7.20 | 6.08 | 5.26 | 7.13 | 5.98 | 5.15 |

a/ Estimated short tons =~ ((DWT * Maximum % Load) - (Immersion Factor * 12 inches per ton * number of feet light-loaded).

b/ Weighted mileage based on distance from Venezuela and Brazil. The weight factor of 0.7 was used for Venezuela, and a factor of 0.3 was used for Brazil. The weights were determined based on the expected percentage of tonnage by origin.

Table 107
SNWW Facilities Associated with Draft-Constrained Vessels by Channel Reach, Mileage Point, Facility Name, Major Commodity, and Cross Section Reference

| Channel Reach | Estimated Miles from Sea Buoy | Existing Facility (Company Name) | Major Commodity | USACE Cross Section Reference Estimate |
|---|---|---|---|---|
| Sabine Bank Channel | 0 | n/a | n/a | n/a |
| Sabine Pass Outer Bar Channel | 14 | n/a | n/a | n/a |
| Sabine Pass Jetty Channel | 16 | n/a | n/a | n/a |
| Sabine Pass Channel | 22 | Cheniere; Golden Pass | LNG | SPC090+00 |
| Port Arthur Canal | 25 | Sempra a/ | LNG | PAC170+00 |
| Taylor Bayou | 32 | Motiva; Premcor | Crude Oil, Petroleum and Chemicals | PAC310+00 |
| Sabine-Neches Canal | 33 | Port of Port Arthur | Bulk Materials | SNC300+00 |
| Neches River Channel | 40 | n/a | | |
| | 42 | Fina | Crude Oil, Petroleum and Chemicals | NRC020+00 |
| | 45 | Motiva; Huntsman | Crude Oil, Petroleum and Chemicals | NRC300+00 |
| | 46 | Transit Mix | Bulk Materials | NRC340+00 |
| | 48 | Sun Oil; Union Oil | Crude Oil, Petroleum and Chemicals | NRC520+00 |
| | 51 | Oil Tanking | Crude Oil and Petroleum Products | NRC700+00 |
| | 55 | ExxonMobil | Crude Oil, Petroleum and Chemicals | NRC950+00 |
| | 56 | Port of Beaumont | Grain; Bulk Materials | NRC975+00 |

a/ Anticipated to be constructed in 2012.

#### 6.4.1.1 Crude Petroleum Imports

The costs per ton computations were calculated over the relevant range of vessels projected for each channel depth improvement. The associated savings per ton were measured using the net differences in costs between the existing 40-foot channel and the depth alternative. The transportation costs were calculated using foreign flag tankers (see Table 82). The distribution of tonnage between the ports of Beaumont and Port Arthur was assumed to reflect the relative historical tonnage shares. The sensitivity section of this appendix addresses the effects of Port Arthur's future share increasing relative to Beaumont's present share. Table 108 presents Port Arthur and Beaumont crude oil import forecasts.

Table 108
SNWW Crude Petroleum Imports by Port and Trade Route, 2019–2069
1,000s of Short Tons

| Beaumont | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|
| Canada | – | – | – | – | – | – |
| Mexico | 7,817 | 8,716 | 9,234 | 9,392 | 9,575 | 10,277 |
| Central/South America | 12,576 | 14,023 | 14,857 | 15,111 | 15,405 | 16,534 |
| Western South America | – | – | – | – | – | – |
| Europe and Africa | 29,327 | 32,701 | 34,644 | 35,237 | 35,922 | 38,556 |
| Middle East | 27,439 | 30,596 | 32,414 | 32,968 | 33,610 | 36,074 |
| Beaumont Total | 77,159 | 86,037 | 91,150 | 92,708 | 94,512 | 101,441 |
| | | | | | | |
| Port Arthur | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
| Canada | – | – | – | – | – | – |
| Mexico | 1,193 | 1,329 | 1,412 | 1,440 | 1,469 | 1,505 |
| Central/South America | 1,915 | 2,133 | 2,262 | 2,304 | 2,350 | 2,470 |
| Western South America | – | – | – | – | – | – |
| Europe and Africa | 4,475 | 4,987 | 5,296 | 5,403 | 5,512 | 5,647 |
| Middle East | 4,187 | 4,666 | 4,955 | 5,055 | 5,157 | 5,283 |
| Port Arthur Total | 11,769 | 13,116 | 13,925 | 14,202 | 14,488 | 14,906 |
| | | | | | | |
| SNWW Used for the Benefits Calculations | 88,928 | 99,153 | 105,075 | 106,909 | 109,000 | 116,347 |
| | | | | | | |
| SNWW Total | 94,229 | 105,129 | 111,669 | 113,950 | 116,263 | 118,608 |
| % Used for Benefits | 95 | 95 | 95 | 95 | 95 | 95 |

An increase in the channel depth to Port Arthur from 40 to 45 feet would allow the existing range of 90,000 to 120,000 DWT vessels to carry approximately 20 percent more cargo. A depth increase from 40 to 50 feet or more would allow the same range of vessels to carry 35 percent more cargo. Table 109 displays the maximum cargo tons by vessel size and channel depth alternatives for representative vessels used in the analysis. Table 110 shows the number of shuttle vessels by channel depth alternatives necessary to offload a VLCC. The maximum loads shown in Table 109 and the number of shuttles shown in Table 110 are based on application of 1 foot of underkeel clearance. The effects of greater underkeel clearance are evaluated in the sensitivity analysis (Section 8). Shuttle vessels between 70,000 and 165,000 DWT were used for Beaumont's lightering cost calculations. Shuttle vessels between 70,000 and 120,000 DWT were used for Port Arthur's lightering cost calculations.

Table 111 summarizes the transportation cost by trade route used for the with- and without-project future condition calculations. The transportation costs for existing conditions and the without-project future are defined by the same range of vessel sizes. The existing range of vessels is concentrated between 75,000 and 120,000 DWT. The maximum vessel sizes presently used are in the 150,000 to 175,000 DWT range. Current distribution of crude oil imports by vessel size can be found in Section 3 (see tables 29, 31, and 32). There is a gap in the world tanker fleet between 175,000 and 250,000 DWT. The reason for the gap is that it is not cost effective to use tankers significantly larger than 175,000 DWT for channel depths of less than 55 feet (Section 3.5.1). An increase in channel depth of the SNWW would provide opportunity for the current range of vessels used for direct shipment and as shuttle vessels associated with offshore lightering to be more fully loaded.

The per ton transportation costs correspond to the least-cost method of shipment associated with the particular trade route. Review of the depths at trading ports and significant savings per ton indicate that a large share of crude petroleum tonnage from Mexico, Venezuela, and Trinidad would be loaded to vessel drafts over 40 feet.

Expectations concerning the percentage of Middle East and Africa movements are subject to greater uncertainty. Nearly all Middle East tonnage is lightered, and nearly all West Africa crude is lightened. The logistics associated with these offshore transfers introduces higher degrees of uncertainty than with direct shipment and, therefore, generates large cost variances.

Additionally, and as Table 111 illustrates, the cost savings for offshore transfer are lower than with direct shipment; however, distinct cost savings are apparent. The savings for lightering results from increases in shuttle loads due to greater channel depth in SNWW. For lightering, the effect of increasing channel depths at SNWW allows for the reduction in the number of shuttles necessary to totally lighter VLCCs. The savings for lightened movements results from decreases in offshore unloading time from the mother vessel to shuttles. For lightening, the mother vessel is substituting offshore unloading time for dock-side unloading time. Additionally, the shuttle vessel reduces its overall loading and unloading time.

Table 109
SNWW Foreign Flag Tanker Vessel Application
Maximum Cargo by Vessel Size and Channel Depth (feet)

| | | | Channel Depth (feet) = | | 40 | 43 | 44 | 45 | 46 | 47 | 48 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ratio of | | Maximum Loaded Draft = | | 39 | 42 | 43 | 44 | 45 | 46 | 47 | 49 |
| DWT | Cargo to DWT (%) | Immersion Factor | Design Draft | Full Load | Cargo Capacity by Channel Depth Alternative | | | | | | | |
| 9,000 | 90 | - | - | 8,100 | 8,100 | 8,100 | 8,100 | 8,100 | 8,100 | 8,100 | 8,100 | 8,100 |
| 12,000 | 90 | - | - | 10,800 | 10,800 | 10,800 | 10,800 | 10,800 | 10,800 | 10,800 | 10,800 | 10,800 |
| 14,000 | 90 | - | - | 12,600 | 12,600 | 12,600 | 12,600 | 12,600 | 12,600 | 12,600 | 12,600 | 12,600 |
| 18,000 | 90 | - | - | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 |
| 20,000 | 92 | 79 | 32 | 18,400 | 18,400 | 18,400 | 18,400 | 18,400 | 18,400 | 18,400 | 18,400 | 18,400 |
| 25,000 | 92 | 91 | 33 | 23,000 | 23,000 | 23,000 | 23,000 | 23,000 | 23,000 | 23,000 | 23,000 | 23,000 |
| 35,000 | 92 | 113 | 36 | 32,200 | 32,200 | 32,200 | 32,200 | 32,200 | 32,200 | 32,200 | 32,200 | 32,200 |
| 50,000 | 92 | 141 | 39 | 46,000 | 46,000 | 46,000 | 46,000 | 46,000 | 46,000 | 46,000 | 46,000 | 46,000 |
| 60,000 | 92 | 159 | 41 | 55,200 | 51,958 | 55,200 | 55,200 | 55,200 | 55,200 | 55,200 | 55,200 | 55,200 |
| 70,000 | 95 | 160 | 46 | 66,500 | 53,060 | 58,820 | 60,740 | 62,660 | 64,580 | 66,500 | 66,500 | 66,500 |
| 75,000 | 95 | 180 | 47 | 71,250 | 53,970 | 60,450 | 62,610 | 64,770 | 66,930 | 69,090 | 71,250 | 71,250 |
| 80,000 | 95 | 191 | 45 | 76,000 | 62,248 | 69,124 | 71,416 | 73,708 | 76,000 | 76,000 | 76,000 | 76,000 |
| 85,000 | 95 | 198 | 46 | 80,750 | 64,795 | 71,939 | 74,320 | 76,702 | 79,083 | 80,750 | 80,750 | 80,750 |
| 90,000 | 95 | 206 | 46 | 85,500 | 67,216 | 74,628 | 77,099 | 79,570 | 82,041 | 84,512 | 85,500 | 85,500 |
| 105,000 | 95 | 227 | 49 | 99,750 | 72,232 | 80,405 | 83,130 | 85,855 | 88,579 | 91,304 | 94,028 | 96,753 |
| 125,000 | 96 | 253 | 52 | 119,875 | 78,951 | 88,071 | 91,111 | 94,151 | 97,191 | 100,231 | 103,271 | 106,311 |
| 130,000 | 96 | 260 | 53 | 125,000 | 80,539 | 89,890 | 93,007 | 96,124 | 99,241 | 102,358 | 105,475 | 108,592 |
| 135,000 | 96 | 266 | 54 | 130,125 | 82,028 | 91,610 | 94,804 | 97,998 | 101,192 | 104,386 | 107,580 | 110,774 |
| 150,000 | 97 | 285 | 56 | 145,500 | 85,908 | 96,183 | 99,608 | 103,032 | 106,457 | 109,882 | 113,307 | 116,732 |
| 165,000 | 97 | 303 | 59 | 160,050 | 88,690 | 99,613 | 103,254 | 106,894 | 110,535 | 114,176 | 117,817 | 121,458 |
| 175,000 | 97 | 314 | 60 | 169,750 | 91,456 | 102,765 | 106,534 | 110,304 | 114,074 | 117,843 | 121,613 | 125,382 |
| 190,000 | 97 | 330 | 62 | 184,300 | 95,040 | 106,928 | 110,891 | 114,854 | 118,816 | 122,779 | 126,742 | 130,704 |

Table 110
Number of Shuttle Vessels Needed by Channel Depth Alternative

| Channel Depth (feet) Alternative | Shuttle Vessel Trips by Channel Depth Alternative and Vessel DWT | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 42,500 | 50,000 | 70,000 | 80,000 | 85,000 | 90,000 | 110,000 | 115,000 | 120,000 | 125,000 | 130,000 | 135,000 | 150,000 | 165,000 |
| 40 | 9.0 | 7.0 | 6.0 | 6.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| 43 | 9.0 | 7.0 | 6.0 | 5.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| 44 | 9.0 | 7.0 | 6.0 | 5.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| 45 | 9.0 | 7.0 | 6.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 |
| 46 | 9.0 | 7.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 |
| 47 | 9.0 | 7.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 |
| 48 | 9.0 | 7.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| 49 | 9.0 | 7.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| 50 | 9.0 | 7.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| 52 | 9.0 | 7.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

Table 111
SNWW Crude Petroleum Imports Transportation Cost and Savings
Most Likely Transportation Mode Trade Route and Channel Depth (December 2008 Vessel Costs)

| Trade Route/Depth (feet) And Method of Shipment | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|
| Mexico | Direct | Direct | Direct | Direct | Direct | Direct | Direct |
| Cost/ton Beaumont | 2.76 | 2.34 | 2.28 | 2.21 | 2.15 | 2.11 | 2.07 |
| Cost/ton Port Arthur | 2.77 | 2.37 | 2.30 | 2.23 | 2.18 | 2.14 | 2.11 |
| Savings/ton Beaumont | | 0.41 | 0.48 | 0.55 | 0.60 | 0.65 | 0.69 |
| Savings/ton Port Arthur | | 0.41 | 0.47 | 0.54 | 0.59 | 0.63 | 0.67 |
| Venezuela | Direct | Direct | Direct | Direct | Direct | Direct | Direct |
| Cost/ton Beaumont | 7.22 | 6.09 | 5.91 | 5.73 | 5.58 | 5.45 | 5.34 |
| Cost/ton Port Arthur | 7.28 | 6.17 | 5.98 | 5.81 | 5.67 | 5.55 | 5.47 |
| Savings/ton Beaumont | | 1.13 | 1.31 | 1.49 | 1.64 | 1.77 | 1.88 |
| Savings/ton Port Arthur | | 1.11 | 1.30 | 1.47 | 1.62 | 1.73 | 1.81 |
| Africa/North Sea | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered |
| Cost/ton Beaumont | 8.41 | 8.18 | 8.13 | 8.12 | 8.05 | 8.01 | 8.01 |
| Cost/ton Port Arthur | 8.46 | 8.19 | 8.13 | 8.12 | 8.12 | 8.11 | 8.08 |
| Savings/ton Beaumont | | 0.23 | 0.28 | 0.30 | 0.36 | 0.40 | 0.40 |
| Cost/ton Port Arthur | | 0.27 | 0.33 | 0.34 | 0.35 | 0.35 | 0.39 |
| Middle East | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered |
| Cost/ton Beaumont | 14.43 | 14.20 | 14.15 | 14.13 | 14.06 | 14.03 | 14.03 |
| Cost/ton Port Arthur | 14.48 | 14.19 | 14.13 | 14.11 | 14.11 | 14.10 | 14.06 |
| Savings/ton Beaumont | | 0.23 | 0.28 | 0.30 | 0.36 | 0.40 | 0.40 |
| Savings/ton Port Arthur | | 0.29 | 0.35 | 0.36 | 0.37 | 0.38 | 0.42 |

Lightening generates comparatively lower savings than lightering because the latter produces the possibility of reducing the number of shuttles needed. Examination of the cost data also revealed that as channel depth increases, the resulting savings may introduce incentive to switch from lightening to direct shipment for movements from Africa and the North Sea. Table 112 presents the lightening and Table 113 presents the lightering costs. Historically, lightening was the most common choice for Africa and the North Sea movements; however, lightering has become more common for this route in recent years due to structural changes in oil production off the coast of West Africa. Lightering has always been the method of choice for Middle East movements. The small percentage of North Sea using SNWW tends to be lightered, and an increasing portion of West Africa crude is lightered. Lightering was assumed to represent the without- and with-project future choice for West Africa crude due to its relative low cost and increasing popularity. Comparison of the cost data in tables 112, 113, and 114 for the Africa and North Sea route demonstrates why lightening will continue for this route; however, method of shipment choices for West African crude will remain subject to a higher level of uncertainty than for other routes. The relative closeness in costs between the shipping methods, and the uncertainty associated “turnaround times” for completing offshore transfers means that direct shipment and lightening will continue as viable

options. At the same time, the effect of an SNWW deeper channel depth will reduce the cost differential and make direct shipment more cost competitive for Africa and North Sea routings and, therefore, may result in a greater frequency of direct shipment, with the uncertainty associated with offshore transfers being a key variable affecting shippers' decision.

Table 112
SNWW Crude Petroleum Imports
Lightened Cost Per Ton by Channel Depth and Trade Route (December 2008 Vessel Costs)

| Depth | 40 feet | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|---|
| Mother Vessels (DWT) | | | | | | | |
| Minimum | 150,000 | 150,000 | 162,500 | 162,500 | 162,500 | 162,500 | 162,500 |
| Maximum | 175,000 | 175,000 | 175,000 | 175,000 | 175,000 | 175,000 | 175,000 |
| Shuttle Vessels (DWT) | | | | | | | |
| Minimum | 72,000 | 57,000 | 57,000 | 57,000 | 57,000 | 57,000 | 57,000 |
| Maximum | 85,000 | 68,000 | 65,000 | 65,000 | 65,000 | 65,000 | 65,000 |
| Africa and North Sea | Per Ton Transportation Cost to SNWW ($) | | | | | | |
| Minimum | 10.10 | 10.08 | 10.08 | 10.08 | 10.08 | 10.08 | 10.08 |
| Mean | 10.56 | 10.49 | 10.49 | 10.49 | 10.49 | 10.49 | 10.49 |
| Maximum | 11.02 | 10.90 | 10.90 | 10.90 | 10.90 | 10.90 | 10.90 |
| Middle East | Per Ton Transportation Cost to SNWW ($) | | | | | | |
| Minimum | 14.70 | 14.68 | 14.68 | 14.68 | 14.68 | 14.68 | 14.68 |
| Mean | 15.17 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 |
| Maximum | 15.63 | 15.51 | 15.51 | 15.51 | 15.51 | 15.51 | 15.51 |

Table 113
SNWW Crude Petroleum Imports
Lightered Cost Per Ton by Channel Depth and Trade Route (December 2008 Vessel Costs)

| Depth | 40 feet | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|---|
| Africa and North Sea Per Ton Transportation Cost ($) | | | | | | | |
| Minimum | 8.31 | 8.16 | 8.04 | 8.02 | 8.00 | 7.90 | 7.89 |
| Mean | 8.41 | 8.18 | 8.13 | 8.12 | 8.05 | 8.01 | 8.01 |
| Maximum | 8.66 | 8.53 | 8.51 | 8.28 | 8.26 | 8.26 | 8.26 |
| Middle East Per Ton Transportation Cost ($) | | | | | | | |
| Minimum | 14.33 | 14.17 | 14.06 | 14.04 | 14.02 | 13.92 | 13.91 |
| Mean | 14.43 | 14.20 | 14.15 | 14.13 | 14.06 | 14.03 | 14.03 |
| Maximum | 14.68 | 14.55 | 14.52 | 14.30 | 14.27 | 14.27 | 14.27 |

Tables 114 and 115 display Beaumont and Port Arthur's transportation cost savings based on the least-cost shipping methods displayed in Table 111. For Port Arthur, the maximum vessel DWT used for the benefit calculations is less than 121,000 DWT. As previously noted, deepening of the channel leading to the Taylor Bayou terminal will enable the existing fleet to be more fully loaded, but it will not result in transition to larger vessels. The transportation costs shown in Table 111 and the savings shown in Table 115 reflect continuation of this limitation.

Table 114
Beaumont Crude Petroleum Imports
Annual Transportation Savings ($1,000s) by Trade Route and Decade (December 2008 Vessel Costs)
2019–2069

| Channel Depth Alternative/ Trade Route | 2002/2004 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| 45-foot Channel | | | | | | | |
| Mexico | 6,065 | 3,227 | 3,597 | 3,808 | 3,870 | 3,945 | 4,235 |
| Central/South America | 8,348 | 14,216 | 15,850 | 16,779 | 17,052 | 17,380 | 18,660 |
| Europe and Africa | 2,021 | 6,842 | 7,629 | 8,076 | 8,207 | 8,365 | 8,981 |
| Middle East | 5,879 | 6,402 | 7,138 | 7,556 | 7,679 | 7,827 | 8,403 |
| Total Savings | 22,313 | 30,686 | 34,214 | 36,219 | 36,808 | 37,516 | 40,280 |
| 46-foot Channel | | | | | | | |
| Mexico | 7,089 | 3,771 | 4,205 | 4,451 | 4,524 | 4,611 | 4,950 |
| Central/South America | 9,724 | 16,558 | 18,461 | 19,543 | 19,861 | 20,243 | 21,735 |
| Europe and Africa | 2,431 | 8,230 | 9,176 | 9,714 | 9,872 | 10,062 | 10,803 |
| Middle East | 7,071 | 7,700 | 8,585 | 9,088 | 9,236 | 9,414 | 10,107 |
| Total Savings | 26,315 | 36,259 | 40,427 | 42,796 | 43,493 | 44,329 | 47,595 |
| 47-foot Channel | | | | | | | |
| Mexico | 8,051 | 4,283 | 4,775 | 5,055 | 5,137 | 5,236 | 5,622 |
| Central/South America | 11,016 | 18,758 | 20,914 | 22,140 | 22,500 | 22,933 | 24,623 |
| Europe and Africa | 2,566 | 8,687 | 9,685 | 10,253 | 10,420 | 10,620 | 11,403 |
| Middle East | 7,464 | 8,128 | 9,062 | 9,593 | 9,749 | 9,937 | 10,669 |
| Total Savings | 29,097 | 39,856 | 44,437 | 47,041 | 47,807 | 48,726 | 52,316 |
| 48-foot Channel | | | | | | | |
| Mexico | 8,867 | 4,717 | 5,259 | 5,567 | 5,658 | 5,767 | 6,192 |
| Central/South America | 12,147 | 20,684 | 23,062 | 24,413 | 24,810 | 25,288 | 27,151 |
| Europe and Africa | 3,162 | 10,705 | 11,935 | 12,635 | 12,840 | 13,087 | 14,052 |
| Middle East | 9,198 | 10,016 | 11,167 | 11,821 | 12,014 | 12,245 | 13,147 |
| Total Savings | 33,373 | 46,121 | 51,423 | 54,437 | 55,323 | 56,387 | 60,541 |
| 49-foot Channel | | | | | | | |
| Mexico | 9,549 | 5,080 | 5,664 | 5,996 | 6,093 | 6,210 | 6,668 |
| Central/South America | 13,093 | 22,295 | 24,858 | 26,315 | 26,743 | 27,258 | 29,266 |
| Europe and Africa | 3,490 | 11,816 | 13,175 | 13,947 | 14,174 | 14,447 | 15,511 |
| Middle East | 10,153 | 11,056 | 12,327 | 13,049 | 13,261 | 13,516 | 14,512 |
| Total Savings | 36,285 | 50,247 | 56,023 | 59,307 | 60,272 | 61,431 | 65,957 |
| 50-foot Channel | | | | | | | |
| Mexico | 10,171 | 5,411 | 6,033 | 6,386 | 6,490 | 6,615 | 7,102 |
| Central/South America | 13,900 | 23,669 | 26,390 | 27,937 | 28,391 | 28,937 | 31,069 |
| Europe and Africa | 3,490 | 11,816 | 13,175 | 13,947 | 14,174 | 14,447 | 15,511 |
| Middle East | 10,153 | 11,056 | 12,327 | 13,049 | 13,261 | 13,516 | 14,512 |
| Total Savings | 37,714 | 51,952 | 57,924 | 61,319 | 62,317 | 63,515 | 68,195 |

Table 115
Port Arthur Crude Petroleum Imports
Annual Transportation Savings ($1,000s) by Trade Route and Decade (December 2008 Vessel Costs)
2019–2069

| Channel Depth Alternative/ Trade Route | 2002/2004 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| 45-foot Channel | | | | | | | |
| Mexico | 3,355 | 484 | 539 | 573 | 584 | 596 | 611 |
| Central/South America | 399 | 2,128 | 2,370 | 2,514 | 2,560 | 2,611 | 2,745 |
| Europe and Africa | 128 | 1,214 | 1,353 | 1,437 | 1,466 | 1,496 | 1,532 |
| Middle East | 299 | 1,194 | 1,331 | 1,414 | 1,442 | 1,471 | 1,507 |
| Total Savings | 4,180 | 5,020 | 5,594 | 5,937 | 6,053 | 6,174 | 6,395 |
| 46-foot Channel | | | | | | | |
| Mexico | 3,928 | 567 | 631 | 670 | 684 | 698 | 715 |
| Central/South America | 465 | 2,481 | 2,764 | 2,931 | 2,985 | 3,044 | 3,201 |
| Europe and Africa | 154 | 1,467 | 1,635 | 1,736 | 1,771 | 1,807 | 1,851 |
| Middle East | 365 | 1,461 | 1,628 | 1,729 | 1,764 | 1,800 | 1,844 |
| Total Savings | 4,913 | 5,976 | 6,659 | 7,067 | 7,205 | 7,349 | 7,611 |
| 47-foot Channel | | | | | | | |
| Mexico | 4,468 | 644 | 718 | 763 | 778 | 794 | 813 |
| Central/South America | 527 | 2,813 | 3,134 | 3,324 | 3,385 | 3,452 | 3,629 |
| Europe and Africa | 160 | 1,527 | 1,702 | 1,807 | 1,843 | 1,881 | 1,927 |
| Middle East | 382 | 1,528 | 1,703 | 1,808 | 1,845 | 1,882 | 1,928 |
| Total Savings | 5,537 | 6,512 | 7,256 | 7,701 | 7,851 | 8,008 | 8,297 |
| 48-foot Channel | | | | | | | |
| Mexico | 4,908 | 708 | 789 | 838 | 855 | 872 | 893 |
| Central/South America | 580 | 3,094 | 3,446 | 3,655 | 3,722 | 3,796 | 3,991 |
| Europe and Africa | 163 | 1,550 | 1,728 | 1,835 | 1,872 | 1,910 | 1,957 |
| Middle East | 389 | 1,554 | 1,732 | 1,840 | 1,877 | 1,915 | 1,962 |
| Total Savings | 6,039 | 6,906 | 7,695 | 8,167 | 8,325 | 8,492 | 8,802 |
| 49-foot Channel | | | | | | | |
| Mexico | 5,242 | 756 | 843 | 895 | 913 | 931 | 954 |
| Central/South America | 620 | 3,306 | 3,683 | 3,906 | 3,978 | 4,057 | 4,265 |
| Europe and Africa | 165 | 1,567 | 1,746 | 1,854 | 1,891 | 1,930 | 1,977 |
| Middle East | 393 | 1,573 | 1,753 | 1,861 | 1,899 | 1,937 | 1,985 |
| Total Savings | 6,420 | 7,201 | 8,024 | 8,516 | 8,681 | 8,855 | 9,181 |
| 50-foot Channel | | | | | | | |
| Mexico | 5,501 | 793 | 884 | 939 | 958 | 977 | 1,001 |
| Central/South America | 649 | 3,461 | 3,856 | 4,089 | 4,165 | 4,247 | 4,465 |
| Europe and Africa | 182 | 1,730 | 1,928 | 2,048 | 2,089 | 2,131 | 2,184 |
| Middle East | 439 | 1,756 | 1,958 | 2,079 | 2,121 | 2,164 | 2,217 |
| Total Savings | 6,771 | 7,741 | 8,626 | 9,155 | 9,332 | 9,519 | 9,866 |

#### 6.4.1.2 Petroleum and Chemical Product Transportation Savings Benefits

Reductions in the vessel operating costs for SNWW foreign petroleum product imports and exports and coastwise shipments were calculated based on the relative difference in transportation costs between the without-project and with-project conditions. For foreign imports and exports, transportation savings were calculated for petroleum product imports and exports and for chemical exports. Chemical imports were not found to be draft limited. As with crude petroleum, transportation costs and savings were calculated for vessels that minimize transportation costs given trade route constraints. Table 116 displays SNWW's petroleum product import forecast and the tonnage used for the benefit calculations. Table 117 displays the petroleum export forecast.

Table 116
SNWW Petroleum Product Imports (short tons), 2019–2069

| Commodity | 2004–2006 Representative Tonnage | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| | Total Petroleum Product Imports (Major Groups) | | | | | | |
| Gasoline | 1,546,750 | 1,835,204 | 2,027,207 | 2,239,298 | 2,473,578 | 2,732,369 | 3,018,235 |
| Distillate | 1,719,000 | 1,895,684 | 2,135,852 | 2,524,052 | 2,843,829 | 3,204,118 | 3,610,054 |
| Residual | 559,500 | 663,941 | 750,277 | 847,840 | 958,090 | 1,082,677 | 1,223,464 |
| Naphtha | 470,250 | 558,031 | 630,595 | 712,595 | 805,258 | 909,971 | 1,028,300 |
| Lube Oil | 185,500 | 220,127 | 248,751 | 281,098 | 317,651 | 358,957 | 405,635 |
| Total Petroleum Product Imports | 4,481,000 | 5,172,987 | 5,792,682 | 6,604,883 | 7,398,406 | 8,288,092 | 9,285,688 |
| | Petroleum Product Imports Used for Benefit Calculations | | | | | | |
| Gasoline | 494,960 | 587,265 | 1,013,603 | 1,119,649 | 1,236,789 | 1,366,184 | 1,509,117 |
| Distillate | 536,328 | 591,453 | 1,067,926 | 1,262,026 | 1,421,914 | 1,602,059 | 1,805,027 |
| Residual | 279,750 | 331,970 | 375,139 | 423,920 | 479,045 | 541,338 | 611,732 |
| Naphtha | 81,353 | 96,539 | 315,297 | 356,298 | 402,629 | 454,986 | 514,150 |
| Lube Oil | 92,750 | 110,063 | 124,376 | 140,549 | 158,826 | 179,479 | 202,817 |
| Total Used for Benefit Calculations | 1,485,141 | 1,717,292 | 2,896,341 | 3,302,442 | 3,699,203 | 4,144,046 | 4,642,844 |
| % of Total | 33 | 33 | 50 | 50 | 50 | 50 | 50 |

Table 117
SNWW Petroleum Product Exports (short tons)
2019–2069

| Commodity | 2004–2006 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| | Total Petroleum Product Exports (Major Groups) | | | | | | |
| Gasoline | 1,834,000 | 3,785,043 | 5,129,249 | 6,473,454 | 7,329,704 | 8,299,210 | 9,396,953 |
| Distillate Fuel | 420,667 | 642,903 | 822,970 | 1,053,472 | 1,348,533 | 1,726,236 | 2,209,728 |
| Residual Fuel Oil | 22,667 | 26,898 | 34,431 | 44,075 | 56,420 | 72,222 | 92,451 |
| Naphtha | 63,667 | 89,959 | 115,156 | 147,409 | 188,696 | 241,547 | 309,200 |
| Lube Oil | 83,300 | 117,701 | 150,667 | 192,866 | 246,885 | 316,034 | 404,550 |
| Petroleum Coke | 4,318,000 | 6,802,246 | 8,768,425 | 10,734,605 | 11,955,318 | 13,206,108 | 14,587,759 |
| Total Petroleum Product Exports | 6,742,300 | 11,464,749 | 15,020,898 | 18,645,881 | 21,125,555 | 23,861,357 | 27,000,641 |
| | Petroleum Product Exports Used for Benefit Calculations | | | | | | |
| Gasoline | 550,200 | 1,135,513 | 2,564,624 | 3,236,727 | 3,664,852 | 4,149,605 | 4,698,476 |
| Distillate Fuel | 126,200 | 192,871 | 411,485 | 526,736 | 674,266 | 863,118 | 1,104,864 |
| Residual Fuel | 11,333 | 13,449 | 17,216 | 22,038 | 28,210 | 36,111 | 46,225 |
| Naphtha | 12,733 | 17,992 | 57,578 | 73,704 | 94,348 | 120,773 | 154,600 |
| Lube Oil | 41,650 | 58,850 | 75,333 | 96,433 | 123,443 | 158,017 | 202,275 |
| Petroleum Coke | 2,159,000 | 3,401,123 | 4,384,213 | 5,367,303 | 5,977,659 | 6,603,054 | 7,293,880 |
| Total Used for Benefit Calculations | 2,901,117 | 4,819,798 | 7,510,449 | 9,322,941 | 10,562,777 | 11,930,678 | 13,500,321 |
| % of Total Tonnage | 43 | 42 | 50 | 50 | 50 | 50 | 50 |

Tables 118 and 119 displays the chemical product import and export forecasts. The presentations show total imports and exports, the commodity groups evaluated for deepening benefits, and the volumes and percentage of total tonnage used for the transportation cost calculations.

Table 118
SNWW Chemical Product Imports (short tons)
2019–2069

| | 2004–2006 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| Total Chemical Product Imports | 957,000 | 1,135,641 | 1,279,518 | 1,441,622 | 1,624,264 | 1,830,045 | 2,061,897 |
| Chemical Product Imports Evaluated for Benefit Calculations | | | | | | | |
| Alcohol Imports | 333,250 | 395,457 | 445,558 | 502,007 | 565,607 | 637,265 | 718,001 |
| Ammonia Imports | 494,750 | 587,104 | 661,485 | 745,290 | 839,712 | 946,097 | 1,065,960 |
| Chemical Product Import Tonnage Used for Benefit Calculations | | | | | | | |
| Draft Restricted Tonnage | 82,800 | 98,256 | 110,704 | 124,730 | 140,532 | 158,336 | 178,396 |
| % of Total Imports | 9 | 9 | 9 | 9 | 9 | 9 | 9 |

Table 119
SNWW Chemical Product Exports (short tons)
2019–2069

| | 2004–2006 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| Total Chemical Product Exports | 2,299,667 | 3,249,369 | 4,159,467 | 5,324,469 | 5,881,526 | 6,496,864 | 7,176,580 |
| Chemical Product Exports Groups Evaluated for Benefit Calculations | | | | | | | |
| Organic Compounds | 501,333 | 708,371 | 906,775 | 1,160,748 | 1,320,786 | 1,502,889 | 1,710,099 |
| Metallic Salts | 1,116,000 | 1,576,879 | 2,018,538 | 2,583,900 | 2,940,154 | 3,345,527 | 3,806,791 |
| Chemical Product Export Tonnage Used for Benefit Calculations | | | | | | | |
| Draft Restricted Tonnage | 339,640 | 479,902 | 614,316 | 786,376 | 894,797 | 1,018,167 | 1,158,547 |
| % of Total Exports | 15 | 15 | 15 | 15 | 15 | 16 | 16 |

Table 120 summarizes the annual transportation cost for Beaumont's petroleum product imports and exports. Table 121 summarizes the annual transportation cost for Port Arthur's petroleum product imports and exports. Table 122 presents the annual savings for Beaumont's and Port Arthur's petroleum product imports and exports.

Table 120
Beaumont Petroleum and Chemical Product Imports and Exports
Annual Transportation Cost ($1,000) by Trade Route and Decade (December 2008 Vessel Costs)
2019–2069

| | 2004/2006 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| 40-foot Channel | | | | | | | |
| Imports | 12,810 | 14,840 | 24,440 | 27,850 | 31,205 | 34,967 | 39,187 |
| Exports | 17,347 | 28,367 | 43,489 | 54,111 | 61,328 | 69,310 | 78,463 |
| Total Cost | 30,157 | 43,207 | 67,928 | 81,962 | 92,533 | 104,278 | 117,650 |
| 45-foot Channel | | | | | | | |
| Imports | 10,795 | 12,506 | 20,595 | 23,469 | 26,296 | 29,467 | 33,023 |
| Exports | 14,618 | 23,905 | 36,648 | 45,599 | 51,681 | 58,408 | 66,121 |
| Total Cost | 25,413 | 36,411 | 57,243 | 69,069 | 77,977 | 87,874 | 99,143 |
| 46-foot Channel | | | | | | | |
| Imports | 10,465 | 12,123 | 19,965 | 22,752 | 25,492 | 28,565 | 32,013 |
| Exports | 14,171 | 23,174 | 35,527 | 44,205 | 50,100 | 56,621 | 64,098 |
| Total Cost | 24,636 | 35,297 | 55,492 | 66,956 | 75,592 | 85,186 | 96,111 |
| 47-foot Channel | | | | | | | |
| Imports | 10,155 | 11,764 | 19,374 | 22,077 | 24,737 | 27,719 | 31,064 |
| Exports | 13,751 | 22,487 | 34,474 | 42,895 | 48,615 | 54,943 | 62,199 |
| Total Cost | 23,906 | 34,251 | 53,848 | 64,972 | 73,352 | 82,662 | 93,263 |
| 48-foot Channel | | | | | | | |
| Imports | 9,885 | 11,451 | 18,859 | 21,491 | 24,080 | 26,983 | 30,239 |
| Exports | 13,386 | 21,890 | 33,558 | 41,755 | 47,324 | 53,484 | 60,547 |
| Total Cost | 23,271 | 33,341 | 52,418 | 63,246 | 71,404 | 80,467 | 90,786 |
| 49-foot Channel | | | | | | | |
| Imports | 9,646 | 11,174 | 18,403 | 20,971 | 23,497 | 26,330 | 29,507 |
| Exports | 13,062 | 21,360 | 32,746 | 40,745 | 46,179 | 52,189 | 59,081 |
| Total Cost | 22,708 | 32,534 | 51,149 | 61,716 | 69,676 | 78,519 | 88,588 |
| 50-foot Channel | | | | | | | |
| Imports | 9,438 | 10,933 | 18,005 | 20,518 | 22,989 | 25,761 | 28,869 |
| Exports | 12,779 | 20,899 | 32,039 | 39,864 | 45,181 | 51,062 | 57,805 |
| Total Cost | 22,217 | 31,831 | 50,044 | 60,382 | 68,170 | 76,822 | 86,674 |

Table 121
Port Arthur Petroleum and Chemical Product Imports and Exports
Annual Transportation Cost ($1,000) by Trade Route and Decade (December 2008 Vessel Costs)
2019–2069

| | 2004/2006 | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
|---|---|---|---|---|---|---|---|
| 40-foot Channel | | | | | | | |
| Imports | 5,956 | 6,887 | 11,616 | 13,244 | 14,835 | 16,619 | 18,620 |
| Exports | 17,563 | 28,722 | 44,032 | 54,788 | 62,094 | 70,176 | 79,444 |
| Total Cost | 23,519 | 35,609 | 55,648 | 68,032 | 76,930 | 86,796 | 98,064 |
| 45-foot Channel | | | | | | | |
| Imports | 5,039 | 5,826 | 9,826 | 11,204 | 12,550 | 14,059 | 15,751 |
| Exports | 14,858 | 24,297 | 37,249 | 46,347 | 52,529 | 59,366 | 67,205 |
| Total Cost | 19,896 | 30,123 | 47,075 | 57,551 | 65,079 | 73,425 | 82,957 |
| 46-foot Channel | | | | | | | |
| Imports | 4,887 | 5,651 | 9,531 | 10,867 | 12,173 | 13,637 | 15,278 |
| Exports | 14,411 | 23,567 | 36,130 | 44,955 | 50,950 | 57,582 | 65,186 |
| Total Cost | 19,298 | 29,218 | 45,661 | 55,822 | 63,123 | 71,219 | 80,464 |
| 47-foot Channel | | | | | | | |
| Imports | 4,745 | 5,486 | 9,253 | 10,551 | 11,818 | 13,240 | 14,833 |
| Exports | 13,991 | 22,881 | 35,077 | 43,645 | 49,466 | 55,905 | 63,287 |
| Total Cost | 18,736 | 28,367 | 44,331 | 54,196 | 61,285 | 69,144 | 78,121 |
| 48-foot Channel | | | | | | | |
| Imports | 4,627 | 5,351 | 9,025 | 10,290 | 11,526 | 12,912 | 14,466 |
| Exports | 13,646 | 22,315 | 34,210 | 42,567 | 48,244 | 54,523 | 61,723 |
| Total Cost | 18,273 | 27,666 | 43,235 | 52,856 | 59,770 | 67,435 | 76,189 |
| 49-foot Channel | | | | | | | |
| Imports | 4,529 | 5,237 | 8,832 | 10,071 | 11,281 | 12,637 | 14,158 |
| Exports | 13,355 | 21,840 | 33,481 | 41,659 | 47,215 | 53,361 | 60,408 |
| Total Cost | 17,884 | 27,076 | 42,314 | 51,730 | 58,496 | 65,998 | 74,566 |
| 50-foot Channel | | | | | | | |
| Imports | 4,453 | 5,149 | 8,684 | 9,901 | 11,091 | 12,425 | 13,920 |
| Exports | 13,130 | 21,472 | 32,918 | 40,959 | 46,422 | 52,464 | 59,392 |
| Total Cost | 17,583 | 26,621 | 41,602 | 50,861 | 57,513 | 64,888 | 73,312 |

Table 122
SNWW Petroleum and Chemical Products Annual Savings by Channel Depth Alternative, 2019–2069
$1,000

| | 2004/2006 | 2019 | 2030 | 2040 | 2050 | 2060 | 2069 |
|---|---|---|---|---|---|---|---|
| SNWW Total Petroleum Product Imports | | | | | | | |
| 45-foot | 2,932.7 | 3,395.3 | 5,633.8 | 6,421.2 | 7,194.1 | 8,060.7 | 9,032.6 |
| 46-foot | 3,414.3 | 3,952.9 | 6,559.0 | 7,475.7 | 8,375.5 | 9,384.5 | 10,516.0 |
| 47-foot | 3,866.7 | 4,476.8 | 7,428.3 | 8,466.5 | 9,485.5 | 10,628.2 | 11,909.7 |
| 48-foot | 4,253.7 | 4,924.8 | 8,171.6 | 9,313.7 | 10,434.6 | 11,691.6 | 13,101.4 |
| 49-foot | 4,591.6 | 5,316.0 | 8,820.4 | 10,053.1 | 11,263.1 | 12,619.9 | 14,141.5 |
| 50-foot | 4,876.2 | 5,645.5 | 9,366.5 | 10,675.5 | 11,960.4 | 13,401.2 | 15,017.1 |
| SNWW Total Petroleum Product Exports | | | | | | | |
| 45-foot | 5,434.3 | 8,886.9 | 13,624.2 | 16,952.0 | 19,212.9 | 21,713.5 | 24,581.0 |
| 46-foot | 6,327.9 | 10,348.1 | 15,864.3 | 19,739.3 | 22,371.9 | 25,283.7 | 28,622.7 |
| 47-foot | 7,167.6 | 11,721.3 | 17,969.5 | 22,358.7 | 25,340.7 | 28,638.9 | 32,421.0 |
| 48-foot | 7,878.6 | 12,884.2 | 19,752.2 | 24,576.9 | 27,854.6 | 31,480.1 | 35,637.3 |
| 49-foot | 8,493.4 | 13,889.5 | 21,293.5 | 26,494.6 | 30,028.1 | 33,936.5 | 38,418.1 |
| 50-foot | 9,000.1 | 14,718.2 | 22,563.8 | 28,075.3 | 31,819.6 | 35,961.1 | 40,710.2 |

Table 123 summarizes the benefit calculations for coastwise product shipments and receipts. As noted, deepening of the channel leading to the Taylor Bayou terminal will enable the existing fleet to be more fully loaded but it will not result in transition to larger vessels. The transportation savings shown in Table 123 reflect continuation of this limitation. The maximum-sized coastwise vessels do not exceed Taylor Bayou's limitation. Transportation costs were estimated for 1-foot channel depth increments; however, the table presentations only include 40-, 45-, 47-, 48-, and 50-foot costs.

Table 123
SNWW Petroleum Product Coastwise Shipments and Receipts
Vessel Data, Base Tonnage, and Transportation Savings Benefit Summary (December 2008 Vessel Costs)

**Origin-Destination Data: U.S. East Coast to/from SNWW**

| | |
|---|---|
| Initial % of total outbound shipments: | 10 |
| Round-trip mileage | 3,000 |
| Hourly Cost at Sea: | 2,425 |
| Hourly Cost in Port: | 2,007 |
| Vessel Speed (Knots) | 14 |

**Vessel Input Data and Transportation Cost**

| Channel Depth (feet) | Design Draft (feet) | Vessel DWT | No. of feet Light-Loaded | Cargo by Channel Depth | Round Trip Voyage Cost ($) | Loading, Unloading and Port Cost ($) | Total Cost ($) | Cost Per Ton ($) |
|---|---|---|---|---|---|---|---|---|
| 40 | 45 | 75,000 | 6 | 58,571 | 519,643 | 124,110 | 643,753 | 10,99 |
| 45 to 50 | 45 | 75,000 | 1 | 69,173 | 519,643 | 124,110 | 641,908 | 9.64 |
| | | | | | | | Savings/ton | 1.36 |

**SNWW Domestic Coastwise Petroleum Product Tonnage**

| Year | Total Short Tons | Short Tons Used For Benefits |
|---|---|---|
| 2004–2006 Average | 5,068,000 | 506,800 |

**SNWW Domestic Coastwise Petroleum Product Annual Transportation Benefits**

| Year | Total Tonnage | Used for Benefits | Percentage Used for Benefits | Annual Savings ($) |
|---|---|---|---|---|
| 2002–2004 | 5,067,667 | 506,767 | 10 | 687,121 |
| 2019 | 7,901,200 | 790,120 | 10 | 1,071,317 |
| 2029 | 9,878,897 | 987,890 | 10 | 1,339,472 |
| 2039 | 11,856,594 | 1,185,659 | 10 | 1,607,626 |
| 2049 | 13,834,291 | 1,383,429 | 10 | 1,875,781 |
| 2059 | 15,811,988 | 1,581,199 | 10 | 2,143,935 |
| 2069 | 17,789,685 | 1,778,968 | 10 | 2,412,089 |

#### 6.4.1.3 Grain Exports Transportation Savings Benefits

Beaumont wheat exports compose 5 percent of the current U.S. total. Forecasts of future exports were estimated based on analysis conducted by the USDA. Beaumont's recent grain exports consist almost exclusively of wheat. Twenty-five percent of 2002–2006 grain export tonnage was shipped in vessels with design drafts over 40 feet. The maximum DWT presently used for grain exports is in the 60,000 to 70,000 DWT range. These vessels have design drafts between 42 and 43 feet. As previously noted, the median year of construction for the range of vessels presently used is 1985. Bulk carrier construction trends (see Table 47) suggest transition in the average DWT range up to the 80,000 to 94,000 DWT range. In the 1980s, grain vessels in the 135,000 to 150,000 DWT range were used for grain exports from

Beaumont and other Texas ports. These larger carriers transported grain to the former Soviet Union and to Northern Europe. Demand for large parcels and channel depth availability at the destination port could result in a return to 135,000 to 150,000 DWT vessels. Currently, the largest parcels from Texas ports are in the range of 40,000 to 60,000 short tons, and parcels of 10,000 to 20,000 short tons are typical. For grain shipped from the Canadian West Coast, it was noted that 40,000 DWT vessels are used for 10,000 parcels even though it is not cost effective. Reasons for small parcels could relate to specific demands not to commingle; however, that was not noted. Containerships are the most common vessel type used for Australian grain exported to Asian countries. Table 124 summarizes the per ton transportation cost associated with the range of bulk carriers expected to use the channel. Table 125 summarizes the grain exports for 2004–2007 and the annual transportation cost. Table 126 displays the annual tonnage forecast and the transportation savings. The transportation costs are based on the cost per ton (Table 124) multiplied by the annual tonnage (Table 125). The transportation savings benefits are based on 30 percent of tonnage would load to drafts over 40 feet (see Table 77). Port depth, trade route, historical vessel utilization data, and completion of the Panama Canal expansion were considerations used to identify the percentage of grain exports tonnage anticipated to benefit from the proposed SNWW depth increases.

Table 124
Beaumont Wheat Exports, Shipments to Europe, Mediterranean, and Far East
Total Cost Per Ton by Channel Depth (December 2008 Vessel Costs, in dollars) a/

| | Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 70,000 | 20.07 | 16.83 | 16.83 | 15.80 | 15.80 | 15.80 | 15.80 |
| 80,000 | 19.58 | 16.39 | 16.39 | 15.38 | 14.92 | 14.49 | 14.49 |
| 90,000 | 17.97 | 15.24 | 14.78 | 14.35 | 13.94 | 13.56 | 13.20 |
| 100,000 | 18.01 | 15.25 | 14.79 | 14.36 | 13.95 | 13.56 | 13.20 |
| 120,000 | 17.32 | 14.73 | 14.31 | 13.92 | 13.49 | 13.13 | 12.78 |

a/ Calculated based on a round-trip mileage of 18,000 and the foreign flag bulk carrier operating costs shown in Table 83.

The possibility of using containerships for grain transport is only being considered at a corporate level; however, the traditional use of bulk carriers provides a less expensive mode. Containerships for wheat and bulk grain transport have the noted advantage of increased versatility in the range of cargoes. The potential effect of using containerships through Beaumont or the transfer of bulk grain to another location is an uncertainty associated with grain export tonnage. The effect of this sensitivity is addressed in the sensitivity section (Section 8).

Table 125
Beaumont Wheat Exports and Annual Transportation Cost
(December 2008 Vessel Costs)

| Year | Total Exports | Used for Benefit Calculations |
|---|---|---|
| 2005 | 1,082.0 | 324.6 |
| 2006 | 1,214.0 | 364.2 |
| 2007 | 1,632.0 | 489.6 |
| 2005/2007 | 1,309.3 | 392.8 |

| DWT | % by Vessel DWT | Transportation Cost ($1,000s) by Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 70,000 | 2.0 | 7,883 | 6,610 | 6,610 | 6,208 | 6,208 | 6,208 | $6,208 |
| 80,000 | 15.0 | 7,691 | 6,437 | 6,437 | 6,040 | 5,860 | 5,690 | $5,690 |
| 90,000 | 55.0 | 7,059 | 5,984 | 5,805 | 5,636 | 5,477 | 5,327 | $5,184 |
| 100,000 | 20.0 | 7,074 | 5,991 | 5,811 | 5,642 | 5,479 | 5,327 | $5,184 |
| 120,000 | 8.0 | 6,802 | 5,786 | 5,621 | 5,466 | 5,298 | 5,156 | $5,019 |
| Weighted Cost | | 7,153 | 6,050 | 5,902 | 5,696 | 5,535 | 5,385 | 5,267 |
| 2005/2007 Savings | | | 1,103 | 1,251 | 1,457 | 1,618 | 1,768 | 1,886 |

Table 126
Beaumont Wheat Annual Transportation Savings, 2019–2069
(December 2008 Vessel Costs)

| Year | Total Exports | Used for Benefit Calculations |
|---|---|---|
| 2005/2007 | 1,309.3 | 392.8 |
| 2019 | 2,128.5 | 638.6 |
| 2029 | 2,351.2 | 705.4 |
| 2039 | 2,597.2 | 779.2 |
| 2049 | 2,868.9 | 860.7 |
| 2059 | 3,169.0 | 950.7 |
| 2069 | 3,500.6 | 1,050.2 |

| Year | Annual Transportation Savings ($1,000) by Channel Depth (feet) | | | | | |
|---|---|---|---|---|---|---|
| | 45 | 46 | 47 | 48 | 49 | 50 |
| 2005/2007 | 1,103 | 1,251 | 1,457 | 1,618 | 1,768 | 1,886 |
| 2019 | 1,793 | 2,033 | 2,369 | 2,630 | 2,874 | 3,065 |
| 2029 | 1,980 | 2,246 | 2,617 | 2,905 | 3,174 | 3,386 |
| 2039 | 2,187 | 2,480 | 2,890 | 3,209 | 3,506 | 3,740 |
| 2049 | 2,416 | 2,740 | 3,193 | 3,545 | 3,873 | 4,132 |
| 2059 | 2,669 | 3,027 | 3,527 | 3,916 | 4,278 | 4,564 |
| 2069 | 2,948 | 3,343 | 3,896 | 4,325 | 4,726 | 5,041 |

#### 6.4.1.4 Crude Materials Transportation Savings

SNWW primary manufactured goods consist nearly exclusively of primary iron and steel products. Reductions in the vessel operating costs for SNWW steel slab and iron ore imports were calculated based on the relative difference in transportation costs between the without- and with-project conditions. As with the previous presentations, transportation costs and savings were calculated for vessels that minimize transportation costs given trade route constraints. Again, long-term fleet selection will continue to reflect goals of minimizing vessel operating costs. Port Arthur's breakbulk terminal is located outside the Taylor Bayou reach, and the bulk carriers are not subject to the beam and length limitations. However, the maximum beam width for the bulk carrier fleet is 106 feet. The design drafts for these vessels are generally less than 45 feet. The DWT range of bulk carriers used for the benefit calculations is 60,000 to 90,000. Larger vessels could be used but are not anticipated over the next 20 years. The maximum size presently being used is 78,000 DWT. The transportation savings calculations were based on average costs for the anticipated 60,000 to 90,000 DWT range.

Table 127 present the cost per ton transportation cost for the representative bulk carriers used to transport steel slab and iron ore. The costs shown are for Port Arthur and Beaumont. Based on existing port depths and vessel utilization, an estimated 10 percent of tonnage was projected to use channel depths over 40 feet for the years prior to 2014. By 2014, the expansion of the Panama Canal is expected to result in the existing base tonnage from the deepwater port of Lazaro Cardenas on the West Coast of Mexico to load to vessel drafts over 40 feet. At that time, an estimated 50 percent of tonnage is anticipated to be loaded to vessel drafts over 40 feet.

Table 127
SNWW Steel Slab and Iron Ore from South America and Far East and the Mediterranean Cost Per Ton by Channel Depth (December 2008 Vessel Costs)

| | Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| | Transportation Cost/Ton to Port Arthur | | | | | | |
| 60,000 | 17.63 | 14.60 | 14.13 | 13.66 | 13.66 | 13.66 | 13.66 |
| 70,000 | 15.60 | 13.08 | 12.68 | 12.29 | 12.29 | 12.29 | 12.29 |
| 80,000 | 15.22 | 12.74 | 12.35 | 11.96 | 11.60 | 11.26 | 11.26 |
| 90,000 | 14.12 | 11.95 | 11.60 | 11.25 | 10.94 | 10.63 | 10.35 |
| | Transportation Cost/Ton to Beaumont | | | | | | |
| 60,000 | 18.35 | 15.22 | 14.73 | 14.23 | 14.23 | 14.23 | 14.23 |
| 70,000 | 16.23 | 13.63 | 13.22 | 12.80 | 12.80 | 12.80 | 12.80 |
| 80,000 | 15.84 | 13.29 | 12.89 | 12.49 | 12.12 | 11.77 | 11.77 |
| 90,000 | 14.70 | 12.47 | 12.12 | 11.77 | 11.44 | 11.14 | 10.84 |

A representative weighted mileage for the applicable South America, Mediterranean, and Far East routes was used. The weighted mileage is approximately 14,000 miles round-trip. The mileage estimated was based on 2005–2007 routings (see Table 48). As previously noted, the tonnage forecast and average annual growth rate for 2002–2004 to 2069 tonnage was displayed in tables 80 and 81. Tables 128 and 129 summarize historical tonnage base and the annual transportation savings benefits for Port Arthur's steel slab and iron ore import tonnage.

Table 128
Port Arthur Steel Slab and Iron Ore from South America, Mediterranean, and the Far East Historical Tonnage and Annual Transportation Cost by Ton
($1,000) (December 2008 Vessel Costs)

| Year | Total Exports | Used for Benefit Calculations |
|---|---|---|
| 2001 | 665,000 | 66,500 |
| 2002 | 641,000 | 64,100 |
| 2003 | 557,000 | 55,700 |
| 2004 | 564,000 | 56,400 |
| 2005 | 710,000 | 71,000 |
| 2006 | 542,000 | 54,200 |
| 2007 | 122,000 | 12,200 |
| 2005–2007 Average | 458,000 | 45,800 |

| | Transportation Cost by Vessel Size and Channel Depth Using 2005–2007 Average Tonnage a/ | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 feet | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
| 60,000 | 807 | 669 | 647 | 625 | 625 | 625 | 625 |
| 70,000 | 714 | 599 | 581 | 563 | 563 | 563 | 563 |
| 80,000 | 697 | 584 | 566 | 548 | 531 | 516 | 516 |
| 90,000 | 647 | 547 | 531 | 515 | 501 | 487 | 474 |
| Average Cost | 716 | 600 | 581 | 563 | 555 | 548 | 544 |
| Average Savings | | 117 | 135 | 154 | 161 | 169 | 172 |

a/ The costs are based on the historical tonnage volume of 45.8 thousand short tons multiplied by the cost per ton shown in Table 124 for Beaumont. The transportation cost of $716,000 is the product of 45.8 thousand short tons times the transportation cost per ton at 40 feet (Table 127).

Note: Application of data as presented may produce some differences due to rounding.

Table 129
Port Arthur Steel Slab and Iron Ore from South America, Mediterranean, and Far East Tonnage Forecast and Transportation Savings
($1,000) (December 2008 Vessel Costs)

| Year | Total Exports | Tonnage Used for Benefit Calculations |
|---|---|---|
| 2003/2005 | 458,000 | 45,800 |
| 2019 | 523,626 | 262,651 |
| 2029 | 607,630 | 304,787 |
| 2039 | 705,110 | 353,683 |
| 2049 | 818,228 | 410,423 |
| 2059 | 949,493 | 476,266 |
| 2069 | 1,101,817 | 552,671 |

| | Transportation Savings by Year a/ | | | | | |
|---|---|---|---|---|---|---|
| Year | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
| 2005/2007 | 117 | 135 | 154 | 161 | 169 | 172 |
| 2019 | 669 | 775 | 881 | 925 | 967 | 986 |
| 2029 | 777 | 899 | 1,022 | 1,073 | 1,122 | 1,144 |
| 2039 | 901 | 1,044 | 1,186 | 1,246 | 1,302 | 1,328 |
| 2049 | 1,046 | 1,211 | 1,376 | 1,446 | 1,511 | 1,541 |
| 2059 | 1,214 | 1,405 | 1,597 | 1,677 | 1,754 | 1,788 |
| 2069 | 1,408 | 1,631 | 1,853 | 1,947 | 2,035 | 2,075 |

Tables 130 and 131 summarize historical tonnage base and the annual transportation savings benefits for Port Arthur's steel slab and iron ore import tonnage.

Table 130
Beaumont Steel Slab and Iron Ore from South America Mediterranean, and
Far East Tonnage Historical Tonnage and Transportation Cost by Ton
($1,000) (December 2008 Vessel Costs)

| Year | Total Exports | Used for Benefit Calculations |
|---|---|---|
| 2001 | 103,000 | 15,450 |
| 2002 | 204,000 | 30,600 |
| 2003 | 115,000 | 17,250 |
| 2004 | 420,000 | 63,000 |
| 2005 | 471,000 | 70,650 |
| 2006 | 364,000 | 54,600 |
| 2007 | 173,000 | 25,950 |
| 2005–2007 Average | 336,000 | 50,400 |

| | Transportation Cost by Vessel Size and Channel Depth Using 2002/2004 Average Tonnage a/ | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 feet | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
| 60,000 | 616 | 511 | 495 | 478 | 478 | 478 | 478 |
| 70,000 | 545 | 458 | 444 | 430 | 430 | 430 | 430 |
| 80,000 | 532 | 446 | 433 | 420 | 407 | 395 | 395 |
| 90,000 | 494 | 419 | 407 | 395 | 385 | 374 | 364 |
| Average Cost | 547 | 459 | 445 | 431 | 425 | 419 | 417 |
| Average Savings | | 88 | 102 | 116 | 122 | 128 | 130 |

a/ The costs are based on the historical tonnage volume of 50.4 thousand short tons multiplied by the cost per ton shown in Table 127. The transportation cost of $547,000 is the product of 50.4 thousand short tons times the difference in transportation costs for the channel depth alternatives.

Note: Application of data as presented may produce some differences due to rounding.

Table 131
Beaumont Steel Slab and Iron Ore from South America and Far East
and the Mediterranean Tonnage Forecast and Annual Transportation Savings
($1,000) (December 2008 Vessel Costs)

| Year | Tonnage Used for Benefit Calculations |
|---|---|
| 2002/2004 | 33,600 |
| 2019 | 213,254 |
| 2029 | 248,025 |
| 2039 | 288,465 |
| 2049 | 335,499 |
| 2059 | 390,201 |
| 2069 | 453,823 |

| | Annual Transportation Savings by Year a/ | | | | | |
|---|---|---|---|---|---|---|
| Year | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
| 2002/2004 | 88 | 102 | 116 | 122 | 128 | 130 |
| 2019 | 560 | 649 | 737 | 774 | 809 | 825 |
| 2029 | 652 | 755 | 857 | 900 | 941 | 960 |
| 2039 | 869 | 1,006 | 1,143 | 1,200 | 1,254 | 1,279 |
| 2049 | 1,175 | 1,360 | 1,546 | 1,623 | 1,697 | 1,730 |
| 2059 | 1,589 | 1,840 | 2,091 | 2,196 | 2,295 | 2,341 |
| 2069 | 2,150 | 2,489 | 2,828 | 2,970 | 3,105 | 3,166 |

a/ The savings for 2005/2007 are based on the difference in transportation costs from the previous table multiplied by the 2005/2007 tonnage. The savings for 2019–2069 are based on application of the tonnage growth to the 2005/2007 historical base.
Note: Application of data as presented may produce some differences due to rounding.

#### 6.4.1.5 Crude Materials Transportation Savings Benefits

As with steel slab and iron ore, the DWT range of bulk carriers used for the aggregate rock and other crude materials benefit calculations are in the 60,000 to 90,000 DWT range. Larger vessels could be used but are not anticipated over the next 20 years. The maximum size presently being used is 78,000 DWT. The transportation savings calculations were based on average costs for the anticipated 60,000 to 90,000 DWT range. As with the previous presentations, transportation costs and savings were calculated for vessels that minimize transportation costs given trade route constraints. The DWT range of bulk carriers used for the benefit calculations are in the 60,000 to 90,000 DWT range.

The applicable tonnage forecast and average annual growth rate for 2002–2004 to 2069 was displayed in tables 80 and 81. The forecast includes imports and exports. Table 132 displays Port Arthur and Beaumont crude material imports and exports. Imports consist nearly exclusively of limestone, rock, and other building materials. Exports consist primarily of dry sulphur, clay, and refractory materials.

Table 132
Port Arthur and Beaumont Crude Materials Imports and Exports
Summary of Recent Historical and Tonnage Forecast (1,000s of short tons)

| | Port Arthur | | | Beaumont | | |
|---|---|---|---|---|---|---|
| Year | Imports | Exports | Total | Imports | Exports | Total |
| 2001 | 131 | – | 131 | 622 | 165 | 787 |
| 2002 | 919 | 2 | 921 | 394 | 14 | 408 |
| 2003 | 481 | 20 | 501 | 583 | 73 | 656 |
| 2004 | 531 | 41 | 572 | 559 | 104 | 663 |
| 2005 | 558 | 14 | 572 | 624 | 106 | 730 |
| 2006 | 566 | 54 | 620 | 550 | 243 | 793 |
| 2007 | 513 | 64 | 577 | 617 | 421 | 1,038 |
| Year | Port Arthur Crude Materials Import and Export Forecast | | | Beaumont Crude Materials Import and Export Forecast | | |
| 2019 | 713 | 38 | 751 | 761 | 345 | 1,106 |
| 2029 | 829 | 44 | 873 | 885 | 400 | 1,285 |
| 2039 | 964 | 52 | 1,016 | 1,029 | 465 | 1,495 |
| 2049 | 1,121 | 60 | 1,181 | 1,197 | 541 | 1,738 |
| 2059 | 1,304 | 70 | 1,374 | 1,392 | 630 | 2,022 |
| 2069 | 1,517 | 81 | 1,598 | 1,619 | 732 | 2,352 |
| Year | Tonnage Used for Benefit Calculations | | | | | |
| 2019 | 353 | 0 | 353 | 358 | 57 | 415 |
| 2029 | 410 | 0 | 410 | 416 | 66 | 482 |
| 2039 | 477 | 0 | 477 | 484 | 77 | 561 |
| 2049 | 555 | 0 | 555 | 563 | 90 | 653 |
| 2059 | 645 | 0 | 645 | 654 | 105 | 759 |
| 2069 | 751 | 0 | 751 | 761 | 122 | 883 |

Source: USACE, *Waterborne Commerce of the U.S.*, Parts, 2001–2007.

Based on existing port depths and vessel utilization, an estimated 50 percent of crude material imports and 10 percent of crude material exports was projected to use channel depths over 40 feet. A representative weighted mileage for the applicable South America and Far East was used. The weighted mileage is approximately 14,000 miles round trip. Table 133 present the cost per ton transportation cost for representative bulk carriers used to transport crude materials based on the trade routes shown.

Table 133
SNWW Crude Material Imports and Exports Via South America and Far East
and the Mediterranean Cost Per Ton (December 2008 Vessel Costs)

| | Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| | Transportation Cost/Ton to Port Arthur | | | | | | |
| 60,000 | 17.85 | 14.78 | 14.31 | 13.83 | 13.83 | 13.83 | 13.83 |
| 70,000 | 15.79 | 13.25 | 12.84 | 12.44 | 12.44 | 12.44 | 12.44 |
| 80,000 | 15.41 | 12.90 | 12.51 | 12.11 | 11.75 | 11.41 | 11.41 |
| 90,000 | 14.30 | 12.09 | 11.75 | 11.40 | 11.08 | 10.77 | 10.48 |
| | Transportation Cost/Ton to Beaumont | | | | | | |
| 60,000 | 17.93 | 14.85 | 14.37 | 13.89 | 13.89 | 13.89 | 13.89 |
| 70,000 | 15.86 | 13.30 | 12.90 | 12.49 | 12.49 | 12.49 | 12.49 |
| 80,000 | 15.48 | 12.96 | 12.56 | 12.16 | 11.80 | 11.46 | 11.46 |
| 90,000 | 14.36 | 12.14 | 11.80 | 11.45 | 11.12 | 10.82 | 10.52 |

Table 134 summarizes the annual transportation savings benefits for Port Arthur's import tonnage. Table 135 summarizes the annual transportation savings benefits for Beaumont's import tonnage. Table 136 summarizes the annual transportation savings benefits for SNWW's exports of crude materials. Transportation savings were calculated for 15 percent of future exports.

Table 134
Port Arthur Limestone and Rock Imports from South America, Mediterranean, and Far East ($1,000) (December 2008 Vessel Costs)

| | Transportation Cost by Vessel Size and Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 60,000 | 1,062 | 879 | 851 | 822 | 822 | 822 | 822 |
| 70,000 | 939 | 788 | 764 | 740 | 740 | 740 | 740 |
| 80,000 | 917 | 767 | 744 | 720 | 699 | 678 | 678 |
| 90,000 | 851 | 719 | 698 | 678 | 659 | 640 | 623 |
| Average Cost | 942 | 788 | 764 | 740 | 730 | 720 | 716 |
| Average | | 154 | 178 | 202 | 212 | 222 | 226 |

| **Transportation Savings** | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| 2005/207 | 154 | 178 | 202 | 212 | 222 | 226 |
| 2019 | 1,042 | 1,205 | 1,368 | 1,452 | 1,531 | 1,579 |
| 2029 | 1,042 | 1,205 | 1,368 | 1,452 | 1,531 | 1,579 |
| 2039 | 1,211 | 1,402 | 1,592 | 1,689 | 1,781 | 1,837 |
| 2049 | 1,409 | 1,630 | 1,851 | 1,964 | 2,071 | 2,136 |
| 2059 | 1,639 | 1,896 | 2,153 | 2,284 | 2,409 | 2,484 |
| 2069 | 1,906 | 2,205 | 2,504 | 2,656 | 2,801 | 2,889 |

Table 135
Beaumont Limestone and Rock Imports from South America, Mediterranean, and Far East ($1,000) (December 2008 Vessel Costs)

| | Transportation Cost by Vessel Size and Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 60,000 | 1,070 | 886 | 858 | 829 | 829 | 829 | 829 |
| 70,000 | 947 | 794 | 770 | 746 | 746 | 746 | 746 |
| 80,000 | 924 | 774 | 750 | 726 | 704 | 684 | 684 |
| 90,000 | 858 | 725 | 704 | 683 | 664 | 646 | 628 |
| Average Cost | 950 | 795 | 770 | 746 | 736 | 726 | 722 |
| Average Savings | | 155 | 179 | 204 | 214 | 224 | 228 |

| **Transportation Savings** | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| 2005/2007 | 155 | 180 | 204 | 214 | 224 | 228 |
| 2019 | 946 | 1,094 | 1,243 | 1,306 | 1,365 | 1,391 |
| 2029 | 1,279 | 1,480 | 1,682 | 1,766 | 1,846 | 1,882 |
| 2039 | 1,488 | 1,722 | 1,956 | 2,054 | 2,147 | 2,189 |
| 2049 | 1,730 | 2,002 | 2,275 | 2,389 | 2,497 | 2,546 |
| 2059 | 2,012 | 2,329 | 2,645 | 2,778 | 2,904 | 2,961 |
| 2069 | 2,340 | 2,709 | 3,077 | 3,231 | 3,378 | 3,444 |

Table 136
SNWW Sulphur and Refractory Material Exports to South America, Mediterranean, and Far East ($1,000) (December 2008 Vessel Costs)

| | Transportation Cost by Vessel Size and Channel Depth (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 60,000 | 535 | 443 | 429 | 415 | 415 | 415 | 415 |
| 70,000 | 473 | 397 | 385 | 373 | 373 | 373 | 373 |
| 80,000 | 462 | 387 | 375 | 363 | 352 | 342 | 342 |
| 90,000 | 429 | 362 | 352 | 342 | 332 | 323 | 314 |
| Average Cost | 475 | 397 | 385 | 373 | 368 | 363 | 361 |
| Average | | 78 | 90 | 102 | 107 | 112 | 114 |

| **Transportation Savings** | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| 2005/2007 | 78 | 90 | 102 | 107 | 112 | 114 |
| 2019 | 148 | 171 | 194 | 204 | 213 | 217 |
| 2029 | 199 | 230 | 262 | 275 | 287 | 293 |
| 2039 | 232 | 268 | 304 | 320 | 334 | 341 |
| 2049 | 269 | 312 | 354 | 372 | 389 | 396 |
| 2059 | 313 | 363 | 412 | 433 | 452 | 461 |
| 2069 | 364 | 422 | 479 | 503 | 526 | 536 |

#### 6.4.1.6 Liquefied Natural Gas Transportation Savings

Table 137 presents the trade route forecast used for the benefit calculations, Table 138 presents the per ton transportation cost. The bottom half of Table 138 presents the annual savings. The maximum loaded draft for LNG vessels is anticipated to be 40 to 42 feet. The majority of vessels will be loaded to 39 feet. The vessels will need from 3 to 6 feet underkeel clearance. The deepening benefits were therefore, believed to stop at a channel depth of approximately 43 feet. The benefits were calculated using 4 feet of underkeel clearance. Recalculation of the benefit estimates using 3 feet would reduce the average annual benefits by approximately 39 percent. Recalculation using 6 feet would increase the average annual savings by approximately 64 percent. Use of less than 4 feet of underkeel clearance is not expected for LNG vessels.

Table 137
SNWW Liquefied Natural Gas Trade Route Forecast, Short Tons

| Year | Middle East | Trinidad | Algeria | Total |
|---|---|---|---|---|
| 2015 | 1,946,522 | 1,940,695 | 1,940,695 | 5,827,913 |
| 2020 | 2,062,339 | 2,056,165 | 2,056,165 | 6,174,670 |
| 2030 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,671 |
| 2049 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,671 |
| 2059 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,671 |
| 2069 | 2,062,340 | 2,056,165 | 2,056,165 | 6,174,671 |

Table 138
Liquefied Natural Gas Transportation Cost per Ton by Channel Depth,
Vessel Dead Weight Tons, and Shipment Origin (December 2008 Vessel Costs)

| Vessel | Middle East | | Trinidad | | Algeria | |
|---|---|---|---|---|---|---|
| DWT | 40 | 43 | 40 | 43 | 40 | 43 |
| 76,500 | 26.70 | 25.65 | 5.83 | 5.62 | 14.12 | 13.58 |
| 100,000 | 24.14 | 20.78 | 5.28 | 4.61 | 12.77 | 11.03 |
| 125,000 | 22.11 | 19.22 | 4.82 | 4.25 | 11.69 | 10.20 |

| | Savings/Ton for 43 Feet For SNWW Fleet | | |
|---|---|---|---|
| DWT | Qatar | Trinidad | Algeria |
| 100,000 | 0.00 | 0.00 | 0.00 |
| 125,000 | 3.36 | 0.67 | 1.74 |
| Average | 2.89 | 0.58 | 1.49 |

SNWW Liquefied Natural Gas Annual Transportation Savings by Trade Route
(December 2008 Vessel Costs)

| Year | Qatar | Trinidad | Algeria | Total |
|---|---|---|---|---|
| 2019 | 6,080,341 | 1,209,365 | 3,137,311 | 10,427,016 |
| 2029 | 6,442,118 | 1,281,321 | 3,323,978 | 11,047,417 |
| 2039 | 6,442,121 | 1,281,321 | 3,323,978 | 11,047,420 |
| 2049 | 6,442,121 | 1,281,321 | 3,323,978 | 11,047,420 |
| 2059 | 6,442,121 | 1,281,321 | 3,323,978 | 11,047,420 |
| 2069 | 6,442,121 | 1,281,321 | 3,323,978 | 11,047,420 |

## 7.0 NED BENEFIT SUMMARY

Table 139 summarizes the transportation cost savings by major group. The majority of benefits are associated with imports of crude petroleum, LNG, and petroleum product and exports of petroleum products. Crude petroleum and petroleum products represent 84 percent of the benefits at the 45-foot depth and 89 percent at the 50-foot depth. LNG comprises 7 percent of benefits at the 45-foot depth and 4 percent at 50 feet. The LNG benefits are for facilities in the Sabine Pass Channel and Port Arthur Canal reaches. Distributions of the Taylor Bayou, Port Arthur, and Neches River deepening benefits are presented in Table 140.

Table 139
Total Average Annual Deepening Benefits ($1,000s)
(50-Year Period of Analysis at 4.375%)
by Project Depth Alternative
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| Crude Petroleum Imports | 41,130 | 48,650 | 53,411 | 61,081 | 66,173 | 68,759 |
| Petroleum Products Imports | 5,923 | 6,896 | 7,810 | 8,591 | 9,273 | 9,848 |
| Petroleum Products Exports | 15,309 | 17,826 | 20,191 | 22,194 | 23,926 | 25,354 |
| Coastwise | 1,481 | 1,481 | 1,481 | 1,481 | 1,481 | 1,481 |
| Grain Exports | 2,172 | 2,463 | 2,870 | 3,187 | 3,482 | 3,714 |
| Breakbulk | 4,536 | 5,247 | 5,247 | 5,247 | 5,247 | 5,247 |
| LNG | 11,140 | 11,140 | 11,140 | 11,140 | 11,140 | 11,140 |
| Deepening Benefits | 81,691 | 93,703 | 102,150 | 112,921 | 120,722 | 125,543 |
| Neches River Anchorages | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |
| Total Annual Benefits | 83,844 | 95,856 | 104,303 | 115,074 | 122,875 | 127,696 |

Table 141 summarizes the benefit cost analysis, including the first cost of construction, net excess benefits, and the benefit to cost ratio (BCR) for the project alternatives. The results of the analysis indicate that the 49-foot channel depth represents the plan that most reasonably maximizes net excess benefits.

Table 140
Total Average Annual Benefits ($1,000s)
by Channel Reach and Alternative
(50-Year Period of Analysis at 4.375%) (December 2008 Vessel Costs)

| Reach and Commodity | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| **Sabine Pass LNG** | 3,676 | 3,676 | 3,676 | 3,676 | 3,676 | 3,676 |
| **Port Arthur LNG** | 7,464 | 7,464 | 7,464 | 7,464 | 7,464 | 7,464 |
| **Taylor Bayou** | | | | | | |
| Crude Petroleum Imports | 5,790 | 6,892 | 7,510 | 7,964 | 8,305 | 8,928 |
| Petro Product Imports | 2,369 | 2,758 | 3,124 | 3,436 | 3,709 | 3,939 |
| Petro-Chem Product Exports | 7,348 | 8,556 | 9,692 | 10,653 | 11,485 | 12,170 |
| Coastwise Petro Products | 563 | 563 | 563 | 563 | 563 | 563 |
| Taylor Bayou Total | 16,070 | 18,769 | 20,889 | 22,616 | 24,062 | 25,600 |
| **Sabine-Neches Canal** | | | | | | |
| Breakbulk and Aggregate | 2,366 | 2,735 | 2,735 | 2,735 | 2,735 | 2,735 |
| **Neches River Channel to Beaumont** | | | | | | |
| Crude Petroleum Imports | 35,340 | 41,759 | 45,901 | 53,117 | 57,868 | 59,832 |
| Petro Product Imports | 3,554 | 4,138 | 4,686 | 5,155 | 5,564 | 5,909 |
| Petro-Chem Product Exports | 7,961 | 9,269 | 10,499 | 11,541 | 12,442 | 13,184 |
| Coastwise Petro Products | 918 | 918 | 918 | 918 | 918 | 918 |
| Grain Exports | 2,172 | 2,463 | 2,870 | 3,187 | 3,482 | 3,714 |
| Breakbulk and Aggregate | 2,471 | 2,860 | 2,860 | 2,860 | 2,860 | 2,860 |
| Neches River Turning Basins | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |
| **Neches River Total** | 54,569 | 63,560 | 69,887 | 78,931 | 85,287 | 88,570 |
| **Total Annual Benefits a/** | 83,844 | 95,856 | 104,303 | 115,074 | 122,875 | 127,696 |

a/ Some totals may not add due to rounding.

Table 141
SNWW Economic Summary Data
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 88,981 | 99,115 | 109,248 | 119,382 | 128,315 | 137,247 |
| Total Investment | 887,901 | 989,021 | 1,090,139 | 1,191,259 | 1,280,394 | 1,369,527 |
| Average Annual Cost | 44,020 | 49,033 | 54,046 | 59,059 | 63,478 | 67,897 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Average Annual Benefits | 83,844 | 95,856 | 104,303 | 115,074 | 122,875 | 127,696 |
| Net Excess Benefits | 13,627 | 18,598 | 20,004 | 23,733 | 26,249 | 25,785 |
| Benefit to Cost Ratios | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 |

## 7.1 INCREMENTAL ANALYSIS

The project benefits start in the Sabine Pass Channel reach where the Cheniere LNG terminal is located.[46]. The Port Arthur Canal reach follows the Sabine Pass Channel reach. The Golden Pass LNG terminal which is nearing completion, is located in the Sabine Pass Channel reach. An additional LNG terminal, Sempra, is permitted for construction in the Port Arthur Canal reach; however, due to uncertainty, the LNG transportation savings benefits (see Table 139) do not include Sempra. The Port Arthur Canal reach also provides access to the Taylor Bayou side channel and basin. The Port of Port Arthur facilities are located along the main portion of the Sabine-Neches Canal. The incremental analyses for channel improvements through Port Arthur excluding the Taylor Bayou side channel are shown in Table 142.

Table 142
Sabine Pass Channel, Port Arthur Canal, and Sabine-Neches Canal Incremental Analysis
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 510,640 | 564,696 | 618,751 | 672,807 | 725,314 | 777,822 |
| Interest During Construction | 48,541 | 54,539 | 60,538 | 66,536 | 71,713 | 76,889 |
| Total Investment | 559,181 | 619,235 | 679,289 | 739,343 | 797,027 | 854,711 |
| Average Annual Cost | 27,723 | 30,700 | 33,677 | 36,655 | 39,514 | 42,374 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 21,870 | 23,477 | 25,089 | 26,705 | 27,332 | 27,965 |
| Total Annual Cost | 49,767 | 54,365 | 58,967 | 63,575 | 67,067 | 70,566 |
| Average Annual Benefits | 13,205 | 13,527 | 13,527 | 13,527 | 13,527 | 13,527 |
| Net Excess Benefits | –36,562 | –40,838 | –45,440 | –50,048 | –53,540 | –57,039 |
| Benefit to Cost Ratios | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |

Separable analysis of Taylor Bayou is shown in Table 143. The analysis presented in Table 143 shows that the BCRs for the Taylor Bayou increment are well above unity. Table 144 presents the Sabine-Neches and Taylor Bayou increments as a separable unit. Table 144 indicates that the BCRs for the segment through the Sabine-Neches Canal and including Taylor Bayou are below unity due to the inclusion of the Entrance Channel costs and exclusion of the Neches River benefits. Incremental analysis of the Neches River reach is shown in Table 145, and the BCRs are well above unity. Table 146 displays Neches River analysis excluding Taylor Bayou. Table 147 reflects exclusion of benefits from Taylor Bayou, LNG, and breakbulk. Table 148 presents calculation of the benefits and costs without inclusion of LNG.

[46] Reference to the facility locations can be found on Figure 1.

The results of the analysis presented in tables 142 through 148 show that the downstream benefits are not needed to justify the upstream costs. The analysis shows that each of the major reaches provides significant incremental benefits.

Table 143
Taylor Bayou Incremental Analysis
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 43,755 | 51,811 | 59,865 | 67,919 | 76,527 | 85,136 |
| Interest During Construction | 2,106 | 2,494 | 2,882 | 3,270 | 3,683 | 4,099 |
| Total Investment | 45,861 | 54,305 | 62,747 | 71,189 | 80,210 | 89,235 |
| Average Annual Cost | 2,274 | 2,692 | 3,111 | 3,529 | 3,977 | 4,424 |
| Average Annual O&M | 1,267 | 1,451 | 1,631 | 1,807 | 1,945 | 2,075 |
| Total Annual Cost | 3,541 | 4,143 | 4,742 | 5,336 | 5,922 | 6,499 |
| Average Annual Benefits | 16,070 | 18,769 | 20,889 | 22,617 | 24,062 | 25,599 |
| Net Excess Benefits | 12,529 | 14,626 | 16,147 | 17,281 | 18,140 | 19,100 |
| Benefit to Cost Ratios | 4.5 | 4.5 | 4.4 | 4.2 | 4.1 | 3.9 |

Table 144
Project Improvements Through Port Arthur (including Taylor Bayou)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 554,395 | 616,507 | 678,616 | 740,725 | 801,842 | 862,958 |
| Interest During Construction | 50,647 | 57,033 | 63,420 | 69,806 | 75,396 | 80,988 |
| Total Investment | 605,042 | 673,540 | 742,036 | 810,531 | 877,238 | 943,946 |
| Average Annual Cost | 30,171 | 33,580 | 36,989 | 40,399 | 43,712 | 47,025 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 23,137 | 24,929 | 26,720 | 28,512 | 29,276 | 30,041 |
| Total Annual Cost | 53,482 | 58,697 | 63,910 | 69,126 | 73,209 | 77,293 |
| Average Annual Benefits | 29,275 | 32,296 | 34,416 | 36,144 | 37,589 | 39,126 |
| Net Excess Benefits | –24,207 | –26,401 | –29,494 | –32,982 | –35,620 | –38,167 |
| Benefit to Cost Ratios | 0.5 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 |

Table 145
Neches River Incremental Economic Analysis
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 244,525 | 273,399 | 302,275 | 331,152 | 350,237 | 369,322 |
| Interest During Construction | 38,334 | 42,081 | 45,829 | 49,576 | 52,918 | 56,259 |
| Total Investment | 282,859 | 315,480 | 348,104 | 380,728 | 403,156 | 425,581 |
| Average Annual Cost | 14,023 | 15,641 | 17,258 | 18,875 | 19,987 | 21,099 |
| Average Annual O&M | 2,885 | 3,109 | 3,332 | 3,555 | 3,651 | 3,746 |
| Total Annual Cost | 16,908 | 18,750 | 20,590 | 22,430 | 23,638 | 24,845 |
| Average Annual Benefits | 54,570 | 63,560 | 69,888 | 78,931 | 85,287 | 88,570 |
| Net Excess Benefits | 37,661 | 44,811 | 49,298 | 56,500 | 61,649 | 63,725 |
| Benefit to Cost Ratios | 3.2 | 3.4 | 3.4 | 3.5 | 3.6 | 3.6 |

Table 146
SNWW Improvements (Excludes Taylor Bayou)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 755,165 | 838,095 | 921,027 | 1,003,958 | 1,075,551 | 1,147,144 |
| Interest During Construction | 86,875 | 96,621 | 106,366 | 116,112 | 124,631 | 133,148 |
| Total Investment | 842,040 | 934,716 | 1,027,392 | 1,120,070 | 1,200,183 | 1,280,292 |
| Average Annual Cost | 41,746 | 46,341 | 50,935 | 55,530 | 59,502 | 63,473 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 24,755 | 26,586 | 28,422 | 30,260 | 30,982 | 31,712 |
| Total Annual Cost | 66,676 | 73,115 | 79,558 | 86,005 | 90,705 | 95,411 |
| Average Annual Benefits | 54,540 | 63,418 | 69,746 | 78,789 | 85,145 | 88,428 |
| Net Excess Benefits | –12,135 | –9,696 | –9,812 | –7,217 | –5,559 | –6,983 |
| Benefit to Cost Ratios | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |

Table 147
Neches River Project Improvements (Excludes Transportation Benefits for
All Other Reaches Except the Neches River)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 755,165 | 838,095 | 921,027 | 1,003,958 | 1,075,551 | 1,147,144 |
| Interest During Construction | 86,875 | 96,621 | 106,366 | 116,112 | 124,631 | 133,148 |
| Total Investment | 842,040 | 934,716 | 1,027,392 | 1,120,070 | 1,200,183 | 1,280,292 |
| Average Annual Cost | 41,746 | 46,341 | 50,935 | 55,530 | 59,502 | 63,473 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 24,755 | 26,586 | 28,422 | 30,260 | 30,982 | 31,712 |
| Total Annual Cost | 66,676 | 73,115 | 79,558 | 86,005 | 90,705 | 95,411 |
| Average Annual Benefits | 38,470 | 44,649 | 48,857 | 56,172 | 61,084 | 62,829 |
| Net Excess Benefits | –28,206 | –28,465 | –30,701 | –29,834 | –29,621 | –32,582 |
| Benefit to Cost Ratios | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 |

Table 148
SNWW Improvements (Excludes LNG)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 755,165 | 838,095 | 921,027 | 1,003,958 | 1,075,551 | 1,147,144 |
| Interest During Construction | 86,875 | 96,621 | 106,366 | 116,112 | 124,631 | 133,148 |
| Total Investment | 842,040 | 934,716 | 1,027,392 | 1,120,070 | 1,200,183 | 1,280,292 |
| Average Annual Cost | 41,746 | 46,341 | 50,935 | 55,530 | 59,502 | 63,473 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 24,755 | 26,586 | 28,422 | 30,260 | 30,982 | 31,712 |
| Total Annual Cost | 66,676 | 73,115 | 79,558 | 86,005 | 90,705 | 95,411 |
| Average Annual Benefits | 72,702 | 84,716 | 93,164 | 103,935 | 111,736 | 116,556 |
| Net Excess Benefits | 6,026 | 11,601 | 13,606 | 17,930 | 21,031 | 21,144 |
| Benefit to Cost Ratios | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |

## 7.2 BENEFIT-COST RATIO AT 7 PERCENT

Calculation of benefits and costs at 7 percent interest is required by EC 11-2-194, commonly referred to as the budget Engineering Circular (paragraph 11). The 7 percent calculations are used for budget ranking purposes. Table 149 outlines the economic calculations at 7 percent.

Table 149
SNWW Economic Summary Data at 7 Percent
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 150,031 | 167,118 | 184,204 | 201,291 | 216,352 | 231,413 |
| Total Investment | 948,951 | 1,057,024 | 1,165,095 | 1,273,168 | 1,368,431 | 1,463,693 |
| Average Annual Cost | 68,761 | 76,592 | 84,423 | 92,254 | 99,156 | 106,059 |
| Deferred Construction (F&W) | 178 | 192 | 206 | 220 | 226 | 232 |
| Average Annual O&M | 25,942 | 27,971 | 29,999 | 32,027 | 32,885 | 33,742 |
| Total Annual Cost | 94,881 | 104,755 | 114,628 | 124,501 | 132,267 | 140,033 |
| Average Annual Benefits | 81,644 | 93,305 | 101,498 | 112,028 | 119,631 | 124,300 |
| Net Excess Benefits | –13,237 | –11,450 | –13,130 | –12,473 | –12,636 | –15,733 |
| Benefit to Cost Ratios | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |

# 8.0 SENSITIVITY ANALYSIS

Sensitivities were evaluated based on trade route variations, vessel underkeel clearance variance, the use of offshore or other pipeline alternatives, and the effect on vessel delays from reductions in vessel trips as a result of channel deepening. The effects of the sensitivities were evaluated in relationship to the BCRs, net excess benefits, and NED plan presented in Table 141. The effects of the combined sensitivities are also discussed.

## 8.1 UNDERKEEL CLEARANCE SENSITIVITY

Table 150 presents the results of a scenario using 3 feet of underkeel clearance instead of 1 foot for crude petroleum and petrochemical products. Table 151 presents the results of a scenario using 1 foot of underkeel clearance for vessels less than 100,000 DWT and 3 feet of underkeel clearance for vessels over 100,000 DWT. The underkeel clearance assumptions remain the same for the without- and with-project conditions. The basis for the second scenario is that as channel depth increases, vessel operators are likely to be more adverse to the risk associated with 1-foot underkeel clearance when operating larger vessels. Table 152 presents the results of using 1 foot of underkeel clearance for the without-project condition and 3 feet for the with-project condition.

Table 150
SNWW Economic Summary Data 3-foot Underkeel Clearance
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 88,981 | 99,115 | 109,248 | 119,382 | 128,315 | 137,247 |
| Total Investment | 887,901 | 989,021 | 1,090,139 | 1,191,259 | 1,280,394 | 1,369,527 |
| Average Annual Cost | 44,020 | 49,033 | 54,046 | 59,059 | 63,478 | 67,897 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Average Annual Benefits | 96,703 | 107,753 | 121,476 | 132,476 | 140,562 | 146,961 |
| Net Excess Benefits | 26,486 | 30,495 | 37,177 | 41,135 | 43,936 | 45,050 |
| Benefit to Cost Ratios | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.4 |

Table 151
SNWW Economic Summary Data 1-Foot Underkeel Clearance for Vessels of Less Than 100,000 DWT
(Without- and With-Project Future)
3 Feet of Underkeel Clearance for Vessels Greater than 100,000 DWT (Without- and With-Project Future)
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 88,981 | 99,115 | 109,248 | 119,382 | 128,315 | 137,247 |
| Total Investment | 887,901 | 989,021 | 1,090,139 | 1,191,259 | 1,280,394 | 1,369,527 |
| Average Annual Cost | 44,020 | 49,033 | 54,046 | 59,059 | 63,478 | 67,897 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Average Annual Benefits | 94,548 | 105,743 | 117,164 | 126,893 | 133,533 | 140,071 |
| Net Excess Benefits | 24,331 | 28,485 | 32,865 | 35,552 | 36,907 | 38,160 |
| Benefit to Cost Ratios | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |

Table 152
SNWW Economic Summary Data 1-Foot Underkeel Clearance for the Without-Project Condition
3 Feet of Underkeel Clearance for the With-Project Future
Cost and Benefits ($1,000s)
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 88,981 | 99,115 | 109,248 | 119,382 | 128,315 | 137,247 |
| Total Investment | 887,901 | 989,021 | 1,090,139 | 1,191,259 | 1,280,394 | 1,369,527 |
| Average Annual Cost | 44,020 | 49,033 | 54,046 | 59,059 | 63,478 | 67,897 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Average Annual Benefits | 65,368 | 76,564 | 87,985 | 97,713 | 104,355 | 110,892 |
| Net Excess Benefits | –4,849 | –694 | 3,686 | 6,372 | 7,729 | 8,981 |
| Benefit to Cost Ratios | 0.9 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 |

The sensitivity presented in Table 152 is based on the assumption that vessel operators use the availability of a deeper channel depth to reduce the risk of operating with minimum underkeel clearance by insisting on greater underkeel clearance at vessels over 100,000 DWT under the with-project alternative. The transportation costs and savings for the scenario were run with the assumption that all crude and product carriers use 1 foot of underkeel clearance under the without-project condition and all carriers use 3 feet under the with-project scenarios. Table 139 presents the result on plan optimization.

## 8.2 OFFSHORE TERMINAL

This scenario evaluates a with- and without-project future represented by increased use of an offshore alternative or other pipeline alternative such as receipt of large volumes of Canadian crude by landside pipeline. These alternatives were evaluated as sensitivities, as plans for these projects are uncertain. Some industry representatives noted that for security reasons, access to more than one alternative is preferable. The logistics, including the use of other waterways and pipelines, necessary to receive feedstock during emergency situations is a part of emergency planning; however, the delivery costs associated with such alternatives exceed the costs associated with those of existing practices. The results of a scenario where 50 percent of future crude petroleum imports from West Africa and the Middle East use an offshore alternative are presented in Table 153. The results of the sensitivity indicate that the 48- and 49-foot deepening alternative project remain justified; however, the benefits are greatly reduced.

Table 153
SNWW Economic Summary Data Offshore Alternative
With 50% of West Africa and Middle East Using Offshore Alternative
Cost and Benefits ($1,000s) by Channel Depth Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 800,356 | 890,863 | 981,370 | 1,071,877 | 1,151,657 | 1,231,437 |
| Interest During Construction | 138,691 | 132,255 | 125,818 | 119,382 | 127,239 | 135,095 |
| Total Investment | 939,047 | 1,023,118 | 1,107,188 | 1,191,259 | 1,278,896 | 1,366,532 |
| Average Annual Cost | 46,555 | 50,723 | 54,891 | 59,059 | 63,404 | 67,749 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 72,752 | 78,948 | 85,144 | 91,341 | 96,552 | 101,763 |
| Average Annual Benefits | 74,829 | 84,994 | 92,858 | 101,352 | 107,894 | 112,515 |
| Net Excess Benefits | 4,612 | 7,736 | 8,559 | 10,011 | 11,268 | 10,604 |
| Benefit to Cost Ratios | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |

## 8.3 OFFSHORE TRANSFER TIME SENSITIVITY

This section evaluates the effects of using both increasingly optimal and less than optimal turnaround times for offshore lightering and lightening. Identification of the number of days used for the SNWW analysis was based on inputs from industry including data outlined in the Skaugen PetroTrans publication "Introduction to Lightering."[47] Detailed discussion of the variables associated with crude petroleum methods of shipment was presented in Section 3.5.1. As noted in that section, SNWW crude petroleum transportation costs were calculated based on the mother vessel being offshore for 24 hours for each shuttle vessel used. The 24-hour period includes offloading from the mother vessel and associated logistics, including routine delays. Table 154 includes the minimum and maximum hours per shuttle evaluated for the sensitivity.

Table 154
Mother Vessel Offshore Hours Per Shuttle (Hrs)

| | Hours |
|---|---|
| Minimum | 18 |
| Most Likely | 24 |
| Maximum | 36 |

The most likely times are based on the assumption of optimal turnaround times with the arrival of the shuttle vessels being coordinated to avoid any delays. The minimum times are based on increasingly optimal turnaround time. Table 155 presents the results of the minimum offshore hours. The maximum times are based on quotes obtained from the lightering companies and industry. Table 156 presents the results of the less than optimal offshore hours.

Table 155
SNWW Economic Summary Data Based on Minimal Mother Vessel Offshore Time
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 88,981 | 99,115 | 109,248 | 119,382 | 128,315 | 137,247 |
| Total Investment | 887,901 | 989,021 | 1,090,139 | 1,191,259 | 1,280,394 | 1,369,527 |
| Average Annual Cost | 44,020 | 49,033 | 54,046 | 59,059 | 63,478 | 67,897 |
| Differed Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Average Annual Benefits | 76,428 | 87,466 | 95,413 | 105,653 | 113,451 | 118,245 |
| Net Excess Benefits | 6,211 | 10,208 | 11,114 | 14,312 | 16,825 | 16,334 |
| B/C Ratios | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 |

[47] Skaugen Petro Trans Inc., Introduction to Lightering, October 25, 2006. http://www.teekay.com/PDFs/Lightering101.pdf.

Table 156
SNWW Economic Summary Data Based on Less Than
Optimal Mother Vessel Offshore Time
Cost and Benefits ($1,000s) by Channel Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 798,920 | 889,906 | 980,891 | 1,071,877 | 1,152,079 | 1,232,280 |
| Interest During Construction | 88,981 | 99,115 | 109,248 | 119,382 | 128,315 | 137,247 |
| Total Investment | 887,901 | 989,021 | 1,090,139 | 1,191,259 | 1,280,394 | 1,369,527 |
| Average Annual Cost | 44,020 | 49,033 | 54,046 | 59,059 | 63,478 | 67,897 |
| Differed Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Average Annual Benefits | 90,732 | 103,802 | 115,167 | 124,827 | 135,600 | 143,581 |
| Net Excess Benefits | 20,515 | 26,544 | 30,868 | 33,486 | 38,974 | 41,670 |
| B/C Ratios | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 |

## 8.4 VESSEL TRIP REDUCTION DUE TO CHANNEL DEEPENING

For this sensitivity, the HarborSym widening model was run based on the reduction in vessel trips as a result of channel deepening The purpose of the sensitivity was to determine changes in the annual delays in relationship to widening of the Sabine Pass Channel and Port Arthur Canal. The change in vessel trips due to channel deepening was estimated based on the decrease in the number of trips necessary to transport future tonnage. These vessel trip calculations were used in the ERDC shoreline effect study. Vessel trip estimates were prepared using 2000–2004 trips and for 2030–2040 average trips (see tables 94 and 95). The results of the HarborSym model show that the reduction in the number of vessel trips resulting from channel deepening will have a significant effect on the net difference in the duration of vessel delays between the without- and with-project conditions. The transportation costs and savings associated with the sensitivity are outlined in Table 157.

Table 158 presents a comparison of the economic summary data for “widening with deepening” and widening as a separate feature. The economic summary data for widening as a separate feature was previously presented in Table 98. Additional analyses based on a range of fleet forecasts indicate that the increase in benefits from scenarios that included either “deepening and widening” or “deepening and the turning basins” were primarily attributable to the reduction in trips due to channel deepening. These savings result from the reduction in trips based on vessels carrying additional cargo or the redistribution of vessel sizes based on the availability of a deeper channel.

Table 157
Comparison of Annual Savings ($1,000s)
Due to Vessel Trip Reductions, 2030
Without- and With-Project Future

| Component | Without-Project Future | Widening No Deepening | Widening and Deepening |
|---|---|---|---|
| # in Call List a/ | 3,448 | 3,448 | 2,815 |
| Number of Vessels Exiting | 3,439 | 3,439 | 2,794 |
| Average Vessel Time in System (hours) | 58.6 | 57.7 | 59.2 |
| Total Cost ($1,000s) | 258,469.3 | 255,821.3 | 236,000.0 |
| Total Cost SD ($1,000s) | 934.0 | 885.3 | 607.8 |
| Total Cost Max ($1,000s) | 260,294.9 | 254,640.1 | 238,200.7 |
| Total Cost Min ($1,000s) | 256,367.1 | 251,205.5 | 235,265.8 |
| Average Cost ($1,000s) | 74.73 | 74.22 | 76.87 |
| Average Time in Reaches (hours) | 8.32 | 8.30 | 8.02 |
| Average Time Waiting at Entry (hours) | 4.01 | 2.56 | 2.24 |
| Average Time Waiting (hours) | 8.83 | 7.85 | 6.39 |
| Savings in Total Cost ($1,000s) | | 3,487.3 b/ | 29,591.3 |

a/ The table reflects 297 LNG vessels. The effect of the lower LNG forecast was not prepared for this sensitivity.
b/ The savings of $3,487.3 thousands is shown on the last page of Table 96.

Table 158
Sabine Pass Channel and Port Arthur Canal
Economic Summary Data (2008 Thousands of Dollars at 4.375%)

| Item | Sabine Pass Channel and Port Arthur Canal Widening to 700 feet | | |
|---|---|---|---|
| First Cost | | 78,448.0 | |
| Mitigation Cost | | 48,484.5 | |
| Interest During Construction | | 36,282.3 | |
| Total First Cost | | 163,214.8 | |
| Average Annual Construction Cost | | 8,091.7 | |
| Incremental Average Annual O&M Cost | | 9,587.1 | |
| Total Average Annual Cost | | 17,678.7 | |
| | Widening No Deepening (Table 97) | Deepening and Widening | Residual Benefits at 48 Feet |
| Average Annual Benefits | 6,379.6 | 29,951.3 | 23,571.7 |
| Net Excess Benefits | –11,299.1 | 12,272.6 | 5,893.0 |
| Benefit to Cost Ratio | 0.4 | 1.7 | 1.3 |

## 8.5 GRAIN EXPORT SENSITIVITY

The potential effect of using containerships through Beaumont or the transfer of bulk grain to another location is an uncertainty associated with grain export tonnage. For purposes of analysis, the effect of excluding transportation savings for grain exports was evaluated. The result of this sensitivity is summarized in Table 159.

Table 159
SNWW Economic Summary Data Offshore Alternative
Excluding Grain Exports
Cost and Benefits ($1,000s) by Channel Depth Alternative
(50-Year Period of Analysis at 4.375%)
(December 2008 Vessel Costs)

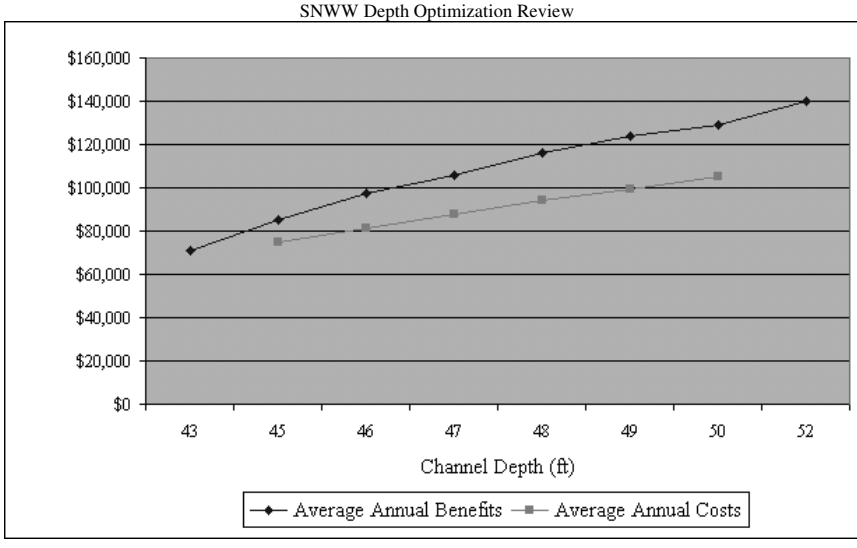
| | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| First Cost of Construction | 800,356 | 890,863 | 981,370 | 1,071,877 | 1,151,657 | 1,231,437 |
| Interest During Construction | 138,691 | 132,255 | 125,818 | 119,382 | 127,239 | 135,095 |
| Total Investment | 939,047 | 1,023,118 | 1,107,188 | 1,191,259 | 1,278,896 | 1,366,532 |
| Average Annual Cost | 46,555 | 50,723 | 54,891 | 59,059 | 63,404 | 67,749 |
| Deferred Construction (F&W) | 174 | 188 | 201 | 215 | 221 | 227 |
| Average Annual O&M | 26,023 | 28,037 | 30,052 | 32,067 | 32,927 | 33,787 |
| Total Annual Cost | 72,752 | 78,948 | 85,144 | 91,341 | 96,552 | 101,763 |
| Average Annual Benefits | 81,973 | 93,741 | 101,781 | 112,235 | 119,741 | 124,330 |
| Net Excess Benefits | 11,756 | 16,483 | 17,482 | 20,894 | 23,115 | 22,419 |
| Benefit to Cost Ratios | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |

## 8.6 DEPTH OPTIMIZATION SENSITIVITY REVIEW

This section provides a review of depth optimization. Current benefits calculations were reviewed in relationship to project construction costs. Benefit calculations for the range of channel depths between 43 and 50 feet continued to be maintained during the study process. While, detailed costs were not made for every channel depth increment after the initial optimization of benefits and costs were prepared, costs calculations for the 45-foot alternative were maintained as they were needed for cost allocation purposes. Comparison of recent project construction costs for the 45- and 50-foot channel depth increments and cost data for earlier study phases were used to estimate the project construction cost for 46, 47, and 49 feet. Detailed calculations were made for 45, 48, and 50 feet.

Comparison of the detailed cost values for 45, 48, and 50 feet with the inclusion of the interpolated values for 46, 47, and 49 feet with calculated transportation cost savings for 43, 45, 46, 47, 48, 49, 50, and 52 feet is displayed on Figure 58. The presentation shows that the average annual benefits by channel depth increase at a greater rate than costs. The results of this comparison suggest that channel depth alternatives less than 45 feet would not produce higher net excess benefits than the proposed 48-foot channel depth.

Figure 58
SNWW Depth Optimization Review




## 8.7 SUMMARY OF MAJOR SENSITIVITY EFFECTS

This sensitivity presents the results of using 1foot of underkeel clearance for the without-project condition and 3 feet for the with-project condition and including the incidental benefits from reductions in vessel trips. Table 160 displays the project benefits for this scenario. The total benefits include the channel deepening and anchorage basin benefits outlined in Table 141 and the incidental reduction in delay benefits shown in Table 157. The annual savings for the without-project future without deepening is $6,339,400. The annual savings for the without-project future that includes deepening to 48 feet is $29,591,300. The results of the analysis indicate that the residual savings from the combined effect of widening and deepening is represented by the net difference of $23,571,700. The savings for the 45-, 46-, and 47-foot depths was interpolated given a savings of zero at 40 feet and $23,571,700 at 48 feet. The savings at 49 and 50 feet were assumed to be the same as at 48 feet.

Table 160
Total Average Annual Deepening and Reduction in Delay Benefits ($1,000s)
(50-Year Period of Analysis at 4.375 percent)
by Project Depth Alternative
(December 2008 Vessel Costs)

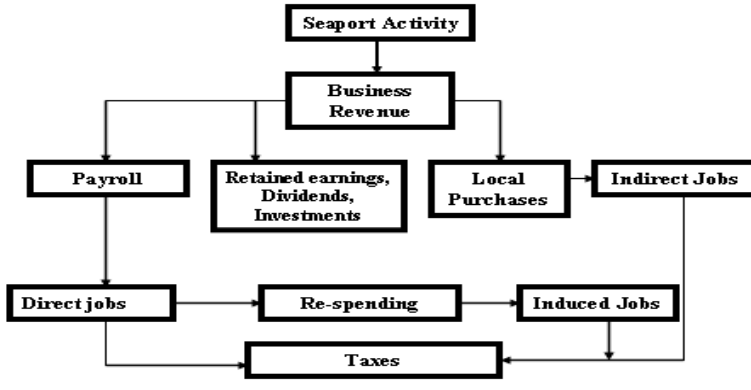
| Item | 45 feet | 46 feet | 47 feet | 48 feet | 49 feet | 50 feet |
|---|---|---|---|---|---|---|
| Crude Petroleum Imports | 49,003 | 55,296 | 62,659 | 68,948 | 72,572 | 75,760 |
| Petroleum Products Imports | 6,728 | 7,817 | 8,836 | 9,714 | 10,483 | 11,352 |
| Petroleum Products Exports | 17,335 | 20,146 | 22,778 | 25,023 | 26,975 | 29,224 |
| Coastwise | 1,481 | 1,481 | 1,481 | 1,481 | 1,481 | 1,481 |
| Grain Exports | 2,172 | 2,463 | 2,870 | 3,187 | 3,482 | 3,714 |
| Breakbulk | 4,837 | 5,595 | 5,595 | 5,595 | 5,595 | 5,595 |
| LNG | 11,140 | 11,140 | 11,140 | 11,140 | 11,140 | 11,140 |
| Deep-Draft Benefits | 81,992 | 94,051 | 102,498 | 113,269 | 121,070 | 125,891 |
| | | | | | | |
| Neches River Anchorages | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |
| Sabine Pass and Port Arthur Canal Widening | 1,595 | 3,190 | 4,785 | 6,380 | 6,380 | 6,380 |
| Reduction in Vessel Trips and Delays Due to Channel Deepening | 5,893 | 11,786 | 17,679 | 23,572 | 23,572 | 23,572 |
| Anchorage Basins and Widening Benefits | 9,641 | 17,129 | 24,617 | 32,105 | 32,105 | 32,105 |
| | | | | | | |
| Total Benefits | 91,633 | 111,180 | 127,115 | 145,374 | 153,175 | 157,996 |
| | | | | | | |
| Total Average Annual Construction Cost a/ | | | | | | |
| Deepening and Anchorage Basins | 70,217 | 77,258 | 84,299 | 91,341 | 96,626 | 101,911 |
| Widening of Sabine Pass Channel and Port Arthur Canal | 17,679 | 17,679 | 17,679 | 17,679 | 17,679 | 17,679 |
| Total Average Annual Construction Cost | 91,633 | 111,180 | 127,115 | 145,374 | 153,175 | 157,996 |
| Net Excess Benefits | 3,737 | 16,243 | 25,137 | 36,354 | 38,870 | 38,406 |
| Benefit to Cost Ratios | 1.0 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 |

a/ The construction costs shown include the average annual construction costs presented in tables 141 and 155.

## 9.0 REGIONAL ECONOMICS

This section provides a summary of regional benefits of port-related activity. Martin Associates' "Jefferson County Waterway and Navigation District – Study for Economic Impact Maintenance Dredging and Economic Impact of Deepening and Widening of the Sabine-Neches Waterway"[48] is the principal source used in preparation of this section. The Martin report includes evaluation of the economic impacts generated by marine activity in 2004. Economic impacts were estimated in terms of jobs, personal earnings, business revenue, and state, local, and federal taxes. Figure 59 outlines how the waterway activity impacts the local, regional, and Federal economies.

Figure 59
Flows of Economic Impacts through the Economy




Source: Martin Associates, "Jefferson County Waterway and Navigation District - Study for Economic Impact Maintenance Dredging and Economic Impact of Deepening and Widening of the Sabine-Neches Waterway" July 2006, Exhibit E-2, page 3.

As the figure indicates, the marine cargo and vessel activity generates revenue to firms providing marine services. This revenue results in a series of impacts including payroll, retained earnings, stockholder earnings, dividends and reinvestment, purchase of goods and services from local firms, as well as national and international firms (creating indirect jobs with these firms). Businesses also pay taxes from the business revenue.

Descriptions of the general job effects associated with port activity are defined as follows:

[48] Martin Associates, "Jefferson County Waterway and Navigation District - Study For Economic Impact Maintenance Dredging and Economic Impact of Deepening and Widening of the Sabine-Neches Waterway," August 2006.

> Direct jobs are described as jobs with local firms providing support services to the waterway. These jobs are dependent upon this activity and would suffer immediate dislocation if the waterway activity were to cease. Direct jobs include employment with railroads and trucking companies, steamship agents, ship chandlers, warehouse operators, shipyards, and marine construction firms.
>
> Induced jobs are described as jobs created locally and throughout the regional economy due to purchases of goods and services by those directly employed. These jobs are with grocery stores, the local construction industry, retail stores, health care providers, local transportation services, etc., and would also be discontinued if waterway activity were to cease.
>
> Indirect jobs are described as jobs generated in the local economy as the result of local purchases by the firms directly dependent upon waterway activity. These jobs include jobs in local office supply firms, equipment and parts suppliers, maintenance and repair services, insurance brokers, business service contractors, and local utilities.

Cargo moving through marine terminals within the Jefferson County Waterway and Navigation District are noted to generate 83,692 jobs in Texas and Louisiana (Table 161). Of these, 14,987 are direct jobs generated by marine cargo and vessel activity. Wages and salaries associated with direct jobs were estimated to be $877.7 million annually. Local and regional purchases made by the 14,987 direct job holders were estimated to result in an additional 13,628 induced jobs. An additional 55,077 indirect jobs are noted to be supported by $3.7 billion in local purchases by businesses supplying services to marine terminals and marine-related businesses located along the SNWW. As the result of respending this income, an additional $1.5 billion of income and consumption expenditures were created. The 55,077 indirect job holders in Texas and Louisiana received $2.4 billion of indirect wages and salaries. In total, $4.7 billion of direct, induced, and indirect personal wages and salaries and consumption expenditures were generated by maritime activity at marine terminals located within the Jefferson County Waterway and Navigation District.

The report also includes an assessment of the job impacts on a “per 1,000 ton basis,” which is noted to provide a tool for port planners to use in evaluating the relative importance of different commodities as economic generators. Table 162 presents the job impacts per 1,000 tons for each commodity moving through the public and private marine terminals. Tables 161 and 162 and Figure 59 are all displayed as presented in the Martin Associates report with minor formatting changes.

Table 161
Summary of the Local and Regional Economic Impacts Generated by
Jefferson County Waterway and Navigation District

| Regional and Local Jobs | |
|---|---|
| Direct | 14,987 |
| Induced | 13,628 |
| Indirect | 55,077 |
| Total | 83,692 |
| | |
| Regional and Local Personal Income and Expenditures ($ millions) | |
| Direct | 877.7 |
| Respending/Consumption | 1,510.1 |
| Indirect | 2,351.3 |
| Total Income | 4,739.1 |
| | |
| Revenue and Taxes | |
| Business Revenue | 2,242.2 |
| State/Local Taxes | 426.5 |
| Federal Income Taxes | 853.0 |

Source: Martin Associates, "Jefferson County Waterway and Navigation District - Study for Economic Impact Maintenance Dredging and Economic Impact of Deepening and Widening of the Sabine-Neches Waterway" July 2006, Exhibit E-2, page 3.

Table 162
Direct Jobs Per 1,000 Tons of Cargo

| Commodity | Number of Direct Jobs | Jobs/1,000s of Tons |
|---|---|---|
| Containers | 46 | 1.24 |
| Steel | 383 | 0.50 |
| General Cargo | 408 | 1.12 |
| Forest Products | 207 | 0.33 |
| Grain | 231 | 0.17 |
| Other Dry Bulk | 437 | 0.48 |
| Crude Petroleum | 4,376 | 0.06 |
| Petroleum Products | 1,855 | 0.06 |
| Chemical Products | 6,097 | 0.49 |
| Not Allocated | 946 | n/a |
| Total | 14,987 | n/a |

Source: Martin Associates, "Jefferson County Waterway and Navigation District - Study for Economic Impact Maintenance Dredging and Economic Impact of Deepening and Widening of the Sabine-Neches Waterway" July 2006, Exhibit II-2, page 18.

Examination of the data presented in Table 162 shows that containers and general cargo create the largest number of direct jobs per 1,000 tons, followed by steel, chemical products, and other dry bulk. The presentation also shows that the relatively large impact per 1,000 tons for containers and general cargo corresponds to a relatively small tonnage handled. In comparison, the number of jobs per 1,000 tons for crude petroleum and petroleum products is small despite the fact that crude petroleum generated the second largest direct job impact. The number of jobs and the jobs per 1,000s of tons for chemical products both rate relatively high. On a per 1,000 ton basis, chemical products generates nearly 0.5 jobs per 1,000 tons. In comparison, crude petroleum and petroleum products results in 0.06 jobs per 1,000 tons. Dry bulk and chemicals represent approximately 10 percent of total tonnage. The remaining 90 percent of tonnage consists of petroleum. The finding that some cargoes generate relatively small direct jobs per 1,000 tons of throughput reflects the fact that the handling of these cargoes is much less labor intensive than handling other commodities. For instance, the supporting infrastructure of agents, freight forwarders and customs house brokers, and warehousing and terminal operators is greater for some cargo.

## 9.1 OTHER INDICATORS

In addition to the Martin Associates report, Beaumont-Port Arthur Metropolitan Statistical Area (MSA) employment data was reviewed in order to assess the distribution of employment and short-term trends. Table 163 displays 2001–2007 MSA employment statistics. Manufacturing, retail trade, and construction are the largest private industry employers. Waterway-related employment is largely associated with private companies, and likely includes, in order of magnitude, transportation and warehousing, manufacturing, and wholesale trade. Additionally, mining employment, particularly offshore-related exploration, results in direct, indirect, and induced employment and income impacts. Analysis of the data presented in Table 163 shows positive job growth in all sectors directly related to waterway activity. The most notable growth rates are for mining (11 percent), wholesale trade (3.4 percent), and transportation and warehousing (3.3 percent). It is recognized that not all jobs associated with these sectors are directly related to the waterway.

## 9.2 SUMMARY AND CONCLUSIONS

While the incremental effects of the Federal action on employment and regional income are not addressed in the Martin Associates report, it is expected that construction of the Federal project will facilitate regional growth. The greatest effect on employment and income are expected to continue to be concentrated among dry bulk and chemical cargoes. Significant growth occurred over the last 10–15 years in these labor-intensive commodity groups. Additionally, overall total tonnage growth will allow for continued increases in regional employment and income.

Table 163
Total Full-Time and Part-Time Employment by NAICS Industry a/

| Employment by Place of Work | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Avg. Annual Growth (%) |
|---|---|---|---|---|---|---|---|---|
| Total employment | 193,540 | 193,465 | 195,025 | 193,571 | 197,097 | 205,065 | 211,062 | 1.5 |
| Wage and salary employment | 164,515 | 162,340 | 162,137 | 160,073 | 161,132 | 167,076 | 170,725 | 0.6 |
| Proprietors employment | 29,025 | 31,125 | 32,888 | 33,498 | 35,965 | 37,989 | 40,337 | 5.6 |
| Farm proprietors employment | 1,501 | 1,528 | 1,493 | 1,486 | 1,510 | 1,505 | 1,494 | –0.1 |
| Nonfarm proprietors employment | 27,524 | 29,597 | 31,395 | 32,012 | 34,455 | 36,484 | 38,843 | 5.9 |
| Farm employment | 1,823 | 1,800 | 1,751 | 1,718 | 1,761 | 1,716 | 1,729 | –0.9 |
| Nonfarm employment | 191,717 | 191,665 | 193,274 | 191,853 | 195,336 | 203,349 | 209,333 | 1.5 |
| Private employment | 164,115 | 164,089 | 165,699 | 164,553 | 168,247 | 176,562 | 182,983 | 1.8 |
| Forestry, fishing, and related activities | 1,464 | 1,531 | 1,269 | 1,178 | 1,154 | 1,084 | 1,038 | –5.6 |
| Mining | 1,046 | 1,024 | 1,128 | 1,122 | 1,611 | 1,887 | 1,979 | 11.2 |
| Utilities | 962 | 1,003 | 1,047 | 1,033 | 1,033 | 1,013 | 1,014 | 0.9 |
| Construction | 20,129 | 18,609 | 18,965 | 17,013 | 18,052 | 19,889 | 21,214 | 0.9 |
| Manufacturing | 22,361 | 20,963 | 19,971 | 19,598 | 19,818 | 21,770 | 23,599 | 0.9 |
| Wholesale trade | 4,787 | 4,701 | 4,866 | 4,851 | 5,045 | 5,308 | 5,867 | 3.4 |
| Retail trade | 24,791 | 25,136 | 25,230 | 25,276 | 25,138 | 26,045 | 25,952 | 0.8 |
| Transportation and warehousing | 5,906 | 5,892 | 6,681 | 7,084 | 7,282 | 7,236 | 7,166 | 3.3 |
| Information | 3,122 | 3,024 | 3,051 | 3,036 | 3,110 | 2,938 | 2,601 | –3.0 |
| Finance and insurance | 6,405 | 6,394 | 6,412 | 5,998 | 6,339 | 6,435 | 6,695 | 0.7 |
| Real estate and rental and leasing | 4,185 | 4,449 | 4,742 | 4,907 | 5,385 | 5,885 | 6,685 | 8.1 |
| Other b/ | 68,957 | 71,363 | 72,337 | 73,457 | 74,280 | 77,072 | 79,173 | 2.3 |
| Government | 27,602 | 27,576 | 27,575 | 27,300 | 27,089 | 26,787 | 26,350 | –0.8 |

a/ NAICS (North American Industry Classification System).
b/ Primarily consists of health care and social services; hotel and food services; and other nonclassified.
Source: Bureau of Economic Analysis, Regional Economic Information System, Table CA25N, April 2009.

# ECONOMIC APPENDIX ADDENDUM
# SABINE-NECHES WATERWAY
# CHANNEL IMPROVEMENT PROJECT
# SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

10 June 2010

# APPENDIX 2
# ECONOMIC ADDENDUM

## 1.0 GENERAL

This addendum presents analysis of issues raised during the Independent External Peer Review (IEPR) (Battelle, 2010).

## 2.0 ANALYSIS OF LOOP AS A NON-STRUCTURAL ALTERNATIVE (IEPR COMMENT 1)

An offshore terminal has the potential of capturing 100 percent of all crude oil imports shipped from the routings represented by Middle East, Africa, North Sea, Mediterranean, and Brazil. Table 2A presents the tonnage that could potentially utilize an offshore terminal.

**TABLE 2A**
**SNWW Offshore Terminal Tonnage and Transportation Cost Savings**

| Representative Trade Route | 1,000's of Short Tons by Trade Routing | | | | | |
|---|---|---|---|---|---|---|
| | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
| Brazil | 4,347 | 4,847 | 5,136 | 5,224 | 5,326 | 5,701 |
| Europe & Africa | 33,801 | 37,688 | 39,940 | 40,639 | 41,434 | 44,203 |
| Middle East | 31,625 | 35,262 | 37,369 | 38,023 | 38,767 | 41,357 |
| Total Tonnage | 38,149 | 42,535 | 45,076 | 45,864 | 46,761 | 49,904 |
| | | | | | | |
| | Transportation Cost and Savings Per Ton | | | | | |
| | | To the | | | | |
| | 40-ft | Offshore | Savings/ | | | |
| Representative Route | SNWW | Terminal | Ton | | | |
| Brazil | $6.73 | $6.28 | $0.45 | | | |
| Europe/Africa | $8.41 | $7.84 | $0.57 | | | |
| Middle East | $14.43 | $12.66 | $1.77 | | | |
| | | | | | | |
| | Annual Transportation Savings | | | | | |
| Representative Route | 2019 | 2029 | 2039 | 2049 | 2059 | 2069 |
| Brazil | $2,466 | $2,750 | $2,913 | $2,964 | $3,022 | $3,234 |
| Europe & Africa | $19,175 | $21,380 | $22,658 | $23,054 | $23,505 | $25,076 |
| Middle East | $55,894 | $62,321 | $66,045 | $67,201 | $68,515 | $73,093 |
| Total | $75,069 | $83,701 | $88,703 | $90,255 | $92,021 | $98,169 |

Table 2B provides a comparison of the transportation savings benefits between the channel deepening alternatives and an offshore oil terminal alternative. The cost for the offshore oil terminal and pipeline structure is estimated to be a first cost of $1.8 billion based on the 2001 BOOTs construction cost estimate published by its sponsor and potential partners. The total annual cost estimates for the offshore alternatives are conservatively low. They do not include escalation of the original 2001 BOOTS estimate to 2010 costs, and they do not include estimated costs for operation and

maintenance (O&M), as we have no means of determining O&M costs for an offshore terminal. The table presents three offshore terminal funding scenarios. The first is based on SNWW users funding 100 percent of the terminal construction; the other scenarios are based on 50 and 25 percent funding. The project benefits are based exclusively on crude petroleum imports.

**TABLE 2B**
**SNWW Channel Deepening and Offshore Terminal Economic Summary Data**

| | SNWW Channel Deepening Alternatives (As Shown in Table 141, Economic Appendix) | | | | | | Offshore Terminal | | |
|---|---|---|---|---|---|---|---|---|---|
| | 45 | 46 | 47 | 48 | 49 | 50 | Funding 100% by SNWW | Funding 50% by SNWW | Funding 25% by SNWW |
| First Cost of Construction | $798.9 | $889.9 | $980.9 | $1,071.9 | $1,152.1 | $1,232.3 | $1,800.0 | $900.0 | $450.0 |
| Interest During Construction | $89.0 | $99.1 | $109.2 | $119.4 | $128.3 | $137.2 | $0.0 | $0.0 | $0.0 |
| Total Investment | $887.9 | $989.0 | $1,090.1 | $1,191.3 | $1,280.4 | $1,369.5 | $2,000.5 | $1,000.2 | $500.1 |
| Average Annual Cost | $44.0 | $49.0 | $54.0 | $59.1 | $63.5 | $67.9 | $99.2 | $49.6 | $24.8 |
| F&W Mitigation Differed Const. | $0.2 | $0.2 | $0.2 | $0.2 | $0.2 | $0.2 | $0.0 | $0.0 | $0.0 |
| Average Annual O&M | $26.0 | $28.0 | $30.1 | $32.1 | $32.9 | $33.8 | $0.0 | $0.0 | $0.0 |
| Total Annual Cost | $70.2 | $77.3 | $84.3 | $91.3 | $96.6 | $101.9 | $99.2 | $49.6 | $24.8 |
| Average Annual Benefits | $83.8 | $95.9 | $104.3 | $115.1 | $122.9 | $127.7 | $86.6 | $86.6 | $86.6 |
| Net Excess Benefits | $13.6 | $18.6 | $20.0 | $23.7 | $26.2 | $25.8 | -$12.6 | $37.0 | $61.8 |
| BCR | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 0.9 | 1.7 | 3.5 |

## 3. ANALYSIS OF CRUDE PETROLEUM IMPORTS BY VESSEL DRAFT (IEPR COMMENT 3)

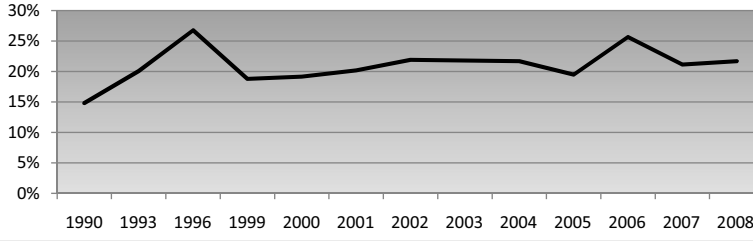
The top section of Table 3A shows the relationship between crude oil design and loaded drafts. The second and third sections of Table 3A show the relative volume and percentage of tonnage transported in vessels with loaded drafts over 37 feet. Figure 3A illustrates the percentage increase in tonnage experienced on the SNWW between 1990 and 2008. While not exhibiting dramatic increases, the table and figure clearly shows a high concentration of loaded drafts over 37 feet for all years, with the percentage of tonnage loaded to drafts over 37 feet increasing from 60 percent in 1999 to 71 percent in 2008. Table 3B includes additional distribution summary data. Trends are more apparent from the second table which shows an average of 7 percent of 2006-2008 tonnage associated with design drafts under 40 feet, compared to an average of 15 percent for 1999-2001. For the 1999-2008 period, the use of vessels with design drafts less or equal to 40 feet ranged from 27 percent in 1990 to 2 percent in 2008, with a mean of 12 percent and median of less than 10 percent. The data show more efficient utilization patterns within the constraints of the existing channel depth, given uncertainties associated with spot market sales, variability in refinery input needs, congestion, and dock and pilot availability.

**TABLE 3A**
**SNWW Total Crude Oil Imports (1,000's of Short Tons) 1990-2008***
**and Imports Transported at Loaded Drafts Over 37 feet (Short Tons and Percentage Distribution)**

| Design Draft (ft) | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|
| | Total Crude Oil Imports by Vessel Design Draft and Year | | | | | | | | |
| <=40 ft | 14,597 | 6,329 | 5,334 | 9,415 | 2,727 | 14,414 | 4,763 | 6,256 | 770 |
| 41-44 | 18,863 | 15,422 | 25,821 | 13,019 | 17,673 | 5,816 | 9,497 | 13,171 | 13,858 |
| 45-49 | 18,889 | 43,994 | 31,450 | 39,073 | 43,263 | 43,934 | 39,445 | 34,200 | 32,554 |
| >50 | 1,485 | 1,442 | 1,621 | 4,876 | 6,495 | 5,711 | 3,910 | 2,452 | 2,690 |
| Total | 53,834 | 67,187 | 64,226 | 66,383 | 70,158 | 69,875 | 57,615 | 56,078 | 49,872 |
| Design Draft (ft) | Total Tonnage for Loaded Drafts Over 37 feet by Design Draft Class and Year | | | | | | | | |
| <=40 ft | 9,744 | 2,473 | 2,294 | 7,814 | 1,176 | 12,684 | 3,334 | 5,277 | 364 |
| 41-44 | 10,460 | 7,706 | 14,976 | 7,291 | 8,499 | 3,955 | 5,318 | 11,502 | 11,276 |
| 45-49 | 11,832 | 26,378 | 20,757 | 24,225 | 22,958 | 27,678 | 24,062 | 23,418 | 22,487 |
| >50 | 793 | 432 | 859 | 3,364 | 3,446 | 3,598 | 1,369 | 1,192 | 1,049 |
| Total | 33,170 | 36,622 | 38,536 | 42,485 | 36,067 | 47,515 | 33,993 | 41,181 | 35,176 |
| Design Draft (ft) | Total Tonnage for Loaded Drafts Over 37 feet by Design Draft Class and Year | | | | | | | | |
| <=40 ft | 65% | 43% | 43% | 83% | 52% | 88% | 70% | 85% | 47% |
| 41-44 | 54% | 55% | 58% | 56% | 58% | 68% | 56% | 88% | 81% |
| 45-49 | 61% | 66% | 66% | 62% | 64% | 63% | 61% | 69% | 69% |
| >50 | 52% | 33% | 53% | 69% | 64% | 63% | 35% | 49% | 39% |
| Total | 60% | 60% | 60% | 64% | 62% | 68% | 59% | 74% | 71% |

Source: USACE, Navigation Data Center Detailed Files (unpublished)
*CY2005 data is not presented due to reporting problems with the loaded draft field

**FIGURE 3A**
**Percentage of Tonnage Shipped In Vessels with Loaded Drafts Over 37 ft**




Source: USACE, Waterborne Commerce of the U.S., Part 2, IWR-WCSC-1990-2008-2

**TABLE 3B**
**SNWW Total Crude Oil Imports 1990-2008***
**Percentage of Imports by Vessel Design Draft**

| Design Draft (ft) | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|
| | % of Total Crude Oil Imports by Vessel Design Draft and Year | | | | | | | | |
| <=40 ft | 27% | 9% | 8% | 14% | 4% | 21% | 8% | 11% | 2% |
| 41-44 | 35% | 23% | 40% | 20% | 25% | 8% | 17% | 24% | 28% |
| 45-49 | 35% | 66% | 49% | 59% | 62% | 63% | 68% | 61% | 65% |
| >50 | 3% | 2% | 3% | 7% | 9% | 8% | 7% | 4% | 5% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Design Draft (ft) | Loaded Drafts Over 37 ft (Percentage of Imports by Vessel Design Draft ) by Year | | | | | | | | |
| <=40 ft | 29% | 7% | 6% | 18% | 3% | 27% | 10% | 13% | 1% |
| 41-44 | 32% | 21% | 39% | 17% | 24% | 8% | 16% | 28% | 32% |
| 45-49 | 36% | 72% | 54% | 57% | 64% | 58% | 71% | 57% | 64% |
| >50 | 2% | 1% | 2% | 8% | 10% | 8% | 4% | 3% | 3% |

Source: USACE, Navigation Data Center Detailed Files (unpublished).

*CY2005 data is not presented due to reporting problems with the loaded draft field

Estimation of how the Table 3A and 3B distributions might change given an increase in channel depth is difficult to discern based on the eight years of data; therefore, comparison to 1970-72 data was made in order to provide overall perspective. While the earlier data is unfortunately more general it provides a useful basis for evaluating overall changes (Table 3C). The change from 1970/72 to 2006/08 is dramatic and emphasizes how tanker load patterns evolved within a period of 35 years with no change in channel depth. As discussed in the Economic Appendix vessel trips have increased at a lower rate than tonnage because more cargo is transported per vessel, through a greater concentration of larger vessels. As outlined in the Appendix, expectations are that the number of vessels will increase as SNWW's cargo base diversifies due to LNG and increases in manufactured goods and dry bulk.

**TABLE 3C**
**SNWW Inbound Tanker Trips 1970/1972 and 2006/2008**
**(includes All Crude Petroleum and Petroleum and Chemical Products)**

| Loaded Draft (ft) | 1970 | 1971 | 1972 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|
| <=24 | 1,015 | 973 | 991 | 185 | 168 | 184 |
| 25-29 | 144 | 113 | 199 | 187 | 151 | 184 |
| 30-37 | 228 | 238 | 198 | 481 | 363 | 337 |
| 38-40 | 1 | 2 | 14 | 492 | 588 | 558 |
| Total | 1,389 | 1,325 | 1,402 | 1,345 | 1,270 | 1,263 |
| Loaded Draft (ft) | Distribution by Loaded Draft | | | | | |
| <=24 | 73% | 73% | 71% | 14% | 13% | 15% |
| 25-29 | 10% | 8% | 14% | 14% | 12% | 15% |
| 30-37 | 16% | 18% | 14% | 36% | 29% | 27% |
| 38-40 | 0% | 0% | 1% | 37% | 46% | 44% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% |

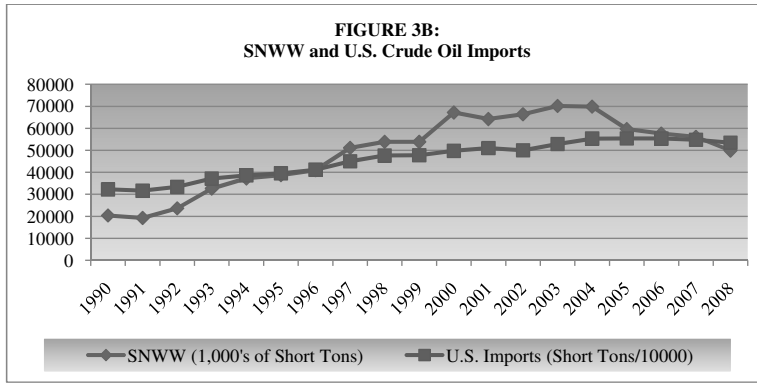
Source: USACE, Waterborne Commerce of the U.S., Part 2, IWR-WCSC-1970-2008-2

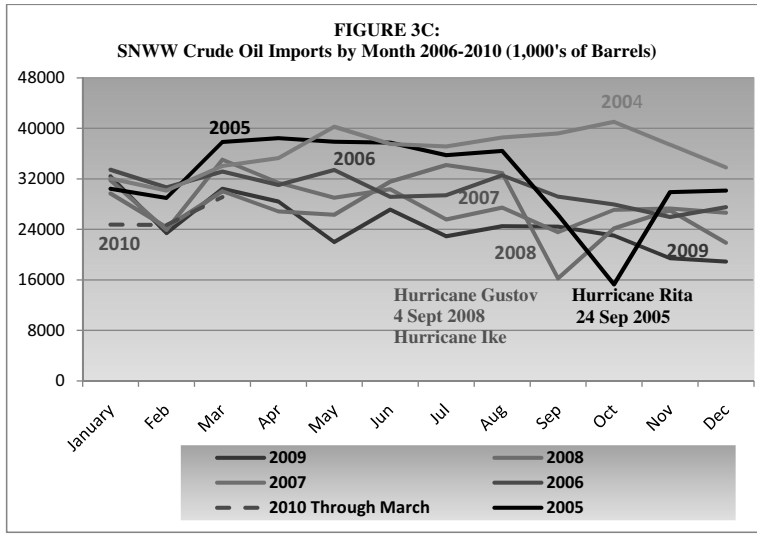
Table 3D provides a separate breakout of crude oil tanker trips included in Table 3C. SNWW 2006-2008 tonnage is down due to the effects of hurricanes and planned outages for refinery expansion; however, regional imports increased at significantly higher rates than the nation until 2004 (Figure 3B). The effect of the major hurricanes is illustrated in Figure 3C.

**TABLE 3D**
**SNWW Inbound Crude Oil Tanker Trip Data (Trips and Tonnage)**

| Loaded Draft (ft) | 1990 | 1993 | 1999 | 2001 | 2002 | 2003 | 2004 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|
| | SNWW Inbound Crude Oil Tanker Trips | | | | | | | | | |
| <=24 | 4% | 3% | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 1% |
| 25-29 | 5% | 4% | 1% | 1% | 1% | 0% | 1% | 2% | 1% | 3% |
| 30-37 | 32% | 58% | 38% | 38% | 34% | 38% | 33% | 42% | 26% | 29% |
| 38-40 | 59% | 36% | 60% | 60% | 64% | 61% | 66% | 55% | 72% | 66% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| | Crude Oil Imports (Millions of Short Tons) | | | | | | | | | |
| | 20.3 | 32.6 | 53.8 | 64.2 | 66.4 | 70.2 | 69.9 | 69.7 | 57.6 | 49.9 |

Source: USACE, Waterborne Commerce of the U.S., Part 2, IWR-WCSC-1990-2008-2 and Navigation Data Center Detailed Files (unpublished). CY2005 data is not presented due to reporting problems with the loaded draft field




Source: Aggregated from U.S. Department of Energy Monthly Import Statistics, 2004-2010

As noted on page 99 of the Appendix, Hurricane Rita's surge resulted in sand bars at the offshore entrance channel and silting of the Neches River Channel to Beaumont, which severely limited transit of the upper reaches for several months and tonnage diversions to other ports well into 2006. The effect of shoals in the entrance channel and silt deposits on the Neches River had a particularly strong effect on crude petroleum traffic due to the use of large heavily loaded vessels.

Specific estimation of future expectations concerning the relationship between loaded and design drafts and future utilization were made based on strong long-term historical utilization of the existing channel, industry interest in channel deepening, the lack of constraints at the points of origin, increasing concentration of larger vessels (Table 3E), and reductions in transportation costs (Table 3F). These trends are indicative that load patterns will continue to become more efficient. A major advantage of the 45- to 50-foot channel depth alternatives is that they reduce the number of shuttles needed to lighter a VLCC (Economic Appendix, Table 110) by allowing the increasingly large concentration of 90,000 to 119,999 DWT vessels to be loaded more fully. Vessels in this group have design drafts between 45 and 49 feet (Economic Appendix, Table 33). Table 3F illustrates the large concentration of 90,000 to 119,999 DWT vessels and the dramatic increase in their use since 1980. As shown in the Appendix, the design drafts for all vessels groups except those less than 50,000 DWT exceed 40 feet. Examination of the 2008 SNWW 50,000 to 74,500 DWT group showed a design draft range of 39 to 48 feet, with a median of 45 feet. For the <50,000 DWT range, the maximum design draft was 43 feet and the median 37 feet.

**TABLE 3F**
**SNWW Crude Petroleum Imports by Vessel Size**
**Percentage of Imports by Vessel DWT**

| Vessel DWT (1000) | Median Design Draft | 1980 | 1990 | 1993 | 1998 | 1999 | 2002 | 2003 | 2004 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <50 | 37 | * | 1% | 0% | 0% | 0% | 0% | 1% | 2% | 1% | 1% | 2% |
| 50–74.5 | 45 | * | 4% | 1% | 9% | 9% | 3% | 2% | 2% | 3% | 4% | 4% |
| 75–84.9 | 43 | * | 18% | 8% | 24% | 9% | 18% | 20% | 18% | 25% | 23% | 18% |
| 85–89.9 | 42 | * | **17%** | **11%** | 10% | 10% | 5% | 1% | 0% | 0% | 0% | 0% |
| 90–119.9 | 48 | <1% | 56% | 72% | 54% | 66% | 66% | 68% | 72% | 64% | 66% | 70% |
| 120–149.9 | 54 | 0% | 2% | 3% | 1% | 3% | 3% | 3% | 3% | 2% | 2% | 2% |
| 150–175 | 53 | 0% | 2% | 5% | 1% | 5% | 5% | 6% | 4% | 5% | 5% | 3% |
| Total | | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

Source: USACE, Navigation Data Center Detailed Files (unpublished), 1990-2008. CY2005 data is not presented due to reporting problems with the loaded draft field.
*Data from SNWW 1981-period report shows that the largest vessel size in 1980 was 99,600. Indications are that the most common were 60,000 to 78,000 DWT.

Table 3G displays the project average annual cost and benefits based on various assumptions associated with the percentage of crude petroleum imports that will be loaded to vessel drafts over 40 feet. The first column shows the benefits presented in Economic Appendix. The calculations in the remaining columns are based on alternative percentages. The results of this analysis, based on study region vessel utilization trends data from 1970-2008, industry expectations, and transportation cost savings indicate that it is reasonable to expect that a significant portion of future crude oil imports will be loaded to drafts over 40 feet given an increase in channel depth for the 50-year planning period starting in CY2019.

**TABLE 3G**
**SNWW Project Average Annual Costs and Benefits**
**Sensitivity Scenarios for the Percentage of Crude Oil Loaded to Drafts Over 40 ft**

| Channel Depth (ft) | Average Annual Cost ($1,000) at 4.375% |
|---|---|
| 45 | $70,217 |
| 46 | $77,258 |
| 47 | $84,299 |
| 48 | $91,341 |
| 49 | $96,626 |
| 50 | $101,911 |

Average Annual Benefits Calculations ($1,000's) at 4.375%
Based on Variation in the Percentage of Future Tonnage Using Channel Depth Increase
2019-2069

| Depth (ft) | 94% | 50% | 60% | 70% | 80% | 100% |
|---|---|---|---|---|---|---|
| 45 | $83,841 | $65,538 | $69,651 | $73,764 | $77,877 | $86,103 |
| 46 | $95,856 | $74,207 | $79,072 | $83,937 | $88,802 | $98,532 |
| 47 | $104,303 | $80,535 | $85,876 | $91,217 | $96,558 | $107,240 |
| 48 | $115,074 | $87,893 | $94,001 | $100,109 | $106,217 | $118,434 |
| 49 | $122,875 | $93,428 | $100,045 | $106,663 | $113,280 | $126,515 |
| 50 | $127,696 | $97,099 | $103,974 | $110,850 | $117,726 | $131,478 |
| | Net Excess Benefits ($1,000) Based on Utilization Scenarios | | | | | |
| 45 | $13,624 | -$4,679 | -$566 | $3,547 | $7,660 | $15,886 |
| 46 | $18,598 | -$3,051 | $1,814 | $6,679 | $11,544 | $21,274 |
| 47 | $20,004 | -$3,764 | $1,577 | $6,918 | $12,259 | $22,941 |
| 48 | $23,733 | -$3,448 | $2,660 | $8,768 | $14,876 | $27,093 |
| 49 | $26,249 | -$3,198 | $3,419 | $10,037 | $16,654 | $29,889 |
| 50 | $25,785 | -$4,812 | $2,063 | $8,939 | $15,815 | $29,567 |
| | BCRs Based on Utilization Scenarios | | | | | |
| 45 | 1.2 | .0.9 | .0.9 | 1.1 | 1.1 | 1.2 |
| 46 | 1.2 | .0.9 | 1.0 | 1.1 | 1.1 | 1.3 |
| 47 | 1.2 | .0.9 | 1.0 | 1.1 | 1.1 | 1.3 |
| 48 | 1.3 | .0.9 | 1.0 | 1.1 | 1.2 | 1.3 |
| 49 | 1.3 | .0.9 | 1.0 | 1.1 | 1.2 | 1.3 |
| 50 | 1.3 | .0.9 | 1.0 | 1.1 | 1.2 | 1.3 |

## 4.0 LNG MARKET SHARE (IEPR COMMENT 3)

The first part of this section addresses the basis for the market share. Table 4A displays the EIA U.S. LNG import forecast and the SNWW LNG forecasts that appear in the in the Economic Appendix (Table 72). As noted in the Appendix LNG permits were approved for the Cheniere Sabine Pass, Exxon-Mobil Golden Pass, and the Sempra Port Arthur Terminals. Cheniere opened in 2008 and Golden Pass is scheduled to open by 2011. Construction of the Sempra Terminal is planned after 2012.

**TABLE 4A**
**U.S. and SNWW LNG Waterborne LNG Forecast**
**Short Tons**

| Year | U.S. Waterborne LNG Imports | SNWW Waterborne LNG Imports |
|---|---|---|
| 2005 | 16,565,000 | |
| 2006 | 18,617,000 | |
| 2007 | 21,238,000 | 4,000 |
| 2008 | 12,072,000 | 39,000 |
| 2009 | 15,514,400 | not available |
| 2019 | 38,852,755 | 5,827,913 |
| 2020 | 38,045,447 | 9,511,362 |
| 2025 | 31,049,691 | 7,762,423 |
| 2029 | 24,698,681 | 6,174,670 |
| 2030 | 22,309,819 | 6,174,670 |
| 2069 | 22,309,819 | 6,174,670 |

Source: USACE, Waterborne Commerce of the U.S., Part 2, IWR-WCSC-2005-08, Parts 2 and 5 Navigation Data Center and the U.S. Department of Energy, 2009 Annual Energy Outlook, March 2009.

As noted in the Appendix, the SNWW LNG forecast is based on a market share of 20 percent. Determination of the expected SNWW market forecast was based on evaluation of industry input, and a report prepared by Michael Gorecki of Alexander Aaron, Inc. in May 2007 for the Galveston District. The Alexander Aaron, Inc. report predicted that the distribution amongst the facilities would range from 28.6 to 41.5 percent. These percentages were based on SNWW LNG plant capacities in relationship to the U.S. total. The 28.6 percent share was based on SNWW having two LNG terminals and the 41.5 percent was based on SNWW having three LNG terminals. Table 4B displays the anticipated U.S. market share presented in the Alexander Aaron, Inc. report. These market shares were expected to be reasonable given construction progress and industry investments. As noted, construction is complete for the Cheniere Terminal and nearly complete for Golden Pass. The market analysis indicated that given two SNWW terminals, the region was likely to capture 28.6 percent of the U.S. LNG import market. The Galveston District used a lower percentage in order to account for uncertainty. The percentage used in the Appendix is 15 percent in 2019 and 25 percent for 2029-2069, with import tonnage remaining constant after 2030.

The remainder of this section addresses the effects of varying the market share used in the report. Table 4C displays the EIA U.S. LNG import forecast and a range of SNWW LNG forecasts.

**TABLE 4B**

**Anticipated U.S. LNG Market Share**

| Name | Operational Bcf/d | Operational Rate | Annual Import Bcf | Operational Bcf/d | Operational Rate | Annual Import Bcf |
|---|---|---|---|---|---|---|
| Everett, MA | 0.869 | 0.627 | 199.0 | 0.869 | 0.719 | 228.3 |
| Cove Point, MD | 1.512 | 0.627 | 346.2 | 1.512 | 0.719 | 397.1 |
| Elba Island, GA | 1.777 | 0.627 | 406.7 | 1.777 | 0.719 | 466.5 |
| Lake Charles, LA | 1.764 | 0.627 | 403.8 | 1.764 | 0.719 | 463.2 |
| Sempra Hackberry, LA * | 2.226 | 0.627 | 509.6 | 2.226 | 0.719 | 584.6 |
| Freeport, TX * | 3.360 | 0.627 | 769.2 | 3.360 | 0.719 | 882.4 |
| SNWW LNG Terminals | | | | | | |
| Cheniere * | 3.360 | 0.627 | 769.2 | 3.360 | 0.719 | 882.4 |
| Golden Pass * | 2.268 | 0.627 | 519.2 | 2.268 | 0.719 | 595.6 |
| Sempra | 2.520 | 0.627 | 576.9 | | | |
| Total | 19.656 | | 4500.0 | | | |

Special Report prepared for the Galveston District by Michael Gorecki of Alexander Aaron, Inc., Sabine-Neches Waterway Project Liquefied Natural Gas Market Share, May 2007

*New or under construction in 2010.

Bcf/d: Billion cubic feet per day

**TABLE 4C**
**SNWW Market Share Sensitivity Analysis**

| Year | SNWW LNG Forecast Range | | | |
|---|---|---|---|---|
| | Economic Appendix | Half of the Economic Appendix Volume | 28.6% of the U.S. Market | 41.5% of the U.S. Market |
| 2019 | 5,827,913 | 2,913,957 | 6,993,496 | 9,713,189 |
| 2030 | 6,174,670 | 3,087,335 | 7,582,495 | 13,164,397 |
| 2069 | 6,174,670 | 3,087,335 | 7,582,495 | 13,164,397 |
| | Average Annual Benefits Calculations ($1,000's) at 4.375% Based on Range of SNWW LNG Market Shares, 2019-2069 | | | |
| 45 | $83,841 | $78,271 | $86,312 | $92,753 |
| 46 | $95,856 | $90,286 | $98,327 | $104,768 |
| 47 | $104,303 | $98,733 | $106,774 | $113,215 |
| 48 | $115,074 | $109,504 | $117,545 | $123,986 |
| 49 | $122,875 | $117,305 | $125,346 | $131,787 |
| 50 | $127,696 | $122,126 | $130,167 | $136,608 |
| | BCRs Based Range of SNWW LNG. Market Shares (The Average Annual Costs Used for the BCR Calculations are Shown at the top of Table 3G) | | | |
| 45 | 1.2 | 1.1 | 1.2 | 1.3 |
| 46 | 1.2 | 1.2 | 1.3 | 1.4 |
| 47 | 1.2 | 1.2 | 1.3 | 1.3 |
| 48 | 1.3 | 1.2 | 1.3 | 1.4 |
| 49 | 1.3 | 1.2 | 1.3 | 1.4 |
| 50 | 1.3 | 1.2 | 1.3 | 1.3 |

The following tables summarize evaluation of the crude petroleum vessel utilization and LNG market share presented in Tables 4A and 4C.

In conclusion, the sensitivities presented in Tables 4A-4D indicate that project justification is much more sensitive to crude oil tanker vessel utilization than to LNG market share. The results of the analyses presented in Table 4D shows that if less than 60 percent of 2019-2069 crude oil imports are regularly loaded to drafts less than 40 feet, the BCR will fall below unity. While not shown in the table, the BCR remains at unity given a reduction in the LNG market share to one-half of the percentages of 15 percent in 2019 and 25 percent for 2029-2069 in combination with 65 percent of 2019-2069 crude oil imports being loaded to drafts over 40 feet. In conclusion, the tanker utilization data presented in Table 3A (1990-2008) and Table 3C (1970/72 and 2006/08) provide sufficient justification to reasonably conclude that the crude oil tanker fleet will continue to realize increased efficiencies under both the without and with project future.

In terms of the SNWW tonnage forecast and the use of the AEO forecasts, the EIA notes that the reasons for variations between the AEO and other forecasters are due to differences among the assumptions that underlie the different projections. For example, the AEO 2010 reference case generally assumes that current laws and regulations will continue through the projection period as enacted, whereas some of the other projections assume the enactment of new public policy over the next 25 years. For the SNWW analysis, the AEO forecast was utilized. The sensitivities analysis addresses the effects of lower forecasts which could occur for a variety of reasons, some of which may include policy changes not explicitly discussed in the Appendix.

## 5.0 CRUDE PETROLEUM TRADE ROUTE AND LIGHTERING ANALYSIS (IEPR COMMENT 4)

This response provides data and discussion concerning lightering volumes and trade route choices. These calculations were based on the assumption that 100 percent of crude oil imports from Middle East and Africa would be lightered. The transportation cost calculations were made on a cost-per-ton basis using the available specific vessel volumes lightered and given knowledge of the range of vessel sizes used. The specific distribution of shuttle vessels used for lightering and lightening is not known because the Corps' National Data Center data records do not provide that level of detail. However, the Economic Guidance Memorandum (EGM) deep-draft vessel operating costs were used to calculate and verify the most efficient range of vessels. Shuttle vessels used for lightering are 80,000 to 120,000 DWT vessels. The number of shuttle trips necessary to offload a 325,000 DWT class VLCC is shown in Table 110 of the Appendix. The volume unloaded at the lightering zone is constrained by channel depth and refinery input needs. Vessel size data were obtained from the detailed waterborne commerce statistics. The vessel sizes used for existing condition lightering are identified in the Appendix (Table 111). The vessel sizes

**TABLE 4D**
**SNWW Combined Analysis of LNG Market Sensitivity and Crude Oil Vessel Utilization Share**

| | Scenario Description | | | | | |
|---|---|---|---|---|---|---|
| | Economic Appendix | Half of the LNG Market And 50% of Crude Petroleum Loaded to Drafts Over 40 ft | Half of the LNG Market And 70% of Crude Petroleum Loaded to Drafts Over 40 ft | 28.6% the LNG Market And 80% of Crude Petroleum Loaded to Drafts Over 40 ft | 41.5% the LNG Market And 80% of Crude Petroleum Loaded to Drafts Over 40 ft | 41.5% the LNG Market And 100% of Crude Petroleum Loaded to Drafts Over 40 ft |
| Channel Depth (ft) | Average Annual Benefits Calculations ($1,000's) at 4.375% Based on Range of SNWW LNG Market Shares, 2019-2069 | | | | | |
| 45 | $83,841 | $59,968 | $68,194 | $80,348 | $86,789 | $95,015 |
| 46 | $95,856 | $68,637 | $78,367 | $91,273 | $97,714 | $107,444 |
| 47 | $104,303 | $74,965 | $85,647 | $99,029 | $105,470 | $116,152 |
| 48 | $115,074 | $82,323 | $94,539 | $108,688 | $115,129 | $127,346 |
| 49 | $122,875 | $87,858 | $101,093 | $115,751 | $122,192 | $135,427 |
| 50 | $127,696 | $91,529 | $105,280 | $120,197 | $126,638 | $140,390 |
| Net Excess Benefits ($1000's) (The average annual costs used for the BCR calculations are shown at the top of Table 3G) | | | | | | |
| 45 | $13,624 | -$10,249 | -$2,023 | $16,572 | $10,131 | $24,798 |
| 46 | $18,598 | -$8,621 | $1,109 | $20,456 | $14,015 | $30,186 |
| 47 | $20,004 | -$9,334 | $1,348 | $21,171 | $14,730 | $31,853 |
| 48 | $23,733 | -$9,018 | $3,198 | $23,788 | $17,347 | $36,005 |
| 49 | $26,249 | -$8,768 | $4,467 | $25,566 | $19,125 | $38,801 |
| 50 | $25,785 | -$10,382 | $3,369 | $24,727 | $18,286 | $38,479 |
| BCRs Based Range of SNWW LNG. Market Shares Range and Variation in Crude Petroleum Loaded Draft Utilization (The average annual costs used for the BCR calculations are shown at the top of Table 3G) | | | | | | |
| 45 | 1.2 | 0.9 | .9 | 1.1 | 1.2 | 1.4 |
| 46 | 1.2 | 0.9 | 1.0 | 1.2 | 1.3 | 1.4 |
| 47 | 1.2 | 0.9 | 1.0 | 1.2 | 1.3 | 1.4 |
| 48 | 1.3 | 0.9 | 1.0 | 1.2 | 1.3 | 1.4 |
| 49 | 1.3 | 0.9 | 1.0 | 1.2 | 1.3 | 1.4 |
| 50 | 1.3 | 0.9 | 1.0 | 1.2 | 1.2 | 1.4 |

for existing condition lightening are identified in the Appendix (Table 112). Determination of the least costly method of shipment was based on comparison of direct shipment, lightering, and lightening costs using the Corps' EGM deep-draft vessel operating cost and optimal lightering turnaround data published in the Skaugen PetroTrans "Introduction to Lightering" along with periodic inquiries to the Skaugen PetroTrans company and other oil company personnel. Table 5A displays lightering cost components by major trade route for the segment from the foreign port of origin to the Gulf of Mexico lightering zone used in the Corps analysis.

**TABLE 5A**
**Lightering Cost for Traditional 325,000 DWT Vessel**

| | |
|---|---|
| 325,000 | Mother Vessel DWT |
| 0.97 | Max load Ratio |
| 315,250 | Fully-loaded cargo capacity |
| 15 | Speed (knots) |
| $2,114 | Hourly Cost at Sea (Economic Guidance Memorandum) |
| $1,377 | Hourly Cost in Port Economic Guidance Memorandum) |
| 24,917 | Mideast Round Trip Mileage Via Cape to Lightering Zone |
| 19,509 | Mideast Round Trip Mileage Via Suez to Lightering Zone |
| 11,488 | Africa/North Sea Round Trip Mileage to Lightering zone |
| 3,805 | Venezuela Round Trip Mileage to Lightering Zone |
| 1,220 | Mexico Round Trip Mileage to Lightering Zone |
| $82,710 | Loading Cost at Origin Port (based on loading rate of 5,250 tons per hour) |
| $3,593,602 | Total Transportation Cost (Middle East via Cape) |
| $2,831,596 | Total Transportation Cost (Middle East via Suez) |
| $1,701,409 | Total Transportation Cost (Africa/North Sea) |
| $618,847 | Total Transportation Cost (Venezuela/Eastern South America) |
| $254,612 | Total Transportation Cost (Mexico) |
| $11.40 | Middle East Cost Per Ton via Cape |
| $8.98 | Middle East Cost Per Ton via Suez |
| $5.40 | Africa/North Sea Cost/ton |
| $1.96 | Venezuela/Eastern South America Cost/ton |
| $0.81 | Mexico Cost/ton |

Table 5B displays the number of shuttles needed to fully load a 325,000 DWT vessel and Table 5C lists the number of hours needed to offload the 325,000 DWT vessel based on a range of shuttle vessels from 90,000 to 135,000 DWT. Based on per-ton transportation costs, this range represents the maximum efficiencies. Use of smaller shuttles is not cost effective when lightering (see Tables 5C-5H). In order to illustrate this point, a 42,500 DWT tanker is included in the Tables 5B-5G. Tables 5B-5E provide input data and Tables 5F and 5G display the cost per ton lightering cost for the Middle East and Africa/Mediterranean/ North Sea routing, respectively. The cost for direct shipment is presented in Tables 5H and 5I. Table 5H presents the direct shipment cost for Africa/North Sea/Mediterranean and Middle East routings. Table 5I presents the direct shipment cost for Mexico and Venezuela/Eastern South America.

TABLE 5B
Number of Shuttles Needed to Unload a 325,000 DWT Tanker

| Channel Depth ft. | Shuttle Vessel DWT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 42,500 | 90,000 | 110,000 | 115,000 | 120,000 | 125,000 | 130,000 | 135,000 |
| 40 | 9.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.0 | 4.0 | 4.0 |
| 43 | 9.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| 44 | 9.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| 45 | 9.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| 46 | 9.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| 47 | 9.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| 48 | 9.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 |
| 49 | 9.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 | 3.0 |
| 50 | 9.0 | 4.0 | 4.0 | 4.0 | 3.0 | 3.0 | 3.0 | 3.0 |

TABLE 5C
Number of Hours to Offload 325,000 DWT Tanker Based on Channel Depth Alternative and Shuttle DWT

| Channel Depth ft. | Shuttle Vessel DWT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 42,500 | 90,000 | 110,000 | 115,000 | 120,000 | 125,000 | 130,000 | 135,000 |
| 40 | 67.0 | 64.0 | 70.1 | 71.9 | 73.6 | 60.2 | 61.4 | 62.5 |
| 43 | 67.0 | 71.1 | 62.5 | 64.1 | 65.6 | 67.1 | 68.5 | 69.8 |
| 44 | 67.0 | 73.4 | 64.6 | 66.3 | 67.9 | 69.4 | 70.9 | 72.2 |
| 45 | 67.0 | 60.6 | 66.8 | 68.5 | 70.2 | 71.7 | 73.2 | 74.7 |
| 46 | 67.0 | 62.5 | 68.9 | 70.7 | 72.4 | 74.1 | 75.6 | 77.1 |
| 47 | 67.0 | 64.4 | 71.1 | 72.9 | 74.7 | 76.4 | 78.0 | 79.5 |
| 48 | 67.0 | 65.1 | 73.2 | 75.1 | 76.9 | 78.7 | 60.3 | 61.5 |
| 49 | 67.0 | 65.1 | 75.3 | 77.3 | 79.2 | 60.7 | 62.1 | 63.3 |
| 50 | 67.0 | 65.1 | 77.5 | 79.5 | 61.1 | 62.5 | 63.8 | 65.1 |

TABLE 5D
Cost to Offload 325,000 DWT Tanker Based on Channel Depth Alternative and Shuttle DWT

| Channel Depth ft. | Shuttle Vessel DWT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 42,500 | 90,000 | 110,000 | 115,000 | 120,000 | 125,000 | 130,000 | 135,000 |
| 40 | $141,668 | $135,300 | $148,148 | $151,936 | $155,527 | $127,137 | $129,693 | $132,092 |
| 43 | $141,668 | $150,220 | $132,089 | $135,492 | $138,736 | $141,823 | $144,752 | $147,522 |
| 44 | $141,668 | $155,194 | $136,613 | $140,139 | $143,508 | $146,718 | $149,771 | $152,665 |
| 45 | $141,668 | $128,134 | $141,137 | $144,787 | $148,280 | $151,614 | $154,790 | $157,809 |
| 46 | $141,668 | $132,113 | $145,660 | $149,435 | $153,051 | $156,509 | $159,810 | $162,952 |
| 47 | $141,668 | $136,091 | $150,184 | $154,082 | $157,823 | $161,405 | $164,829 | $168,095 |
| 48 | $141,668 | $137,683 | $154,708 | $158,730 | $162,594 | $166,300 | $127,386 | $129,929 |
| 49 | $141,668 | $137,683 | $159,232 | $163,378 | $167,366 | $128,397 | $131,151 | $133,786 |
| 50 | $141,668 | $137,683 | $168,279 | $176,532 | $138,589 | $144,778 | $150,968 | $157,158 |

TABLE 5E
Cost for Shuttle Travel Time Set-Up/Associated Logistics,
Based on Channel Depth Alternative and Shuttle DWT (Middle East Routings)

| Channel Depth ft. | Shuttle Vessel DWT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 42,500 | 90,000 | 110,000 | 115,000 | 120,000 | 125,000 | 130,000 | 135,000 |
| 40 | $266,308 | $147,949 | $147,949 | $147,949 | $147,949 | $118,359 | $118,359 | $118,359 |
| 43 | $266,308 | $147,949 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 |
| 44 | $266,308 | $147,949 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 |
| 45 | $266,308 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 |
| 46 | $266,308 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 |
| 47 | $266,308 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 |
| 48 | $266,308 | $118,359 | $118,359 | $118,359 | $118,359 | $118,359 | $88,769 | $88,769 |
| 49 | $266,308 | $118,359 | $118,359 | $118,359 | $118,359 | $88,769 | $88,769 | $88,769 |
| 50 | $266,308 | $118,359 | $118,359 | $118,359 | $88,769 | $88,769 | $88,769 | $88,769 |

TABLE 5F
Total Cost Per Ton for Mother and Shuttle Vessels based on Vessel Range
and Channel Depth Alternative (Middle East Routings)

| Channel Depth ft. | Shuttle Vessel DWT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 42,500 | 90,000 | 110,000 | 115,000 | 120,000 | 125,000 | 130,000 | 135,000 |
| 40 | $15.21 | $14.34 | $14.40 | $14.45 | $14.45 | $14.25 | $14.24 | $14.25 |
| 43 | $15.22 | $14.24 | $14.10 | $14.15 | $14.15 | $14.14 | $14.14 | $14.15 |
| 44 | $15.22 | $14.21 | $14.07 | $14.12 | $14.13 | $14.12 | $14.11 | $14.12 |
| 45 | $15.22 | $13.99 | $14.05 | $14.10 | $14.10 | $14.10 | $14.09 | $14.10 |
| 46 | $15.22 | $13.96 | $14.02 | $14.07 | $14.08 | $14.07 | $14.07 | $14.08 |
| 47 | $15.22 | $13.94 | $14.00 | $14.05 | $14.05 | $14.05 | $14.04 | $14.06 |
| 48 | $15.22 | $13.93 | $13.98 | $14.03 | $14.04 | $14.03 | $13.80 | $13.81 |
| 49 | $15.22 | $13.93 | $13.97 | $14.02 | $14.02 | $13.79 | $13.78 | $13.79 |
| 50 | $15.22 | $13.93 | $13.96 | $14.02 | $13.80 | $13.80 | $13.81 | $13.83 |

TABLE 5G
Total Cost Per Ton for Mother and Shuttle Vessels based on Vessel Range
and Channel Depth Alternative (Africa, North Sea, and Mediterranean Routings)

| Channel Depth ft. | Shuttle Vessel DWT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 42,500 | 90,000 | 110,000 | 115,000 | 120,000 | 125,000 | 130,000 | 135,000 |
| 40 | $9.21 | $8.34 | $8.40 | $8.45 | $8.45 | $8.25 | $8.24 | $8.25 |
| 43 | $9.21 | $8.24 | $8.10 | $8.15 | $8.15 | $8.14 | $8.13 | $8.14 |
| 44 | $9.21 | $8.21 | $8.07 | $8.12 | $8.12 | $8.12 | $8.11 | $8.12 |
| 45 | $9.21 | $7.99 | $8.05 | $8.10 | $8.10 | $8.09 | $8.09 | $8.10 |
| 46 | $9.21 | $7.96 | $8.02 | $8.07 | $8.07 | $8.07 | $8.06 | $8.07 |
| 47 | $9.21 | $7.94 | $8.00 | $8.05 | $8.05 | $8.05 | $8.04 | $8.05 |
| 48 | $9.21 | $7.93 | $7.98 | $8.03 | $8.03 | $8.03 | $7.80 | $7.81 |
| 49 | $9.21 | $7.93 | $7.97 | $8.02 | $8.02 | $7.78 | $7.78 | $7.79 |
| 50 | $9.21 | $7.93 | $7.96 | $8.02 | $7.80 | $7.80 | $7.81 | $7.83 |

TABLE 5H
Africa/North Sea/Mediterranean and Middle East Direct Shipment Transportation Cost

| Africa/North Sea/Mediterranean | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 70000 | $16.04 | $13.59 | $13.19 | $12.81 | $12.81 | $12.81 | $12.81 |
| 75000 | $15.40 | $12.40 | $11.95 | $11.52 | $11.13 | $10.78 | $10.44 |
| 80000 | $14.29 | $12.11 | $11.75 | $11.75 | $11.75 | $11.75 | $11.75 |
| 85000 | $14.21 | $12.03 | $11.66 | $11.42 | $11.42 | $11.42 | $11.42 |
| 90000 | $14.00 | $11.86 | $11.50 | $11.17 | $11.04 | $11.04 | $11.04 |
| 100000 | $13.57 | $11.51 | $11.18 | $10.86 | $10.55 | $10.27 | $10.21 |
| 105000 | $13.84 | $11.68 | $11.32 | $10.99 | $10.67 | $10.38 | $10.09 |
| 110000 | $13.70 | $11.56 | $11.21 | $10.88 | $10.58 | $10.29 | $10.01 |
| 120000 | $13.60 | $11.47 | $11.12 | $10.79 | $10.49 | $10.20 | $9.92 |
| 135000 | $13.48 | $11.35 | $11.00 | $10.67 | $10.37 | $10.08 | $9.80 |
| 150000 | $13.55 | $11.36 | $11.00 | $10.67 | $10.36 | $10.07 | $9.79 |
| 165000 | $13.55 | $11.36 | $11.00 | $10.67 | $10.36 | $10.07 | $9.79 |
| Middle East | | | | | | | |
| | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 80000 | $23.58 | $19.93 | $19.33 | $19.33 | $19.33 | $19.33 | $19.33 |
| 90000 | $22.52 | $19.10 | $18.53 | $18.00 | $17.80 | $17.80 | $17.80 |
| 100000 | $22.61 | $19.09 | $18.51 | $17.96 | $17.45 | $16.96 | $16.87 |
| 110000 | $22.52 | $18.95 | $18.36 | $17.81 | $17.30 | $16.82 | $16.36 |
| 120000 | $22.31 | $18.75 | $18.17 | $17.63 | $17.12 | $16.64 | $16.18 |
| 135000 | $22.12 | $18.55 | $17.97 | $17.42 | $16.91 | $16.43 | $15.97 |
| 150000 | $22.21 | $18.55 | $17.96 | $17.40 | $16.88 | $16.40 | $15.93 |
| 165000 | $22.21 | $18.55 | $17.96 | $17.40 | $16.88 | $16.40 | $15.93 |
| 175000 | $20.86 | $17.33 | $16.76 | $16.23 | $15.73 | $15.26 | $14.82 |
| 325000 | $24.93 | $20.04 | $19.29 | $18.59 | $17.95 | $17.36 | $16.81 |

| TABLE 5I<br>Mexico and Venezuela/Eastern South America Direct Shipment Transportation Cost | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mexico | | | | | | | |
| | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 70000 | $3.17 | $2.69 | $2.61 | $2.54 | $2.54 | $2.54 | $2.54 |
| 75000 | $3.20 | $2.68 | $2.59 | $2.51 | $2.44 | $2.44 | $2.44 |
| 80000 | $2.86 | $2.43 | $2.36 | $2.36 | $2.36 | $2.36 | $2.36 |
| 85000 | $2.81 | $2.40 | $2.33 | $2.28 | $2.28 | $2.28 | $2.28 |
| 90000 | $2.77 | $2.37 | $2.30 | $2.23 | $2.21 | $2.21 | $2.21 |
| 100000 | $2.79 | $2.38 | $2.31 | $2.25 | $2.19 | $2.13 | $2.11 |
| 105000 | $2.78 | $2.37 | $2.30 | $2.24 | $2.18 | $2.12 | $2.06 |
| 110000 | $2.78 | $2.37 | $2.30 | $2.23 | $2.17 | $2.12 | $2.06 |
| 120000 | $2.80 | $2.38 | $2.31 | $2.25 | $2.19 | $2.13 | $2.08 |
| 135000 | $2.76 | $2.34 | $2.27 | $2.21 | $2.15 | $2.10 | $2.04 |
| 150000 | $2.78 | $2.35 | $2.28 | $2.21 | $2.15 | $2.10 | $2.04 |
| 165000 | $2.78 | $2.35 | $2.28 | $2.21 | $2.15 | $2.10 | $2.04 |
| | | | | | | | |
| | | | | | | | |
| Venezuela and Eastern South America | | | | | | | |
| | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
| 70000 | $8.46 | $7.18 | $6.97 | $6.76 | $6.76 | $6.76 | $6.76 |
| 75000 | $8.56 | $7.14 | $6.91 | $6.70 | $6.49 | $6.49 | $6.49 |
| 80000 | $7.63 | $6.46 | $6.26 | $6.26 | $6.26 | $6.26 | $6.26 |
| 85000 | $7.50 | $6.36 | $6.17 | $6.04 | $6.04 | $6.04 | $6.04 |
| 90000 | $7.07 | $6.04 | $5.87 | $5.71 | $5.65 | $5.65 | $5.65 |
| 100000 | $7.35 | $7.18 | $6.97 | $6.76 | $6.76 | $6.76 | $6.76 |
| 105000 | $7.33 | $6.20 | $6.01 | $5.84 | $5.67 | $5.52 | $5.37 |
| 110000 | $7.32 | $6.18 | $6.00 | $5.82 | $5.66 | $5.51 | $5.35 |
| 120000 | $7.29 | $6.15 | $5.97 | $5.79 | $5.63 | $5.47 | $5.32 |
| 135000 | $7.22 | $6.07 | $5.89 | $5.71 | $5.55 | $5.40 | $5.25 |
| 150000 | $7.25 | $6.08 | $5.89 | $5.71 | $5.55 | $5.39 | $5.24 |
| 165000 | $7.25 | $6.08 | $5.89 | $5.71 | $5.55 | $5.39 | $5.24 |

Table 5J presents the lightening cost for the Africa/North Sea/Mediterranean route. Lightening represents a less costly shipping method than direct shipment for Africa/North Sea/Mediterranean routing; however, it is less competitive than lightering. As noted in the Appendix, lightening was historically the most common choice for Africa and the North Sea movements; however, it has become more common for the Africa/North Sea/ Mediterranean routes in recent years due to structural changes in oil production off the coast of West Africa. For this reason, the Africa/North Sea/Mediterranean cost calculations reflect lightering (Appendix, Table 111). Use of an average between lightering and lightening cost for this route may have been a more appropriate choice.

**TABLE 5J**
**SNWW Crude Petroleum Lightening Cost**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DWT: 165,000 | | Hourly Cost at Sea: $1,439 (Appendix, p. 148) | | | | Transportation Cost Per Ton: $7.02 (Table 5A) | |
| Fully loaded cargo: 160,050 short tons | | Hourly Cost in Port: $922 (Appendix p. 148) | | | | | |
| Channel Depth | 40 ft | 45ft | 46ft | 47ft | 48ft | 49ft | 50ft |
| Maximum Cargo | 88,690 | 106,894 | 110,535 | 110,535 | 114,176 | 121,458 | 117,817 |
| Cargo Offloaded | 71,360 | 53,156 | 49,515 | 49,515 | 45,874 | 38,592 | 42,233 |
| Shuttle DWT Needed | 77,500 | 60,000 | 56,667 | 58,000 | 50,000 | 42,500 | 47,500 |
| Hourly at Sea Cost | $1,044 | $952 | $923 | $923 | $865 | $816 | $849 |
| Hourly in Port Cost | $682 | $622 | $599 | $599 | $554 | $518 | $542 |
| Mother Vessel (MV) Unloading Cost Based on Standard Unloading Rate of 5,250 short tons/hr multiplied by the MV At Sea Cost, Offshore Lightened Cargo | | | | | | | |
| | $19,559 | $14,570 | $13,572 | $13,572 | $12,574 | $10,578 | $11,576 |
| Mother Vessel (MV) Waiting Time and Associated Logistics | | | | | | | |
| 4hrs Minimum | $34,536 | $34,536 | $34,536 | $34,536 | $34,536 | $34,536 | $34,536 |
| 8 hrs Most Likely | $17,268 | $17,268 | $17,268 | $17,268 | $17,268 | $17,268 | $17,268 |
| 12 hrs Maximum | $51,804 | $51,804 | $51,804 | $51,804 | $51,804 | $51,804 | $51,804 |
| MV Travel Cost from Offshore Lightering Zone to Dockside (Estimated Travel Time is 12 hours) | | | | | | | |
| | $34,536 | $34,536 | $34,536 | $34,536 | $34,536 | $34,536 | $34,536 |
| Pilot Cost | $46,194 | $50,282 | $50,754 | $51,225 | $52,200 | $53,174 | $53,174 |
| Tug Cost | $16,000 | $16,000 | $16,000 | $16,000 | $16,000 | $16,000 | $16,000 |
| MV Unloading Cost for Remaining Cargo In Port (Based on Unloading Rate of 5,250, Hourly Port Cost, and 2 Hours for Customs) | | | | | | | |
| | $17,420 | $20,617 | $21,256 | $21,256 | $21,895 | $23,174 | $22,535 |
| Total Cost for Mother Vessel (Sum of the Above Cost Divided by the Offshore Lightened Cargo) | | | | | | | |
| Minimum | $8.66 | $8.40 | $8.36 | $8.36 | $8.32 | $8.25 | $8.29 |
| Most Likely | $8.72 | $8.45 | $8.41 | $8.41 | $8.37 | $8.29 | $8.34 |
| Maximum | $9.11 | $8.78 | $8.72 | $8.72 | $8.68 | $8.58 | $8.63 |
| Shuttle Vessel Transportation Cost to the Lightering Zone | | | | | | | |
| | $25,050 | $22,848 | $22,152 | $22,152 | $20,760 | $19,572 | $20,364 |
| Shuttle Cost While Lightering | | | | | | | |
| | $14,187 | $9,639 | $8,705 | $8,705 | $7,558 | $5,995 | $6,826 |
| Unloaded Cost in Port and Associated Logistics for Shuttle Vessel | | | | | | | |
| | $16,374 | $14,928 | $14,384 | $14,384 | $13,296 | $12,420 | $13,004 |
| Pilot Cost | $27,795 | $24,996 | $24,594 | $24,594 | $23,508 | $21,781 | $22,337 |
| Tug Cost | $8,000 | $8,000 | $4,000 | $4,000 | $4,000 | $4,000 | $4,000 |
| Supply Vessel Transportation Cost to Lightering Zone | | | | | | | |
| | $11,864 | $11,864 | $11,864 | $11,864 | $11,864 | $11,864 | $11,864 |
| Supply Vessel While Lightering | | | | | | | |
| | $13,659 | $10,621 | $10,014 | $10,014 | $9,406 | $8,191 | $8,799 |
| Total Cost/Ton for Lightening Operation (Includes Mother Vessel, Shuttle, and Supply Vessel) a/ b/ | | | | | | | |
| Minimum | $10.30 | $10.34 | $10.29 | $10.29 | $10.29 | $10.42 | $10.35 |
| Most Likely | $10.36 | $10.39 | $10.34 | $10.34 | $10.34 | $10.47 | $10.40 |
| Maximum | $10.75 | $10.71 | $10.65 | $10.66 | $10.65 | $10.75 | $10.69 |

a/ Maximum cost reductions occur at the 46-foot channel depth.

b/ There are some differences between the costs per ton shown here and what is presented in the Economic Appendix (Table 112), with these costs being slightly less that those presented in the table; however, lightening was still found to be higher relative to lightering.

The remainder of this comment response addresses uncertainty pertaining to the trade route shipments of Venezuelan and other new routes such as Brazil. Application of the FY2008 EGM costs and the lightering company operational expectations of optimal turnaround times indicated that the resulting costs per ton suggested uncertainties. This uncertainty increased based on the release of the FY2008 vessel operating cost release, which showed a 17 percent drop in hourly costs for foreign flag tankers shown in the Appendix. Uncertainties associated with the transportation cost application are particularly high for routings that include Venezuela and Brazil because they have relatively short travel distance compared to the Middle East routes. For the Middle East, the relatively low FY2008 EGM costs showed that lightering is less costly than direct shipment. Additionally, the cost analyses for Africa crude showed that lightering is less costly than direct shipment, although by a comparatively smaller margin. However, the application for the Venezuelan routing revealed cost incentives to lighter which were not found using the higher vessel operating costs for the established optimal lightering turnaround time assumptions. As indicated, the cost of direct shipment is close to that for lightering and specifically relates to the operational assumptions based on optimal turnaround times and seamless logistics from the lightering company. The lightering company and industry indicate that it is not cost effective to lighter Venezuelan products.

Given the uncertainty associated with lightering logistics and associated transfer times, a sensitivity analysis was prepared evaluating the effect of minimum and maximum turnaround times. Table 5K displays columns showing both the mother vessel offshore unloading times and waiting times used for the analysis presented in the Economic Appendix, as well as the times for this sensitivity analysis. The times used in the Appendix suggest that multiple shuttles would be loaded simultaneously using innovations to be developed over the 2010-2069 future. However, these innovations were found not to be realistic for existing or future conditions. In the sensitivity analysis the offshore times are considered reasonable, given standard unloading time. For instance using a standard unloading rate of 5,250 tons per hour, it would take 60 hours to unload (lighter) a 325,000 DWT tanker ((325,000 * 0.97 capacity)/(5,250 short tons per hour). This sensitivity is included because of concerns that assumptions based on optimal offshore turnaround time, optimal scheduling of shuttle arrivals, and perhaps lower than realistic vessel operating cost, such as the Corps' FY08 tanker vessel operating costs being 17 percent lower than the FY07 release, result in criteria that is unrealistically conservative. The sensitivity was found to be representative of actual conditions while by comparison the times used for the base are not realistic.

An additional component modified for this sensitivity was to separate Venezuela products from those from Brazil. While shipments of crude oil from Brazil to SNWW are presently less than 1 percent, future expectations are that this will change. The Appendix analysis included Venezuela and Brazil as one

**TABLE 5K**
**Mother Vessel Combined Time Offloading and Waiting Between Shuttles**

| | Mother Vessel Offshore Hours (Appendix) | | Mother Vessel Offshore Hours (Sensitivity) | |
|---|---|---|---|---|
| Component | **Lightering** | *Lightening* | **Lightering** | *Lightening* |
| Minimum (hrs) | **8** | *8* | **60** | *24* |
| Most Likely (hrs) * | **12** | *12* | **60** * | *31* * |
| Maximum (hrs) | **36** | *36* | **168** | *120* |
| Hours Used for Calculation | **12** | *12* | **96** * | *30* * |

*The most likely time for the mother vessel for **lightering** is based on a 325,000 DWT tanker, a cargo to short ton ratio of 0.97, and an unloading rate of 5,250 short tons per hour. The most likely time for the mother vessel for *lightening* is based on a 165,000 DWT tanker, a cargo to short ton ratio of 0.97, and an unloading rate of 5,250 short tons per hour. The hours used for calculation are based on a @risk triangular distribution using the minimum, most likely, and maximum values shown. The maximum values used as input into the @risk distribution are noted quotes from the lightering company.

region. Table 5L displays the transportation cost with Brazil separated out from Venezuela. Table 5M displays the results of using the routing shown in Table 5L and the mother vessel sensitivity-based times from Table 5J (i.e. 96 hours offshore for the lightering mother vessel and 30 hours offshore for the lightening mother vessels).

TABLE 5L
SNWW Crude Petroleum Imports Transportation Cost ($1,000) by Channel Depth Alternative
(same as Table 111, Economic Appendix)

| Trade Route and Cost/Ton | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|
| Mexico | Direct | Direct | Direct | Direct | Direct | Direct | Direct |
| Cost/Ton Beaumont | $2.76 | $2.34 | $2.28 | $2.21 | $2.15 | $2.11 | $2.07 |
| Cost/Ton Port Arthur | $2.77 | $2.37 | $2.30 | $2.23 | $2.18 | $2.14 | $2.11 |
| Venezuela & E South America | Direct | Direct | Direct | Direct | Direct | Direct | Direct |
| Cost/Ton Beaumont | $7.22 | $6.09 | $5.91 | $5.73 | $5.58 | $5.45 | $5.34 |
| Cost/Ton Port Arthur | $7.28 | $6.17 | $5.98 | $5.81 | $5.67 | $5.55 | $5.47 |
| Africa/North Sea | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered |
| Cost/Ton Beaumont | $8.41 | $8.18 | $8.13 | $8.12 | $8.05 | $8.01 | $8.01 |
| Cost/Ton Port Arthur | $8.46 | $8.19 | $8.13 | $8.12 | $8.12 | $8.11 | $8.08 |
| Middle East | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered |
| Cost/Ton Beaumont | $14.43 | $14.20 | $14.15 | $14.13 | $14.06 | $14.03 | $14.03 |
| Cost/Ton Port Arthur | $14.48 | $14.19 | $14.13 | $14.11 | $14.11 | $14.10 | $14.06 |

TABLE 5L-1
SNWW Economic Summary Data
Average Annual Costs and Benefits, Net Excess Benefits and BCRs by Channel Depth Alternative
(As Included in Table 141, Economic Appendix)

| Cost Component | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| Total Annual Cost ($1,000) | $70,217 | $77,258 | $84,299 | $91,341 | $96,626 | $101,911 |
| Average Annual Benefits ($1,000) | $83,841 | $95,856 | $104,30 | $115,074 | $122,875 | $127,696 |
| Net Excess Benefits ($1,000) | $13,624 | $18,598 | $20,004 | $23,733 | $26,249 | $25,785 |
| B/C Ratios | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 |

TABLE 5M
SNWW Crude Petroleum Imports Transportation Cost ($1,000) by Channel Depth Alternative
Separate Breakout of Venezuela and Brazil, with 100% of Brail Imports Lightered and
Sensitivity of Realistic Offshore Transfer Times

| Trade Route and Cost/Ton | 40 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|
| Mexico | Direct | Direct | Direct | Direct | Direct | Direct | Direct |
| Cost/Ton Beaumont | $2.76 | $2.34 | $2.28 | $2.21 | $2.15 | $2.11 | $2.07 |
| Cost/Ton Port Arthur | $2.77 | $2.37 | $2.30 | $2.23 | $2.18 | $2.14 | $2.11 |
| Venezuela | Direct | Direct | Direct | Direct | Direct | Direct | Direct |
| Cost/Ton Beaumont | $4.87 | $4.58 | $4.44 | $4.31 | $4.20 | $4.10 | $4.02 |
| Cost/Ton Port Arthur | $4.89 | $4.60 | $4.46 | $4.33 | $4.23 | $4.14 | $4.08 |
| Brazil | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lighter |
| Cost/Ton Beaumont | $6.68 | $6.50 | $6.47 | $6.46 | $6.40 | $6.37 | $6.37 |
| Cost/Ton Port Arthur | $6.72 | $6.51 | $6.47 | $6.46 | $6.45 | $6.45 | $6.42 |
| Africa/North Sea | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lighter |
| Cost/Ton Beaumont | $8.41 | $8.18 | $8.13 | $8.12 | $8.05 | $8.01 | $8.01 |
| Cost/Ton Port Arthur | $8.46 | $8.19 | $8.13 | $8.12 | $8.12 | $8.11 | $8.08 |
| Middle East | Lightered | Lightered | Lightered | Lightered | Lightered | Lightered | Lighter |
| Cost/Ton Beaumont | $14.43 | $14.20 | $14.15 | $14.13 | $14.06 | $14.03 | $14.0 |
| Cost/Ton Port Arthur | $14.48 | $14.19 | $14.13 | $14.11 | $14.11 | $14.10 | $14.0 |

TABLE 5M-1
SNWW Economic Summary Data
Average Annual Costs and Benefits, Net Excess Benefits and BCRs by Channel Depth Alternative
Based on Inclusion of a Separate Breakout of Venezuela and Brazil, with 100% of Brail Imports Lightered

| Cost Component | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|
| Total Annual Cost ($1,000) | $70,217 | $77,258 | $84,299 | $91,341 | $96,626 | $101,911 |
| Average Annual Benefits ($1,000) | $91,523 | $105,287 | $112,44 | $126,830 | $135,987 | $142,323 |
| Net Excess Benefits ($1,000) | $21,306 | $28,029 | $28,150 | $35,489 | $39,361 | $40,412 |
| B/C Ratios | 1.3 | 1.4 | 1.3 | 1.4 | 1.4 | 1.4 |

Table 5N summarizes the data aggregated and incorporates the critical sensitivities evaluated under Comment 3. It was found in preparation of the response to Comment 4 that the duration of the VLCC offshore times used in the Appendix analysis was unrealistically low. For this aspect of the analysis, the sensitivity was found to be representative of actual conditions.

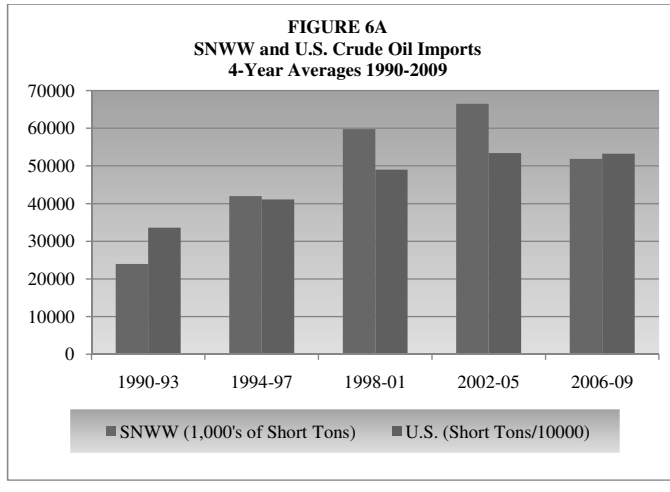
In conclusion, the results of the data and the additional sensitivities presented provide sufficient justification to reasonably conclude that the recommended plan for the 48-foot depth is economically justified.

**TABLE 5N**
**SNWW Combined Analysis of LNG Market Sensitivity and Crude Oil Vessel Utilization Share**

| | Scenario Description | | | | | |
|---|---|---|---|---|---|---|
| | Economic Appendix (Table 141) | Half of the LNG Market And 50% of Crude Petroleum Loaded to Drafts Over 40 ft | Half of the LNG Market And 70% of Crude Petroleum Loaded to Drafts Over 40 ft | Half the LNG Market And 70% of Crude Petroleum Loaded to Drafts Over 40 ft | Economic Appendix LNG Market And 80% of Crude Petroleum Loaded to Drafts Over 40 ft | Economic Appendix LNG Market And 80% of Crude Petroleum Loaded to Drafts Over 40 ft (Same as Table 4D) |
| | | Separate Breakout of Venezuela and Brazil, with 100% of Brail Imports Lightered | Separate Breakout of Venezuela and Brazil, with 100% of Brail Imports Lightered | Separate Breakout of Venezuela and Brazil, with 100% of Brail Imports Lightered and Inclusion of Sensitivity Realistic Offshore Transfer Time Sensitivity | Separate Breakout of Venezuela and Brazil, with 100% of Brail Imports Lightered and Inclusion of Sensitivity Realistic Offshore Transfer Time Sensitivity | Separate Breakout of Venezuela and Brazil, with 100% of Brail Imports Lightered and Inclusion of Sensitivity Realistic Offshore Transfer Time Sensitivity |
| Channel Depth (ft) | Average Annual Benefits Calculations ($1,000's) at 4.375% Based on Range of SNWW LNG Market Shares, 2019-2069 | | | | | |
| 45 | $83,841 | $64,936 | $67,644 | $80,944 | $88,558 | $91,523 |
| 46 | $95,856 | $74,458 | $77,669 | $93,737 | $101,748 | $105,287 |
| 47 | $104,303 | $81,033 | $84,508 | $100,576 | $108,719 | $112,449 |
| 48 | $115,074 | $89,251 | $93,249 | $113,762 | $122,392 | $126,830 |
| 49 | $122,875 | $95,196 | $99,514 | $122,248 | $131,152 | $135,987 |
| 50 | $127,696 | $98,699 | $103,129 | $128,154 | $137,234 | $142,323 |
| | Net Excess Benefits ($1000's) (The Average Annual Costs Used for the BCR Calculations are Shown at the top of Table 4A) | | | | | |
| 45 | $13,624 | -$5,281 | -$2,573 | $10,727 | $18,341 | $21,306 |
| 46 | $18,598 | -$2,800 | $411 | $16,479 | $24,490 | $28,029 |
| 47 | $20,004 | -$3,266 | $209 | $16,277 | $24,420 | $28,150 |
| 48 | $23,733 | -$2,090 | $1,908 | $22,421 | $31,051 | $35,489 |
| 49 | $26,249 | -$1,430 | $2,888 | $25,622 | $34,526 | $39,361 |
| 50 | $25,785 | -$3,212 | $1,218 | $26,243 | $35,323 | $40,412 |
| | BCRs Based Range of SNWW LNG. Market Shares Range and Variation in Crude Petroleum Loaded Draft Utilization (The Average Annual Costs Used for the BCR Calculations are Shown at the top of Table 4A) | | | | | |
| 45 | 1.2 | 0.9 | .9 | 1.2 | 1.3 | 1.3 |
| 46 | 1.2 | 0.9 | 1.0 | 1.2 | 1.3 | 1.4 |
| 47 | 1.2 | 0.9 | 1.0 | 1.2 | 1.3 | 1.3 |
| 48 | 1.3 | 0.9 | 1.0 | 1.2 | 1.3 | 1.4 |
| 49 | 1.3 | 0.9 | 1.0 | 1.3 | 1.4 | 1.4 |
| 50 | 1.3 | 0.9 | 1.0 | 1.3 | 1.3 | 1.4 |

## 6.0 CRUDE PETROLEUM MARKET SHARE AND TONNAGE FORECAST (IEPR COMMENT 6)

In overall terms and in spite of a recent decline in the SNWW share of the U.S. total, comparison of overall regional imports using 4-year averages from 1990-2009 shows that SNWW imports grew by 117 percent in comparison to a U.S. increase of 58 percent. During the period from 2004 to 2009, SNWW's refinery capacity increased from 6 percent to 6.5 percent (Economic Appendix, Table 10). Port Arthur refinery capacity in 2009 is nearly 13 percent higher than in 2004, with additional expansions scheduled. Motiva announced plans for a 325,000 barrel-per-day (BPD) refinery expansion in Port Arthur in December 2007. Additionally, expansion of the Motiva-Port Arthur refinery is currently underway and expected to be complete by 2012. Motiva's current capacity of 285,000 BBD will increase to 610,000 BBD until completion.




Source: Aggregated from U.S. Army Corps of Engineers, Waterborne Commerce of the U.S and U.S. Department of Energy, Energy Information Administration data.

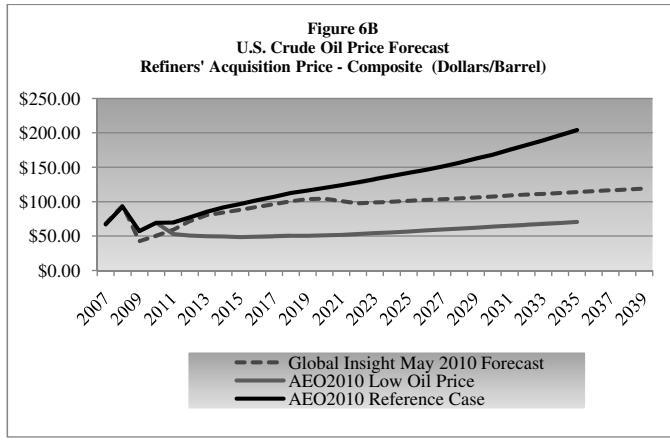
Regarding expectations concerning the region's percentage share of the U.S. market, SNWW's relative share has been affected by a combination of factors, both regional and national. Regionally, the share has been affected by hurricanes. Additionally, its relative share of the U.S. total has also been affected by the large influx of Canadian crude to the U.S. Midwest. Presently less than 1 percent of Canadian crude is transported to SNWW, with the majority of that being transported by vessel. Expansion of the Keystone TransCanada Pipeline to the U.S. Gulf Coast ports that include Port Arthur and Houston remains uncertain. SNWW refinery representatives do not foresee increases in their receipt of Canadian crude. While industry is noncommittal, interest in current pipeline delivery and the TransCanada Pipeline

Expansion was noted to be limited to the companies that buy excess oil for resale and transmittal to various SNWW, Texas City, and Houston refineries. This market is characteristically uncertain and small and the Gulf Coast represents a relatively high transmittal cost in comparison to markets in the U.S. Midwest. Texas imports of Canadian crude for 2005-2009 by pipeline and vessel averaged 1.1 percent, with a low of 0.6 percent in 2008 and a high of 1.5 percent in 2008. This issue's conclusion is that long-term expectations concerning the specific volume of Canadian crude that could be pipelined into the study region will remain uncertain in the short-term. Realization would depend upon high oil prices, among other factors. But with falling demand, falling crude oil prices, and carbon emission concerns, forecasts of future Canadian oil sands production have declined, as have expectations of likely volumes reaching the Gulf Coast in the near future.

The U.S. Department of Energy's Annual Energy Outlook 2007 (AEO 2007) forecast was used for the March 2007 Economic Appendix provided for IEPR. During the review period, the Galveston District continued to review new forecasts as they were released. The SNWW crude oil imports forecasts in the 2008 and 2009 draft reports reflect forecast modifications that are more conservative than the AEO 2007. The AEO 2008 showed a significant change from the AEO 2007 and from Global Insight's 2008 forecast release. The AEO 2008 release occurred at the same time that Motiva Port Arthur refinery expansion was announced. The Motiva expansion and SNWW's existing role as the largest waterway port of entry for petroleum suggested that Global Insight's slightly higher forecast was likely to be more reflective of long-term regional trends. Global Insight's 2008 forecast was subsequently used in the 2008 draft report and their 2009 forecast was used in current report.

In regard to differences between the AEO and Global Insight, the major difference between the two is that AEO forecasts much higher domestic crude oil production throughout the projection period than other noted forecasters. As noted in the AEO website, their forecast not only shows higher domestic production, it also shows a rapid increase in domestic production. Other differences pertain to the forecast price of crude oil. The figure below provides a comparison of the AEO 2010 Reference and low oil price based forecast with Global Insight's May 2010 price forecast release.

Table 6A displays the U.S. oil import data evaluated during 2008-09 preparation of the Appendix and since its submittal. Table 6B presents regression equation outputs using the AEO 2010 Reference and Low Price case scenarios. The regression equations were prepared using 1990-2007 and 1990-2008 base data.




Source: Global Insight, May 2010 and U.S. Department of Energy, 2010 Annual Energy Outlook.

TABLE 6A

SNWW Crude Petroleum Imports Forecast Projections

| Year | AEO Reference | | | AEO 2010 | Purvin & Gertz | | | Global Insight | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2010 | | 2008 | 2009 | 2010 | 2008 | 2009 | 2010 |
| 2007 | 10.0 | 10.0 | 10.0 | 10.0 | n/a | 10.0 | 10.0 | | 10.0 | 10.0 |
| 2015 | 10.2 | 8.1 | 8.9 | 10.1 | n/a | n/a | 11.8 | 12.0 | 11.1 | 9.7 |
| 2025 | 11.0 | 6.7 | | 11.7 | n/a | 12.4 | 12.3 | 13.7 | 12.1 | 10.6 |
| 2030 | 11.9 | 7.0 | 8.7 | 12.7 | n/a | 12.7 | | 14.5 | 12.5 | 11.7 |
| 2035 | n/a | n/a | 8.7 | 13.6 | n/a | n/a | n/a | n/a | 12.9 | n/a |

Source: U.S. Department of Energy, AEO2008, 2008, and 2010. Global Insight 2035 forecast value was obtained from non-published back-up data obtained from Global Insight

TABLE 6B
SNWW Crude Petroleum Imports Forecast Projections
Millions of Barrels/Day

| Year | 1990-2008 SNWW as a Function of U.S. Imports<br>Adjusted R Square: .28<br>F Statistic: 8.17<br>Standard Error of Y Estimate: 14046.6 | | 1990-2007 SNWW as a Function of U.S. Imports<br>Adjusted R Square: .88<br>F Statistic: 129.99<br>Standard Error of Y Estimate: 6020.9 | |
|---|---|---|---|---|
| | AEO 2010 | AEO 2010 | AEO 2010 | AEO 2010 |
| 2015 | 53,150 | 57,849 | 55,338 | 74,582 |
| 2019 | 52,680 | 60,355 | 54,080 | 82,689 |
| 2025 | 51,975 | 64,115 | 52,192 | 94,850 |
| 2029 | 52,132 | 65,681 | 52,612 | 99,917 |
| 2030 | 52,366 | 68,031 | 53,241 | 107,518 |
| 2035 | 52,366 | 71,555 | 53,241 | 118,919 |

Source: U.S. Department of Energy, AEO2008, 2008, and 2010. Global Insight 2035 forecast value was obtained from non-published back-up data obtained from Global Insight

A comparison table of the BCRs based on the alternative forecasts was not prepared. It is recognized that SNWW import forecast is higher than all of the AEO 2009 and AEO 2010 projections, with the exception of the AEO 2010 Low Price scenario; however, the forecast for SNWW falls within the range of forecasts published by other recognized forecasters. As previously indicated, the Motiva expansion and SNWW's existing role as the largest waterway port of entry for petroleum suggested that the higher forecast would most reasonably reflect long-term trends for the study area.

# Appendix 3

# Baseline Cost Estimate

# Sabine-Neches Navigation Channel Improvement Project

## Engineering Appendix
## Chapter 13.0
## Cost Estimates

Attachment 13.1 – Narrative
Attachment 13.2 – MII Estimate
Attachment 13.3 – CSRA
Attachment 13.4 – Total Project Cost Summary
Attachment 13.5 – ATR Certification of Cost Estimate (To Be Provided)
Attachment 13.6 – 50 Year O&M (To Be Provided)

Revised
June 2010

ATTACHMENT 13.1 - Narrative

**SABINE-NECHES NAVIGATION CHANNEL IMPROVEMENT PROJECT**

This MII estimate was prepared for the Feasibility Study of deepening the Sabine Neches Waterway to a depth of 48 feet. The work consists of deepening the navigation channel from the existing inland reaches to the Port of Beaumont from 40 to 48 ft; and extending the existing entrance channel by 13.2 miles into the Gulf of Mexico to a depth of 50 ft. The plan also consists of: 1) bend easing in the Sabine-Neches Canal and Neches River channel; 2) widening up to an additional 183 feet the Taylors Bayou Entrance channel and turning basins; and 3) Constructing new and enlarging/deepening existing turning and anchorage basins on the Neches River Channel. The entire plan involves dredging about 406,464 feet of channel. Quantities and design features were developed by the Galveston District (SWG) Engineering Branch.

This estimate was revised July 2009 using the latest price levels and the labor rates. During the update the marine fuel price was locked in at $2.60/gal, (see attachment 13.2). This updated Mii estimate reflects changes in the scope. The major changes in scope are the removal of the widening of the entrance, removal of five turning basins, removal of two Beneficial Use (BU) sites, reduction of one BU, and the removal of the oyster reef. The estimate was escalated to October 2009 price levels in the Total Project Cost Summary Sheet (TPCS), (see attachment 13.4). The estimate was divided into 15 contracts, with each contract being subdivided into Non-Federal and Federal Costs. The costs were further organized in accordance with the work breakdown structure. The midpoint date of each account code for each of the construction contracts was provided by the project manager for developing the fully funded costs. The estimate was prepared in accordance with ER 1110-2-1302, dated 15 September 2008. The costs were escalated in accordance with the above Engineering Regulation and EM 1110-2-1304 dated 31 March 2009. All this data was input into the TPCS. The baseline estimate provides for all pertinent elements for a complete project ready for operations.

The original Independent Technical Review (ITR) of the cost estimate, construction schedules, and contingencies was performed in June 2006 by Mobile District, some minor revision were performed to the estimate in response to the comments. In July 2007 new requirements were published for the development of contingencies in Civil Works. A formal cost risk analysis for development of project contingences was done with the results presented in the Total Project Cost Summary Sheet (TPCS). Crystal Ball software was used to conduct the Cost Risk Analysis.

A formal Cost Risk Analyses was performed with the cooperation of the PDT and Cost Engineering Directory of Expertise (DX) of the Walla Walla District in August 2009. The risks were quantified and a cost risk model developed to determine a contingency at 80% confidence level (CL), (see attachment 13.3). For Hopper dredge work a 33% contingency was used for the 80% CL and for Pipeline dredge work a 30% contingency was used for the 80%. The estimate was escalated to October 2009 price level. The contingencies were used along with the updated estimate to revise the TPCS. An ITR Certification of Cost Estimate was provided by Cost Engineering DX for Civil Works, (see attachment 13.5). The Operation and Maintenance estimate was prepared in July 2009, with an effective pricing date of October 2009, (see attachment 13.6).

**ACCOUNT CODE 01 – LANDS AND DAMAGES:** Costs for this Account Code were provided by SWG, Real Estate Division.

**ACCOUNT CODE 02 -- RELOCATIONS:** A total of 42 pipelines would require relocation and 6 would require removal. The relocated lines were assumed to be directionally drilled, and bundled when possible. It is assumed that the lines which are currently abandoned in place will be removed from the limits of the new channel and disposed off-site. Relocation work is assumed to take place prior to dredging the new channel.

**ACCOUNT CODE 12 -- NAVIGATION PORTS AND HARBORS**: Dredge quantities were developed by the design engineer. It was assumed that the first 5 contracts would be done using one large hopper dredge per contract. The material from the hopper dredge would be placed in open water disposal. The remainder of the channel was assumed to be dredged using a 30" pipeline, with the material going into existing placement areas (PA's) or new PA's located along the waterway. The dredging cost was developed using CEDEP. The dredge production rates were reduced to account for the stiffer "new work" material to be encountered. The cost for mobilization and demobilization was developed using CEDEP, and assuming the pipeline dredge was based in New Orleans. The Dredging estimates were based on standard operating practices for the Galveston District which assumed conventional contracting practices of large business IFB's.

Included under the hopper dredge cost is the cost for Sea Turtle Protection. Included in this item are: 1) cost for two trawlers per hopper, 2) a sea turtle protection device fitted to the hopper, and 3) 24 hour monitoring survey.

The cost for creating a PA was included under this code of account. Part of the cost for creating a PA included clearing, grubbing, and stripping the area; as well as turfing the outside of the new levee. Labor rates and overhead costs were adjusted to reflect Region 6. Soil characteristics were provided by SWG, Engineering Division, Geotechnical and Structures Section.

Also, included under this account code were bridge dolphin fender systems. They are required for the MLK Hwy 82 Bridge located at Station 105+00 on the Sabine Neches Canal; as well as Hwy 87, (twin bridges), located at Station 93+00 on the Neches River. The cost for this work was provided by TXDOT. The cost for the Taylors Bayou sheet Pile Wall was also included under this account code.

Navigational aids are placed in accordance with U.S. Coast Guard Standards and all the quantities and cost data were provided by the Coast Guard.

**ACCOUNT CODE 18 – CULTURAL RESOUCRCE PRESERVATION:** Cost for this account code was developed by the archeologist in SWG, Environmental Section, Planning and Environmental Branch.

**ACCOUNT CODE 30 -- ENGINEERING AND DESIGN:** The cost for this account was developed using the guidelines provided in the TPCS, with the agreement of the cost engineer and the project manager. In addition, the costs for survey and soil borings were provided by SWG, General Engineering Section and Geotechnical & Structures Sections in Engineering & Construction Division.

**ACCOUNT CODE 31 -- CONSTRUCTION MANAGEMENT:** The cost for this account was developed using the guidelines provided in the TPCS, with the agreement of the cost engineer and the project manager.

ATTACHMENT 13.2 - MII Estimate

July 2009 - SNWW - LPP
Feasibility Study

| | |
|---|---|
| Estimated by | J. Lockhart |
| Designed by | CESWG-EC-PS |
| Prepared by | U.S. Army Corps of Engineers Galveston District |
| Preparation Date | 7/10/2009 |
| Effective Date of Pricing | 10/1/2008 |
| Estimated Construction Time | Days |

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| Description | UOM | Quantity | DirectCost | ContractCost | ProjectCost |
|---|---|---|---|---|---|
| **Project Cost Summary Report** | | | **693,752,318** | **700,812,057** | **700,812,057** |
| **Expenditures for Study** | **LS** | **1.00** | **13,249,000** | **13,249,000** | **13,249,000** |
| **Reconnaissance Phase** | **LS** | **1.00** | **125,000** | **125,000** | **125,000** |
| **Feasibility Phase** | **LS** | **1.00** | **13,124,000** | **13,124,000** | **13,124,000** |
| **01 Contract 1 - Sabine Bank Sta 165+000 to 132+000** | **LS** | **1.00** | **52,355,825** | **52,724,883** | **52,724,883** |
| **0101 Non-Federal Costs** | **LS** | **1.00** | **1,299,615** | **1,668,673** | **1,668,673** |
| **010102 Relocations** | **LS** | **1.00** | **1,299,615** | **1,668,673** | **1,668,673** |
| **0102 Federal Costs** | **LS** | **1.00** | **51,056,210** | **51,056,210** | **51,056,210** |
| **010212 Navigation Ports and Harbors** | **LS** | **1.00** | **51,056,210** | **51,056,210** | **51,056,210** |
| **02 Contract 2 - Sabine Bank Sta 132+000 to 95+734** | **LS** | **1.00** | **24,449,335** | **24,449,335** | **24,449,335** |
| **0202 Federal Costs** | **LS** | **1.00** | **24,449,335** | **24,449,335** | **24,449,335** |
| **020212 Navigation Ports and Harbors** | **LS** | **1.00** | **24,449,335** | **24,449,335** | **24,449,335** |
| **03 Contract 3 - Sabine Bank Ch Sta 95+734 to 53+000** | **LS** | **1.00** | **27,962,068** | **28,182,119** | **28,182,119** |
| **0301 Non-Federal Costs** | **LS** | **1.00** | **774,897** | **994,948** | **994,948** |
| **030102 Relocations** | **LS** | **1.00** | **774,897** | **994,948** | **994,948** |
| **0302 Federal Costs** | **LS** | **1.00** | **27,187,171** | **27,187,171** | **27,187,171** |
| **030212 Navigation Ports and Harbors** | **LS** | **1.00** | **27,187,171** | **27,187,171** | **27,187,171** |
| **04 Contract 4 - Sab Pass Outer Bar Sta 53+000 to 0+000** | **LS** | **1.00** | **47,013,937** | **47,380,443** | **47,380,443** |
| **0401 Non-Federal Costs** | **LS** | **1.00** | **1,290,627** | **1,657,133** | **1,657,133** |
| **040102 Relocations** | **LS** | **1.00** | **1,290,627** | **1,657,133** | **1,657,133** |
| **0402 Federal Costs** | **LS** | **1.00** | **45,723,310** | **45,723,310** | **45,723,310** |
| **040212 Navigation Ports and Harbors** | **LS** | **1.00** | **45,723,310** | **45,723,310** | **45,723,310** |
| **05 Contract 5 - Sabine Pass Jetty Ch Sta -214+88 to 0+00** | **LS** | **1.00** | **15,498,540** | **15,498,540** | **15,498,540** |
| **0502 Federal Costs** | **LS** | **1.00** | **15,498,540** | **15,498,540** | **15,498,540** |
| **050212 Navigation Ports and Harbors** | **LS** | **1.00** | **15,498,540** | **15,498,540** | **15,498,540** |
| **06 Contract 6 - Sab Pass Ch Sta 0+00 to 296+25** | **LS** | **1.00** | **40,131,460** | **40,780,690** | **40,780,690** |

| Description | UOM | Quantity | DirectCost | ContractCost | ProjectCost |
|---|---|---|---|---|---|
| 0601 Non-Federal Costs | LS | 1.00 | 2,286,220 | 2,935,449 | 2,935,449 |
| 060102 Relocations | LS | 1.00 | 2,286,220 | 2,935,449 | 2,935,449 |
| 0602 Federal Costs | LS | 1.00 | 37,845,240 | 37,845,240 | 37,845,240 |
| 060212 Navigation Ports and Harbors | LS | 1.00 | 36,885,240 | 36,885,240 | 36,885,240 |
| 060218 Cultural Resources | LS | 1.00 | 960,000 | 960,000 | 960,000 |
| 07 Contract 7 - Pt Arthur Canal Sta 0+00 to 325+84, Taylor Bayou 0+00 to 106+24 | LS | 1.00 | 76,938,758 | 76,938,758 | 76,938,758 |
| 0701 Non-Federal Costs | LS | 1.00 | 879,710 | 879,710 | 879,710 |
| 070112 NavigationPorts & Harbor | EA | 1.00 | 879,710 | 879,710 | 879,710 |
| 0702 Federal Costs | LS | 1.00 | 76,059,048 | 76,059,048 | 76,059,048 |
| 070212 Navigation Ports and Harbors | LS | 1.00 | 76,059,048 | 76,059,048 | 76,059,048 |
| 08 Contract 8 - Sabine-Neches Canal Sta 0+00 to 170+00 | LS | 1.00 | 34,136,504 | 34,289,928 | 34,289,928 |
| 0801 Non-Federal Costs | LS | 1.00 | 540,272 | 693,696 | 693,696 |
| 080102 Relocations | LS | 1.00 | 540,272 | 693,696 | 693,696 |
| 0802 Federal Costs | LS | 1.00 | 33,596,232 | 33,596,232 | 33,596,232 |
| 080212 Navigation Ports and Harbors | LS | 1.00 | 33,596,232 | 33,596,232 | 33,596,232 |
| 09 Contract 9 - Sabine-Neches Canal Sta 170+00 to 592+93 | LS | 1.00 | 51,839,330 | 51,963,375 | 51,963,375 |
| 0901 Non-Federal Costs | LS | 1.00 | 436,817 | 560,862 | 560,862 |
| 090102 Relocations | LS | 1.00 | 436,817 | 560,862 | 560,862 |
| 0902 Federal Costs | LS | 1.00 | 51,402,513 | 51,402,513 | 51,402,513 |
| 09212 Navigation Ports and Harbors | LS | 1.00 | 51,402,513 | 51,402,513 | 51,402,513 |
| 10 Contract 10 - Neches River Ch Sta 0+00 to 292+00 | LS | 1.00 | 71,281,746 | 72,991,198 | 72,991,198 |
| 1001 Non-Federal Costs | LS | 1.00 | 7,417,357 | 9,126,809 | 9,126,809 |
| 100102 Relocations | LS | 1.00 | 6,019,727 | 7,729,179 | 7,729,179 |
| 100112 NavigationPorts & Harbor | EA | 1.00 | 1,397,630 | 1,397,630 | 1,397,630 |
| 1002 Federal Costs | LS | 1.00 | 63,864,389 | 63,864,389 | 63,864,389 |
| 100212 Navigation Ports and Harbors | LS | 1.00 | 63,864,389 | 63,864,389 | 63,864,389 |

| Description | UOM | Quantity | DirectCost | ContractCost | ProjectCost |
|---|---|---|---|---|---|
| 11 Contract 11 - Neches River Ch Sta 292+00 to 716+00 | LS | 1.00 | 94,177,162 | 97,645,135 | 97,645,135 |
| 1101 Non-Federal Costs | LS | 1.00 | 17,449,580 | 20,917,554 | 20,917,554 |
| 110102 Relocations | LS | 1.00 | 12,212,250 | 15,680,224 | 15,680,224 |
| 110112 NavigationPorts & Harbor | EA | 1.00 | 5,237,330 | 5,237,330 | 5,237,330 |
| 1102 Federal Costs | LS | 1.00 | 76,727,582 | 76,727,582 | 76,727,582 |
| 110212 Navigation Ports and Harbors | LS | 1.00 | 76,727,582 | 76,727,582 | 76,727,582 |
| 12 Contract 12 - Neches River Ch Sta 716+00 to 980+00 | LS | 1.00 | 85,111,124 | 85,111,124 | 85,111,124 |
| 1201 Non-Federal Costs | LS | 1.00 | 8,064,890 | 8,064,890 | 8,064,890 |
| 120112 NavigationPorts & Harbor | EA | 1.00 | 8,064,890 | 8,064,890 | 8,064,890 |
| 1202 Federal Costs | LS | 1.00 | 77,046,234 | 77,046,234 | 77,046,234 |
| 120212 Navigation Ports and Harbors | LS | 1.00 | 77,046,234 | 77,046,234 | 77,046,234 |
| 13 Contract 13 - Dredging Sabine Lake | LS | 1.00 | 21,495,876 | 21,495,876 | 21,495,876 |
| 1302 Federal Costs | LS | 1.00 | 21,495,876 | 21,495,876 | 21,495,876 |
| 13060212 Fish and Wildlife Facilities | EA | 1.00 | 21,495,876 | 21,495,876 | 21,495,876 |
| 14 Contract 14 - Channel to Orange | LS | 1.00 | 906,758 | 906,758 | 906,758 |
| 1402 Federal Costs | LS | 1.00 | 906,758 | 906,758 | 906,758 |
| 140206 Fish and Wildlife Facilities | LS | 1.00 | 906,758 | 906,758 | 906,758 |
| 15 Contract 15 - GIWW East of Orange | LS | 1.00 | 37,204,894 | 37,204,894 | 37,204,894 |
| 1502 Federal Costs | LS | 1.00 | 37,204,894 | 37,204,894 | 37,204,894 |
| 150206 Fish and Wildlife Facilities | LS | 1.00 | 37,204,894 | 37,204,894 | 37,204,894 |

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ATTACHMENT 13.3 – CSRA

US Army Corps
of Engineers®

# SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT

# FEASIBILITY RISK ANALYSIS FOR GALVESTON DISTRICT, TEXAS

*Prepared for:*

*U.S. Army Corps of Engineers, Galveston District*

*Prepared by:*

*U.S. Army Corps of Engineers, Walla Walla District*
*Engineering and Construction Division, Cost Engineering Branch*

August 14, 2009

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# EXECUTIVE SUMMARY

## PURPOSE

The purpose of this report is to document the results of the cost and schedule risk analysis (CSRA) performed for the Sabine-Neches Waterway (SNWW) Channel Improvement Project (CIP), located along the border between Texas and Louisiana. The CSRA reflects a feasibility level study under development by the U.S. Army Corps of Engineers (USACE), Galveston District.

## BACKGROUND

The single alternative plan selected for recommendation is also the national economic development (NED) plan and the locally preferred plan (LPP). The recommended plan calls for the following modifications to the existing SNWW:

- Deepening of the SNWW to Beaumont to 48 feet.
- Widening the SNWW by 700 feet from offshore in the Gulf of Mexico to the Port Arthur Canal.
- Deepening and widening of Taylors Bayou channels and turning basins.
- Construction of several turning and anchorage basins on the Neches River Channel.
- Tapering Sabine Bank Channel from 800 feet wide (Station 23+300) to 700 feet wide.

## SCOPE

The scope of the risk analysis report is to reflect the feasibility study and to calculate and present the cost contingencies at the 80 percent (P80) confidence level using the risk analysis processes as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for both cost and schedule risks for all construction features at feasibility level development.

The major project construction scope is comprised of dredging, utilizing both hopper and pipeline dredges depending upon location in relationship to the Gulf and inland waterway. The project scope also includes some efforts contributing to sea turtle protection, navigational aids, and mitigation such as plantings and relocations by the sponsor(s). Within the feasibility study and in consideration of contract acquisition in accomplishing the project construction, the plan was separated into 15 distinct contract estimates. In each contract, dredging is the major effort, consequently, carrying the greatest risks. Separating the project into separate contracts results in the ability to more efficiently fund, procure, manage, and construct the separate contracts, thereby, reducing risks. The contracts studied within the CSRA are:

- Contract 1: Sabine Bank – Sta 165+00 to 132+00.
- Contract 2: Sabine Bank – Sta 132+00 to 95+734.
- Contract 3: Sabine Bank Channel – Sta 95+734 to 53+000.
- Contract 4: Sabine Pass Outer Bar Jetty – Sta 53+000 to 0+000.
- Contract 5: Sabine Pass Outer Bar Jetty Channel Sta 214-88 to 0+00.
- Contract 6: Sabine Pass Channel Sta 0+00 to 295+60.
- Contract 7: Port Arthur Canal & Taylor Bayou.
- Contract 8: Sabine Neches Canal Sta 0+00 to 170+00.
- Contract 9: Sabine Neches Canal Sta 170+00 to 592+93.
- Contract 10: Neches River Channel Sta 0+00 to 292+00.
- Contract 11: Neches River Channel Sta 292+00 to 716+00.
- Contract 12: Neches River Channel Sta 716+00 to 980+00.
- Contract 13: Dredging Sabine Lake.
- Contract 14: Channel to Orange.
- Contract 15: GIWW East of Orange.

**RISK ANALYSIS PROCESS**

As required by USACE, the CSRA was developed using the Crystal Ball software. The Crystal Ball software relies on Excel-based spreadsheets for its model development. All 15 contracts within the study consist of dredging work and were estimated using the USACE Cost Engineering Dredge Estimating Program (CEDEP), which is Excel based. Those same Excel-based estimates were used as the model basis for the Crystal Ball risk analysis, incorporating both cost and schedule.

Specifically related to this project, it became apparent that the contracts related to dredging carried similar risks with a separate distinction made regarding the use of hopper dredges and pipeline dredges in certain contracts. For this reason, the risk analysis utilized the same risk events identified within the risk register to support the risk models and resulting contingencies. The study did recognize that the limited availability of hopper dredges and their use further into the Gulf present a higher degree of some risks as compared to the pipeline dredging work. This resulted in slightly higher contingencies for the hopper dredges.

**CONTINGENCY RESULTS**

The USACE Cost Engineering Directory of Expertise (DX) for Civil Works recommends risk analyses output reflect the P80 confidence level in successfully completing the project. The following table reflects those results for the fifteen specific contracts. These contingencies are reflected within the Total Project Cost Summary.

**Table ES-1. Contract Contingency Results - 80 Percent Confidence**

| Contract No. | Contract Description/Title | Type of Dredging Work | Contingency |
|---|---|---|---|
| Contract 1 | Sabine Bank – Sta 165+00 to 132+00 | Hopper | 33% |
| Contract 2 | Sabine Bank – Sta 132+00 to 95+734 | Hopper | 33% |
| Contract 3 | Sabine Bank Channel – Sta 95+734 to 53+000 | Hopper | 33% |
| Contract 4 | Sabine Pass Outer Bar Jetty – Sta 53+000 to 0+000 | Hopper | 33% |
| Contract 5 | Sabine Pass Outer Bar Jetty Channel Sta 214-88 to 0+00 | Hopper | 33% |
| Contract 6 | Sabine Pass Channel Sta 0+00 to 295+60 | Pipeline | 30% |
| Contract 7 | Port Arthur Canal & Taylor Bayou | Pipeline | 30% |
| Contract 8 | Sabine Neches Canal Sta 0+00 to 170+00 | Pipeline | 30% |
| Contract 9 | Sabine Neches Canal Sta 170+00 to 592+93 | Pipeline | 30% |
| Contract 10 | Neches River Channel Sta 0+00 to 292+00 | Pipeline | 30% |
| Contract 11 | Neches River Channel Sta 292+00 to 716+00 | Pipeline | 30% |
| Contract 12 | Neches River Channel Sta 716+00 to 980+00 | Pipeline | 30% |
| Contract 13 | Dredging Sabine Lake | Pipeline | 30% |
| Contract 14 | Channel to Orange | Pipeline | 30% |
| Contract 15 | GIWW East of Orange | Pipeline | 30% |

Note: Contingency % reflects an 80% confidence level.

Dredging Risks: The four most common risk concerns, related to dredging, carrying the greater risks were:

- Limited bid competition due to a shortage of dredge plants.
- Fuel price fluctuations, which greatly impact dredging costs.
- Limited geotechnical data of underwater materials.
- Scoping changes resulting in dredge quantity changes.

## 1. PURPOSE

The purpose of this report is to document the results of the cost and schedule risk analysis (CSRA) performed for the Sabine-Neches Waterway (SNWW) Channel Improvement Project (CIP), located along the border between Texas and Louisiana. The CSRA reflects a feasibility level study under development by the U.S. Army Corps of Engineers, Galveston District.

## 2. BACKGROUND

The single alternative plan selected for recommendation is also the national economic development (NED) plan and the locally preferred plan (LPP). The recommended plan calls for the following modifications to the existing SNWW:

- Deepening of the SNWW to Beaumont to 48 feet.
- Widening the SNWW by 700 feet from offshore in the Gulf of Mexico to the Port Arthur Canal.
- Deepening and widening of Taylors Bayou channels and turning basins.
- Construction of several turning and anchorage basins on the Neches River Channel.
- Tapering Sabine Bank Channel from 800 feet wide (Station 23+300) to 700 feet wide.

More in-depth project background information can be found within the Galveston District Feasibility Report.

## 3. SCOPE

The scope of the risk analysis report is to calculate and present the cost contingencies at the 80 percent confidence level using the risk analysis processes as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for both cost and schedule risks for all construction features.

The major project construction scope is comprised of dredging, utilizing both hopper and pipeline dredges depending upon location in relationship to the Gulf and inland waterway. The project scope also includes some efforts contributing to sea turtle protection, navigational aids, and mitigation such as plantings and relocations by the sponsor(s). Within the feasibility study and in consideration of contract acquisition in accomplishing the project construction, the plan was separated into 15 distinct contract estimates. In each contract, dredging is the major effort, consequently, carrying the greatest risks. The advantage of separating the project into separate contracts results in the ability to more efficiently fund, procure, manage, and construct the separate contracts, thereby, reducing risks. The contracts studied within the CSRA are:

- Contract 1: Sabine Bank – Sta 165+00 to 132+00.
- Contract 2: Sabine Bank – Sta 132+00 to 95+734.
- Contract 3: Sabine Bank Channel – Sta 95+734 to 53+000.
- Contract 4: Sabine Pass Outer Bar Jetty – Sta 53+000 to 0+000.
- Contract 5: Sabine Pass Outer Bar Jetty Channel Sta 214-88 to 0+00.
- Contract 6: Sabine Pass Channel Sta 0+00 to 295+60.
- Contract 7: Port Arthur Canal & Taylor Bayou.
- Contract 8: Sabine Neches Canal Sta 0+00 to 170+00.
- Contract 9: Sabine Neches Canal Sta 170+00 to 592+93.
- Contract 10: Neches River Channel Sta 0+00 to 292+00.
- Contract 11: Neches River Channel Sta 292+00 to 716+00.
- Contract 12: Neches River Channel Sta 716+00 to 980+00.
- Contract 13: Dredging Sabine Lake.
- Contract 14: Channel to Orange.
- Contract 15: GIWW East of Orange.

## 4. METHODOLOGY/PROCESS

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence. In simple terms, contingency is an amount added to an estimate (cost or schedule) to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The USACE Cost Engineering Directory of Expertise (DX) for Civil Works guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk adverse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes.

In addition to broadly defined risk analysis standards and recommended practices, the risk analysis is performed to meet the requirements and recommendations of the following documents and sources:

- Engineering Regulation ER 1110-2-1150 dated August 31, 1999.
- Engineering Regulation ER 1110-2-1302 dated September 15, 2008.
- Engineering Technical Letter 1110-2-573 dated September 30, 2008.
- Memorandum from Major General Don T. Riley (US Army Director of Civil Works), dated July 3, 2007.
- Engineering and Construction Bulletin issued by James C. Dalton, P.E. (Chief, Engineering and Construction, Directorate of Civil Works), dated September 10, 2007.
- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering DX.

Since the 15 contracts are dredging related, with the estimates developed within the USACE Cost Engineering Dredge Estimating Program (CEDEP), which is Excel based, the risk analysis used the CEDEP as the risk model basis, incorporating both cost and schedule. Noting that the hopper dredges carry somewhat different risks than the pipeline dredges, the two methods were modeled separately. The risk analysis results are provided in section 5.

### 4.1 Identify and Assess Risk Factors

Identifying the risk factors via the Project Development Team (PDT) is considered a qualitative process that results in establishing a risk register document. That risk register document then serves to support the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

The qualitative risks are captured and placed within the risk register format. That format is the basis used for establishing the quantitative risks and developing the Crystal Ball risk model. Specifically related to this project, it became apparent that the contracts carry quite similar risks because the major efforts within each contract require dredging. For this reason, the risk analysis utilized the same risk events identified within the risk register to support the risk models and resulting contingencies. The study did recognize that the limited availability of hopper dredges and their use further into the Gulf present a higher degree of some risks as compared to the pipeline dredging work. This resulted in slightly higher contingencies for the hopper dredging.

### 4.2 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The risk register reflects the results of risk factor identification and assessment, risk factor quantification, and contingency analysis. It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost

estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting risk analysis feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

The summary risk register in table 2 presents the risks related to the 15 contracts, considering internal and external risks. In the cases studied, the schedule analysis was incorporated into the cost analysis as another risk event related to productivity within the CEDEP estimates.

**Table 2. Dredging Risk Register**

| Risk No. | Risk/Opportunity Event | Discussion and Concerns | Likelihood* | Impact* | Risk Level* | Measurement / Adjustments | Risk Applied to |
|---|---|---|---|---|---|---|---|
| 1 | Bid Competition | Corps studies have determined an expected dredge shortage due to the many anticipated projects scheduled in the Gulf region. But a distinction must be made between hopper dredges and pipeline dredges. Pipeline dredges are more prevalent; therefore, hopper dredges carry a greater risk in bidding competition. The Acquisition planning of 15 contracts with shorter construction durations helps alleviate some of this concern. | VERY LIKELY | SIGNIFICANT | HIGH | Limited Bid Competition impacting Mobilization distance and contractor markups. | Profit & Plant Acquisition |
| 2 | Type of Dredged Material | Limited Geotechnical data of the dredged material may result in encountering unanticipated materials that could be more difficult to dredge that would impact productivity. | LIKELY | MARGINAL | MODERATE | Productivity - Duration | Production |
| 3 | Dredged Quantity (prism) | Dredging commonly results in changed quantities resulting from inadequate underwater surveys and underwater changes over time. There is potential that the dredging material prism could change. | LIKELY | MARGINAL | MODERATE | Volume - CY | Quantities |
| 4 | Scope Changes | As the designs are further developed, there is potential that the scope could change. | LIKELY | MARGINAL | MODERATE | Volume - CY | Quantities |
| 5 | Weather | Severe weather in the Gulf region can cause delays and possible remobilizations. To impact dredging, weather would have to be very severe. The severity would impact the gulf work for the hopper dredges more than the inland pipeline dredges. | UNLIKELY | SIGNIFICANT | MODERATE | Productivity - Duration | Production - Hopper |
| 6 | Schedule Constraints | Contract and environmental schedule constraints can cause delays, force acceleration, require larger dredges that may be unavailable due to competing needs. The greater schedule concern would be funding availability which studied under a different risk. | UNLIKELY | MARGINAL | LOW | Duration | N/A |
| 7 | Labor Availability/Pricing | Gulf region labor rates are fairly low when compared to national rates. Slower economy should keep the rates reasonable with little impact. | UNLIKELY | MARGINAL | LOW | Hourly Wage Rates | N/A |
| 8 | Dredge Acquisition | Corps studies have resulted in an expected dredge shortage as compared to the many anticipated projects in the Gulf region. Less competition is likely, resulting in higher bids. | LIKELY | SIGNIFICANT | HIGH | Equipment Rates | Plant Acquisition & Ownership |
| 9 | Current Fuel Prices | Fuel price fluctuations continue, but have stabilized on a steady upward trend. Dredge operations are significantly impacted by fuel usage and cost. Current estimate uses current fuel pricing. | VERY LIKELY | SIGNIFICANT | HIGH | Fuel $/Gal | Fuel |
| 10 | VE Opportunities | There seems to be little potential for efficiency gains with the dredging projects. "It is what it is." | VERY UNLIKELY | NEGLIGIBLE | LOW | Volume - CY | N/A |
| 11 | Inflation Increases | Inflationary costs could impact project costs in the long term. Volatile fuel pricing on a dredge project could exceed standard OMB inflation rates. Current estimate fuel pricing is considered conservative. | LIKELY | MARGINAL | MODERATE | Escalation comparisons | Fuel |

### 4.3 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are quantified using probability distributions (density functions), because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering, designers, and risk analysis team members with lesser inputs from other functions and disciplines.

The following is an example of the PDT quantifying risk factor impacts by using an iterative, consensus-building approach to estimate the elements of each risk factor:

- Maximum possible value for the risk factor.
- Minimum possible value for the risk factor.
- Most likely value (the statistical mode), if applicable.
- Nature of the probability density function used to approximate risk factor uncertainty.
- Mathematical correlations between risk factors.
- Affected cost estimate and schedule elements.

In this study, the risk discussions focused on the similar moderate and high risks common to the 15 contracts.since the PDT was more interested in the contingency management per contract The resulting product from the PDT discussions is captured within a single risk register as presented in the section above. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

### 4.4 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the base cost estimate. Each option-specific contingency is then

allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

## 5. RISK ANALYSIS RESULTS

### 5.1 Contingency Results at 80 Percent Confidence

The Cost Engineering DX recommends risk analyses output reflect the P80 confidence level in successfully completing the project. The following table reflects those results for the fifteen specific contracts. These contingencies are reflected within the Total Project Cost Summary.

**Table 3. Contract Contingency Results - 80 Percent Confidence**

| Contract No. | Contract Description/Title | Type of Dredging Work | Contingency |
|---|---|---|---|
| Contract 1 | Sabine Bank – Sta 165+00 to 132+00 | Hopper | 33% |
| Contract 2 | Sabine Bank – Sta 132+00 to 95+734 | Hopper | 33% |
| Contract 3 | Sabine Bank Channel – Sta 95+734 to 53+000 | Hopper | 33% |
| Contract 4 | Sabine Pass Outer Bar Jetty – Sta 53+000 to 0+000 | Hopper | 33% |
| Contract 5 | Sabine Pass Outer Bar Jetty Channel Sta 214-88 to 0+00 | Hopper | 33% |
| Contract 6 | Sabine Pass Channel Sta 0+00 to 295+60 | Pipeline | 30% |
| Contract 7 | Port Arthur Canal & Taylor Bayou | Pipeline | 30% |
| Contract 8 | Sabine Neches Canal Sta 0+00 to 170+00 | Pipeline | 30% |
| Contract 9 | Sabine Neches Canal Sta 170+00 to 592+93 | Pipeline | 30% |
| Contract 10 | Neches River Channel Sta 0+00 to 292+00 | Pipeline | 30% |
| Contract 11 | Neches River Channel Sta 292+00 to 716+00 | Pipeline | 30% |
| Contract 12 | Neches River Channel Sta 716+00 to 980+00 | Pipeline | 30% |
| Contract 13 | Dredging Sabine Lake | Pipeline | 30% |
| Contract 14 | Channel to Orange | Pipeline | 30% |
| Contract 15 | GIWW East of Orange | Pipeline | 30% |

Note: Contingency % reflects an 80% confidence level.

### 5.2 CSRA Contingency Tables

Depicted below in table 4 are the CSRA contingency results, making separate distinction between the hopper and the pipeline dredges. The tables present the contingency values and percents at a 5 percent confidence level interval. The 80 percent confidence results were applied against the dredging activities within the Total Project Cost Summary. Since the 30 and 31 Feature Accounts (Planning, Engineering and Design and the Construction Management) are based upon a percentage of the construction costs, the same contingency was applied. The 01 Feature Account of Lands and Damages received a 25 percent contingency based upon the Galveston District's Real Estate Office.

**Table 4. CSRA Contingency Tables**

| HOPPER DREDGE CONTINGENCY TABLE | |
|---|---|
| **Confidence Level** | **Contingency** |
| 0% | -35% |
| 5% | -10% |
| 10% | -5% |
| 15% | -2% |
| 20% | 1% |
| 25% | 4% |
| 30% | 6% |
| 35% | 9% |
| 40% | 11% |
| 45% | 13% |
| 50% | 16% |
| 55% | 18% |
| 60% | 21% |
| 65% | 23% |
| 70% | 26% |
| 75% | 29% |
| **80%** | **33%** |
| 85% | 37% |
| 90% | 42% |
| 95% | 50% |
| 100% | 104% |

| PIPELINE DREDGE CONTINGENCY TABLE | |
|---|---|
| **Confidence Level** | **Contingency** |
| 0% | -11% |
| 5% | 3% |
| 10% | 6% |
| 15% | 8% |
| 20% | 10% |
| 25% | 11% |
| 30% | 13% |
| 35% | 14% |
| 40% | 16% |
| 45% | 17% |
| 50% | 18% |
| 55% | 20% |
| 60% | 22% |
| 65% | 23% |
| 70% | 25% |
| 75% | 27% |
| **80%** | **30%** |
| 85% | 33% |
| 90% | 37% |
| 95% | 44% |
| 100% | 101% |

### 5.3 Model Sensitivity Analysis and Output

The sensitivity analysis output indicates the risk events carrying the greatest potential variance in cost and schedule that also result in the greatest risks. For this report, the sensitivity results are presented, making separate distinction between the hopper dredges and the pipeline dredges.

**Hopper Dredges**: The greatest sensitivity related to risk concerns for the hopper dredging were concern for:

- Limited bid competition due to a shortage of hopper dredge plants reflected in greater contractor profit.
- Fuel price fluctuations, which greatly impact dredging costs.
- Limited geotechnical data of underwater materials
- Scoping changes resulting in dredge quantity changes.

**Pipeline Dredges**: The greatest sensitivity related to risk concerns for the pipeline dredging were concern for:

- Fuel price fluctuations that carry a greater risk for dredging activities.
- Limited bid competition resulting in greater contractor profits.
- Scoping changes resulting in dredge quantity changes.

ATTACHMENT 13.4 – Total Project Cost Summary

****** TOTAL PROJECT COST SUMMARY ******



PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer

PREPARED: 7-Oct-09

This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

Cost ($1,000)

Estimate Prepared: 31-Jul-09
Effective Price Level: 1-Oct-09

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Spent Thru: 1 OCT 11 ($K) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02 | RELOCATIONS | 31,921 | 9,706 | 30% | 41,627 | 2.8% | 32,830 | 9,983 | 42,813 | - | 34,753 | 10,564 | 45,317 |
| 06 | FISH & WILDLIFE FACILITIES | 59,608 | 17,883 | 30% | 77,491 | 2.7% | 61,220 | 18,366 | 79,586 | - | 64,699 | 19,410 | 84,109 |
| 12 | NAVIGATION PORTS & HARBORS | | | | | | | | | | | | |
| | Non-Federal Cost | 15,580 | 4,674 | 30% | 20,254 | 2.7% | 16,002 | 4,799 | 20,801 | - | 16,791 | 5,037 | 21,828 |
| | Federal Cost | 579,495 | 178,767 | 31% | 758,262 | 2.7% | 595,162 | 183,601 | 778,763 | - | 628,569 | 193,887 | 822,456 |
| 18 | CULTURAL RESOURCE PRESERVATION | 960 | 288 | 30% | 1,248 | 2.7% | 986 | 296 | 1,282 | - | 1,068 | 321 | 1,389 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 687,564 | 211,318 | | **898,882** | | 706,200 | 217,045 | 923,245 | | 745,880 | 229,219 | 975,099 |
| 01 | LANDS AND DAMAGES | | | | | | | | | | | | |
| | Non-Federal Cost | 2,892 | 725 | 25% | 3,617 | 3.1% | 2,982 | 747 | 3,729 | - | 3,090 | 774 | 3,864 |
| | Federal Cost | 595 | 149 | 25% | 744 | 3.0% | 613 | 153 | 766 | - | 643 | 159 | 802 |
| | | | | - | - | | | | - | | | | |
| 30 | PLANNING, ENGINEERING & DESIGN | 80,879 | 24,833 | 31% | 105,712 | 2.7% | 83,071 | 25,501 | 108,572 | **13,249** | 86,707 | 26,613 | 126,569 |
| 31 | CONSTRUCTION MANAGEMENT | 48,129 | 14,792 | 31% | 62,921 | 2.7% | 49,433 | 15,190 | 64,623 | - | 52,237 | 16,050 | 68,287 |
| | **PROJECT COST TOTALS:** | 820,060 | 251,817 | 31% | **1,071,877** | | 842,299 | 258,636 | 1,100,935 | 13,249 | 888,557 | 272,815 | **1,174,621** |

| | |
|---|---|
| ESTIMATED FEDERAL COST: | **1,103,612** |
| ESTIMATED NON-FEDERAL COST: | **71,009** |
| **ESTIMATED TOTAL PROJECT COST:** | **1,174,621** |

CHIEF, Professional Services, Carl Anderson

Project Management, Byron D. Williams

CHIEF, REAL ESTATE, Orlando Rosa

CHIEF, PLANNING, Dolan Dunn

CHIEF, ENGINEERING, Peter Perez

CHIEF, OPERATIONS, Johnny Rozypal

CHIEF, CONSTRUCTION, John Curtis

CHIEF, CONTRACTING, Thomas Benero

CHIEF, PM-J, William A. Wise

CHIEF, DPM, Arthur Janecka

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

| | | Estimate Prepared: 2009(Jul - Sep) Effective Price Level: 2011(Oct - Dec) | | | | Program Year (Budget EC): 2012 Effective Price Level Date: 1 OCT 11 | | | | FULLY FUNDED PROJECT ESTIMATE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WBS | Civil Works | COST | CNTG | CNTG | TOTAL | ESC | COST | CNTG | TOTAL | Mid-Point | ESC | COST | CNTG | FULL |
| NUMBER | Feature & Sub-Feature Description | ($K) | ($K) | (%) | ($K) | (%) | ($K) | ($K) | ($K) | Date | (%) | ($K) | ($K) | ($K) |
| | Contract #1 - Sabine Bank Sta 165+000 to 132+000 | | | | | | | | | | | | | |
| 02 | RELOCATIONS | 1,669 | 551 | 33% | 2,220 | 2.8% | 1,717 | 567 | 2,284 | | | 1,717 | 567 | 2,284 |
| 12 | NAVIGATION PORTS & HARBORS | 51,056 | 16,848 | 33% | 67,904 | 2.7% | 52,436 | 17,304 | 69,740 | | 0.9% | 52,885 | 17,452 | 70,337 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 52,725 | 17,399 | 33% | **70,124** | | 54,153 | 17,871 | 72,024 | | | 54,602 | 18,019 | 72,621 |
| 01 | LANDS AND DAMAGES | - | - | | - | | | | | - | | | | |
| 22 | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| 30 | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 527 | 174 | 33% | 701 | 2.7% | 542 | 179 | 721 | 2012Q1 | | 542 | 179 | 721 |
| *1.0%* | Planning & Environmental Compliance | 527 | 174 | 33% | 701 | 2.7% | 542 | 179 | 721 | 2012Q1 | | 542 | 179 | 721 |
| *5.0%* | Engineering & Design | 2,636 | 870 | 33% | 3,506 | 2.7% | 2,708 | 894 | 3,602 | 2012Q1 | | 2,708 | 894 | 3,602 |
| *1.0%* | Engineering Tech Review ITR & VE | 527 | 174 | 33% | 701 | 2.7% | 542 | 179 | 721 | 2012Q1 | | 542 | 179 | 721 |
| *1.0%* | Contracting & Reprographics | 527 | 174 | 33% | 701 | 2.7% | 542 | 179 | 721 | 2012Q1 | | 542 | 179 | 721 |
| *2.0%* | Engineering During Construction | 1,055 | 348 | 33% | 1,403 | 2.7% | 1,083 | 357 | 1,440 | 2012Q3 | 0.9% | 1,092 | 360 | 1,452 |
| *0.1%* | Surveys - Hydro | 28 | 9 | 33% | 37 | 2.7% | 29 | 9 | 38 | 2012Q3 | 0.9% | 29 | 9 | 38 |
| *0.1%* | Soil Boring & Testing | 40 | 13 | 33% | 53 | 2.7% | 41 | 13 | 54 | 2012Q1 | | 41 | 13 | 54 |
| 31 | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 3,164 | 1,044 | 33% | 4,208 | 2.7% | 3,249 | 1,072 | 4,321 | 2012Q3 | 0.9% | 3,277 | 1,081 | 4,358 |
| | Project Operation: | | | | | | | | | | | | | |
| *1.0%* | Project Management | 527 | 174 | 33% | 701 | 2.7% | 542 | 179 | 721 | 2012Q3 | 0.9% | 547 | 181 | 728 |
| | **CONTRACT COST TOTALS:** | 62,284 | 20,553 | | **82,837** | | 63,973 | 21,111 | 85,084 | | | 64,464 | 21,273 | **85,737** |

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | FULLY FUNDED PROJECT ESTIMATE Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #2 - Sabine Bank Sta 132+00 to 95+734 | | | | | | | | | | | | | |
| 12 | NAVIGATION PORTS & HARBORS | 24,449 | 8,068 | 33% | 32,517 | 2.7% | 25,110 | 8,286 | 33,396 | 2014Q1 | 3.6% | 26,012 | 8,584 | 34,596 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 24,449 | 8,068 | 33% | **32,517** | | 25,110 | 8,286 | 33,396 | | | 26,012 | 8,584 | 34,596 |
| 01 | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| 22 | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| 30 | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 244 | 81 | 33% | 325 | 2.7% | 251 | 83 | 334 | 2013Q3 | 2.7% | 258 | 85 | 343 |
| *1.0%* | Planning & Environmental Compliance | 244 | 81 | 33% | 325 | 2.7% | 251 | 83 | 334 | 2013Q3 | 2.7% | 258 | 85 | 343 |
| *5.0%* | Engineering & Design | 1,222 | 403 | 33% | 1,625 | 2.7% | 1,256 | 414 | 1,670 | 2013Q3 | 2.7% | 1,290 | 425 | 1,715 |
| *1.0%* | Engineering Tech Review & VE | 244 | 81 | 33% | 325 | 2.7% | 251 | 83 | 334 | 2013Q3 | 2.7% | 258 | 85 | 343 |
| *1.0%* | Contracting & Reprographics | 244 | 81 | 33% | 325 | 2.7% | 251 | 83 | 334 | 2013Q3 | 2.7% | 258 | 85 | 343 |
| *2.0%* | Engineering During Construction | 489 | 161 | 33% | 650 | 2.7% | 502 | 165 | 667 | 2014Q1 | 3.6% | 520 | 171 | 691 |
| *0.1%* | Surveys - Hydro | 30 | 10 | 33% | 40 | 2.7% | 31 | 10 | 41 | 2014Q1 | 3.6% | 32 | 10 | 42 |
| *0.2%* | Soil Boring & Testing | 40 | 13 | 33% | 53 | 2.7% | 41 | 13 | 54 | 2013Q3 | 2.7% | 42 | 13 | 55 |
| 31 | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 1,467 | 484 | 33% | 1,951 | 2.7% | 1,507 | 497 | 2,004 | 2014Q1 | 3.6% | 1,561 | 515 | 2,076 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 244 | 81 | 33% | 325 | 2.7% | 251 | 83 | 334 | 2014Q1 | 3.6% | 260 | 86 | 346 |
| | **CONTRACT COST TOTALS:** | 28,920 | 9,544 | | **38,464** | | 29,702 | 9,800 | 39,502 | | | 30,749 | 10,144 | **40,893** |

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #3 -Sabine Bank Sta 95+734 to 53+000 | | | | | | | | | | | | | |
| **02** | RELOCATIONS | 995 | 328 | 33% | 1,323 | 2.8% | 1,023 | 337 | 1,360 | 2014Q3 | 4.5% | 1,069 | 352 | 1,421 |
| **12** | NAVIGATION PORTS & HARBORS | 27,187 | 8,972 | 33% | 36,159 | 2.7% | 27,922 | 9,215 | 37,137 | 2015Q2 | 5.9% | 29,579 | 9,762 | 39,341 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 28,182 | 9,300 | 33% | **37,482** | | 28,945 | 9,552 | 38,497 | | | 30,648 | 10,114 | 40,762 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 282 | 93 | 33% | 375 | 2.7% | 289 | 96 | 385 | 2014Q3 | 4.5% | 302 | 100 | 402 |
| *1.0%* | Planning & Environmental Compliance | 282 | 93 | 33% | 375 | 2.7% | 289 | 96 | 385 | 2014Q3 | 4.5% | 302 | 100 | 402 |
| *5.0%* | Engineering & Design | 1,409 | 465 | 33% | 1,874 | 2.7% | 1,447 | 478 | 1,925 | 2014Q3 | 4.5% | 1,513 | 500 | 2,013 |
| *1.0%* | Engineering Tech Review & VE | 282 | 93 | 33% | 375 | 2.7% | 289 | 96 | 385 | 2014Q3 | 4.5% | 302 | 100 | 402 |
| *1.0%* | Contracting & Reprographics | 282 | 93 | 33% | 375 | 2.7% | 289 | 96 | 385 | 2014Q3 | 4.5% | 302 | 100 | 402 |
| *2.0%* | Engineering During Construction | 564 | 186 | 33% | 750 | 2.7% | 579 | 191 | 770 | 2015Q2 | 5.9% | 613 | 202 | 815 |
| *0.1%* | Surveys - Hydro | 25 | 8 | 33% | 33 | 2.7% | 26 | 8 | 34 | 2015Q2 | 5.9% | 28 | 8 | 36 |
| *0.1%* | Soil Boring & Testing | 23 | 8 | 33% | 31 | 2.7% | 24 | 8 | 32 | 2014Q3 | 4.5% | 25 | 8 | 33 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 1,691 | 558 | 33% | 2,249 | 2.7% | 1,737 | 573 | 2,310 | 2015Q2 | 5.9% | 1,840 | 607 | 2,447 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 282 | 93 | 33% | 375 | 2.7% | 289 | 96 | 385 | 2015Q2 | 5.9% | 306 | 102 | 408 |
| | **CONTRACT COST TOTALS:** | 33,303 | 10,990 | | **44,293** | | 34,203 | 11,290 | 45,493 | | | 36,181 | 11,941 | **48,122** |

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #4 - Sabine Pass Outer Bar Jetty Ch Sta 53+000 to 0+000 | | | | | | | | | | | | | |
| **02** | RELOCATIONS | 1,657 | 547 | 33% | 2,204 | 2.8% | 1,704 | 563 | 2,267 | 2015Q3 | 6.4% | 1,813 | 599 | 2,412 |
| **12** | NAVIGATION PORTS & HARBORS | 45,723 | 15,089 | 33% | 60,812 | 2.7% | 46,959 | 15,497 | 62,456 | 2016Q4 | 8.8% | 51,099 | 16,863 | 67,962 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 47,380 | 15,636 | 33% | **63,016** | | 48,663 | 16,060 | 64,723 | | | 52,912 | 17,462 | 70,374 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 474 | 156 | 33% | 630 | 2.7% | 487 | 160 | 647 | 2015Q3 | 6.4% | 518 | 170 | 688 |
| *1.0%* | Planning & Environmental Compliance | 474 | 156 | 33% | 630 | 2.7% | 487 | 160 | 647 | 2015Q3 | 6.4% | 518 | 170 | 688 |
| *5.0%* | Engineering & Design | 2,369 | 782 | 33% | 3,151 | 2.7% | 2,433 | 803 | 3,236 | 2015Q3 | 6.4% | 2,589 | 855 | 3,444 |
| *1.0%* | Engineering Tech Review & VE | 474 | 156 | 33% | 630 | 2.7% | 487 | 160 | 647 | 2015Q3 | 6.4% | 518 | 170 | 688 |
| *1.0%* | Contracting & Reprographics | 474 | 156 | 33% | 630 | 2.7% | 487 | 160 | 647 | 2015Q3 | 6.4% | 518 | 170 | 688 |
| *2.0%* | Engineering During Construction | 948 | 313 | 33% | 1,261 | 2.7% | 973 | 321 | 1,294 | 2016Q4 | 8.8% | 1,059 | 349 | 1,408 |
| *0.1%* | Surveys - Hydro | 38 | 13 | 33% | 51 | 2.7% | 39 | 13 | 52 | 2016Q4 | 8.8% | 42 | 14 | 56 |
| *0.1%* | Soil Boring & Testing | 35 | 12 | 33% | 47 | 2.7% | 36 | 12 | 48 | 2015Q3 | 6.4% | 38 | 13 | 51 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 2,843 | 938 | 33% | 3,781 | 2.7% | 2,920 | 963 | 3,883 | 2016Q4 | 8.8% | 3,177 | 1,048 | 4,225 |
| *1.0%* | Project Operation: Project Management | 474 | 156 | 33% | 630 | 2.7% | 487 | 160 | 647 | - 2016Q4 | 8.8% | 530 | 174 | 704 |
| | **CONTRACT COST TOTALS:** | 55,981 | 18,474 | | **74,455** | | 57,499 | 18,972 | 76,471 | | | 62,419 | 20,595 | **83,014** |

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #5 - Sabine Pass Outer Bar Jetty Ch Sta -214+88 to 0+00 | | | | | | | | | | | | | |
| **12** | NAVIGATION PORTS & HARBORS | 15,499 | 5,115 | 33% | 20,614 | 2.7% | 15,918 | 5,253 | 21,171 | 2017Q3 | 10.3% | 17,554 | 5,793 | 23,347 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 15,499 | 5,115 | 33% | **20,614** | | 15,918 | 5,253 | 21,171 | | | 17,554 | 5,793 | 23,347 |
| **22** | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 155 | 51 | 33% | 206 | 2.7% | 159 | 52 | 211 | 2017Q1 | 9.3% | 174 | 57 | 231 |
| *1.0%* | Planning & Environmental Compliance | 155 | 51 | 33% | 206 | 2.7% | 159 | 52 | 211 | 2017Q1 | 9.3% | 174 | 57 | 231 |
| *5.0%* | Engineering & Design | 775 | 256 | 33% | 1,031 | 2.7% | 796 | 263 | 1,059 | 2017Q1 | 9.3% | 870 | 287 | 1,157 |
| *1.0%* | Engineering Tech Review ITR & VE | 155 | 51 | 33% | 206 | 2.7% | 159 | 52 | 211 | 2017Q1 | 9.3% | 174 | 57 | 231 |
| *1.0%* | Contracting & Reprographics | 155 | 51 | 33% | 206 | 2.7% | 159 | 52 | 211 | 2017Q1 | 9.3% | 174 | 57 | 231 |
| *2.0%* | Engineering During Construction | 310 | 102 | 33% | 412 | 2.7% | 318 | 105 | 423 | 2017Q3 | 10.3% | 351 | 116 | 467 |
| *0.3%* | Surveys - Hydro | 50 | 17 | 33% | 67 | 2.7% | 51 | 17 | 68 | 2017Q3 | 10.3% | 56 | 19 | 75 |
| *0.3%* | Soil Boring & Testing | 46 | 15 | 33% | 61 | 2.7% | 47 | 15 | 62 | 2017Q1 | 9.3% | 51 | 16 | 67 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 930 | 307 | 33% | 1,237 | 2.7% | 955 | 315 | 1,270 | 2017Q3 | 10.3% | 1,053 | 347 | 1,400 |
| | Project Operation: | | | | | | | | | | | | | |
| *1.0%* | Project Management | 155 | 51 | 33% | 206 | 2.7% | 159 | 52 | 211 | 2017Q3 | 10.3% | 175 | 57 | 232 |
| | **CONTRACT COST TOTALS:** | 18,385 | 6,067 | | **24,452** | | 18,880 | 6,228 | 25,108 | | | 20,806 | 6,863 | **27,669** |

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #6 - Sabine Pass Ch Sta 0+00 to 295+60 | | | | | | | | | | | | | |
| **02** | RELOCATIONS | 2,936 | 881 | 30% | 3,817 | 2.8% | 3,020 | 906 | 3,926 | 2016Q3 | 8.3% | 3,272 | 981 | 4,253 |
| **12** | NAVIGATION PORTS & HARBORS | 36,885 | 11,066 | 30% | 47,951 | 2.7% | 37,882 | 11,365 | 49,247 | 2017Q1 | 9.3% | 41,401 | 12,421 | 53,822 |
| **18** | CULTURAL RESOURCE PRESERVATION | 960 | 288 | 30% | 1,248 | 2.7% | 986 | 296 | 1,282 | 2016Q3 | 8.3% | 1,068 | 321 | 1,389 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 40,781 | 12,235 | 30% | **53,016** | | 41,888 | 12,567 | 54,455 | | | 45,741 | 13,723 | 59,464 |
| **01** | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| | Non-Fed Cost | 827 | 207 | 25% | 1,034 | 4.2% | 862 | 216 | 1,078 | 2016Q1 | 7.4% | 925 | 232 | 1,157 |
| | Federal cost | 102 | 26 | 25% | 128 | 4.2% | 106 | 27 | 133 | 2016Q1 | 7.4% | 114 | 29 | 143 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 408 | 122 | 30% | 530 | 2.7% | 419 | 125 | 544 | 2016Q3 | 6.7% | 447 | 133 | 580 |
| *1.0%* | Planning & Environmental Compliance | 408 | 122 | 30% | 530 | 2.7% | 419 | 125 | 544 | 2016Q3 | 6.7% | 447 | 133 | 580 |
| *5.0%* | Engineering & Design | 2,039 | 612 | 30% | 2,651 | 2.7% | 2,094 | 629 | 2,723 | 2016Q3 | 6.7% | 2,235 | 671 | 2,906 |
| *1.0%* | Engineering Tech Review & VE | 408 | 122 | 30% | 530 | 2.7% | 419 | 125 | 544 | 2016Q3 | 6.7% | 447 | 133 | 580 |
| *1.0%* | Contracting & Reprographics | 408 | 122 | 30% | 530 | 2.7% | 419 | 125 | 544 | 2016Q3 | 6.7% | 447 | 133 | 580 |
| *2.0%* | Engineering During Construction | 816 | 245 | 30% | 1,061 | 2.7% | 838 | 252 | 1,090 | 2017Q1 | 9.3% | 916 | 275 | 1,191 |
| *1.0%* | Surveys - Hydro | 405 | 122 | 30% | 527 | 2.7% | 416 | 125 | 541 | 2017Q1 | 9.3% | 455 | 137 | 592 |
| *1.0%* | Surveys - Land | 405 | 122 | 30% | 527 | 2.7% | 416 | 125 | 541 | 2017Q1 | 9.3% | 455 | 137 | 592 |
| *0.2%* | Soil Boring & Testing | 90 | 27 | 30% | 117 | 2.7% | 92 | 28 | 120 | 2016Q3 | 6.7% | 98 | 30 | 128 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 2,447 | 734 | 30% | 3,181 | 2.7% | 2,513 | 754 | 3,267 | 2017Q1 | 9.3% | 2,746 | 824 | 3,570 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 408 | 122 | 30% | 530 | 2.7% | 419 | 125 | 544 | 2017Q1 | 9.3% | 458 | 137 | 595 |
| | **CONTRACT COST TOTALS:** | 49,951 | 14,940 | | **64,891** | | 51,320 | 15,348 | 66,668 | | | 55,931 | 16,727 | **72,658** |

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | FULLY FUNDED PROJECT ESTIMATE Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #7 -Pt Arthur Canal & Taylor Bayou | | | | | | | | | | | | | |
| 12 | NAVIGATION PORTS & HARBORS | | | | | | | | | - | | | | |
| | Non-Fed Cost | 880 | 264 | 30% | 1,144 | 2.7% | 904 | 271 | 1,175 | 2013Q4 | 3.1% | 932 | 280 | 1,212 |
| | Federal cost | 76,059 | 22,818 | 30% | 98,877 | 2.7% | 78,115 | 23,435 | 101,550 | 2013Q4 | 3.1% | 80,571 | 24,172 | 104,743 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 76,939 | 23,082 | 30% | 100,021 | | 79,019 | 23,706 | 102,725 | | | 81,503 | 24,452 | 105,955 |
| 01 | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| | Non-Fed Cost | 639 | 160 | 25% | 799 | 2.7% | 656 | 164 | 820 | 2012Q4 | 1.3% | 664 | 166 | 830 |
| | Federal cost | 64 | 16 | 25% | 80 | 2.7% | 66 | 16 | 82 | 2012Q4 | 1.3% | 67 | 16 | 83 |
| 22 | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| 30 | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 769 | 231 | 30% | 1,000 | 2.7% | 790 | 237 | 1,027 | 2012Q1 | | 790 | 237 | 1,027 |
| *1.0%* | Planning & Environmental Compliance | 769 | 231 | 30% | 1,000 | 2.7% | 790 | 237 | 1,027 | 2012Q1 | | 790 | 237 | 1,027 |
| *5.0%* | Engineering & Design | 3,847 | 1,154 | 30% | 5,001 | 2.7% | 3,951 | 1,185 | 5,136 | 2012Q1 | | 3,951 | 1,185 | 5,136 |
| *1.0%* | Engineering Tech Review & VE | 769 | 231 | 30% | 1,000 | 2.7% | 790 | 237 | 1,027 | 2012Q1 | | 790 | 237 | 1,027 |
| *1.0%* | Contracting & Reprographics | 769 | 231 | 30% | 1,000 | 2.7% | 790 | 237 | 1,027 | 2012Q1 | | 790 | 237 | 1,027 |
| *2.0%* | Engineering During Construction | 1,539 | 462 | 30% | 2,001 | 2.7% | 1,580 | 474 | 2,054 | 2013Q4 | 3.1% | 1,630 | 489 | 2,119 |
| | Planning During Construction | | | 30% | | | | | | - | | | | |
| *0.9%* | Surveys - Hydro | 353 | 106 | 30% | 459 | 2.7% | 363 | 109 | 472 | 2013Q4 | 3.1% | 374 | 112 | 486 |
| *0.9%* | Surveys - Land | 353 | 106 | 30% | 459 | 2.7% | 363 | 109 | 472 | 2013Q4 | 3.1% | 374 | 112 | 486 |
| *0.2%* | Soil Boring & Testing | 96 | 29 | 30% | 125 | 2.7% | 99 | 30 | 129 | 2012Q1 | | 99 | 30 | 129 |
| 31 | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 4,616 | 1,385 | 30% | 6,001 | 2.7% | 4,741 | 1,422 | 6,163 | 2013Q4 | 3.1% | 4,890 | 1,467 | 6,357 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 769 | 231 | 30% | 1,000 | 2.7% | 790 | 237 | 1,027 | 2013Q4 | 3.1% | 815 | 244 | 1,059 |
| | **CONTRACT COST TOTALS:** | 92,293 | 27,655 | | **119,948** | | 94,788 | 28,400 | 123,188 | | | 97,527 | 29,221 | **126,748** |

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #8 - Sabine Neches Canal Sta 0+00 tp 170+00 | | | | | | | | | | | | | |
| **02** | RELOCATIONS | 694 | 208 | 30% | 902 | 2.8% | 714 | 214 | 928 | 2017Q1 | 9.3% | 780 | 234 | 1,014 |
| **12** | NAVIGATION PORTS & HARBORS | 33,596 | 10,079 | 30% | 43,675 | 2.7% | 34,504 | 10,352 | 44,856 | 2018Q2 | 11.8% | 38,562 | 11,569 | 50,131 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 34,290 | 10,287 | 30% | **44,577** | | 35,218 | 10,566 | 45,784 | | | 39,342 | 11,803 | 51,145 |
| **01** | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| | Non-Fed Cost | 70 | 18 | 25% | 88 | 2.7% | 72 | 18 | 90 | 2017Q2 | 9.8% | 79 | 20 | 99 |
| | Federal cost | 60 | 15 | 25% | 75 | 2.7% | 62 | 15 | 77 | 2017Q2 | 9.8% | 68 | 16 | 84 |
| **22** | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 343 | 103 | 30% | 446 | 2.7% | 352 | 106 | 458 | 2017Q2 | 9.8% | 386 | 116 | 502 |
| *1.0%* | Planning & Environmental Compliance | 343 | 103 | 30% | 446 | 2.7% | 352 | 106 | 458 | 2017Q2 | 9.8% | 386 | 116 | 502 |
| *5.0%* | Engineering & Design | 1,715 | 514 | 30% | 2,229 | 2.7% | 1,761 | 528 | 2,289 | 2017Q2 | 9.8% | 1,933 | 580 | 2,513 |
| *1.0%* | Engineering Tech Review & VE | 343 | 103 | 30% | 446 | 2.7% | 352 | 106 | 458 | 2017Q2 | 9.8% | 386 | 116 | 502 |
| *1.0%* | Contracting & Reprographics | 343 | 103 | 30% | 446 | 2.7% | 352 | 106 | 458 | 2017Q2 | 9.8% | 386 | 116 | 502 |
| *2.0%* | Engineering During Construction | 686 | 206 | 30% | 892 | 2.7% | 704 | 212 | 916 | 2018Q2 | 11.8% | 787 | 237 | 1,024 |
| *0.1%* | Surveys - Hydro | 13 | 4 | 30% | 17 | 2.7% | 13 | 4 | 17 | 2017Q2 | 11.8% | 15 | 4 | 19 |
| *0.3%* | Soil Boring & Testing | 52 | 16 | 30% | 68 | 2.7% | 53 | 16 | 69 | 2018Q2 | 9.8% | 58 | 18 | 76 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 2,057 | 617 | 30% | 2,674 | 2.7% | 2,113 | 634 | 2,747 | 2018Q2 | 11.8% | 2,361 | 709 | 3,070 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 343 | 103 | 30% | 446 | 2.7% | 352 | 106 | 458 | 2018Q2 | 11.8% | 393 | 118 | 511 |
| | **CONTRACT COST TOTALS:** | 40,657 | 12,192 | | **52,849** | | 41,756 | 12,523 | 54,279 | | | 46,580 | 13,969 | **60,549** |

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #9 - Sabine Neches Canal Sta 170+00 to 592+93 | | | | | | | | | | | | | |
| **02** | RELOCATIONS | 561 | 168 | 30% | 729 | 2.8% | 577 | 173 | 750 | 2014Q1 | 6.8% | 616 | 185 | 801 |
| **12** | NAVIGATION PORTS & HARBORS | 51,403 | 15,421 | 30% | 66,824 | 2.7% | 52,793 | 15,838 | 68,631 | 2015Q3 | 6.4% | 56,179 | 16,854 | 73,033 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 51,964 | 15,589 | 30% | **67,553** | | 53,370 | 16,011 | 69,381 | | | 56,795 | 17,039 | 73,834 |
| **01** | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| | Non-Fed Cost | 70 | 18 | 25% | 88 | 2.7% | 72 | 18 | 90 | 2014Q3 | 4.5% | 75 | 19 | 94 |
| | Federal cost | 60 | 15 | 25% | 75 | 2.7% | 62 | 15 | 77 | 2014Q3 | 4.5% | 65 | 16 | 81 |
| **22** | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 520 | 156 | 30% | 676 | 2.7% | 534 | 160 | 694 | 2014Q1 | 3.6% | 553 | 166 | 719 |
| *1.0%* | Planning & Environmental Compliance | 520 | 156 | 30% | 676 | 2.7% | 534 | 160 | 694 | 2014Q1 | 3.6% | 553 | 166 | 719 |
| *5.0%* | Engineering & Design | 2,598 | 779 | 30% | 3,377 | 2.7% | 2,668 | 800 | 3,468 | 2014Q1 | 3.6% | 2,764 | 829 | 3,593 |
| *1.0%* | Engineering Tech Review & VE | 520 | 156 | 30% | 676 | 2.7% | 534 | 160 | 694 | 2014Q1 | 3.6% | 553 | 166 | 719 |
| *1.0%* | Contracting & Reprographics | 520 | 156 | 30% | 676 | 2.7% | 534 | 160 | 694 | 2014Q1 | 3.6% | 553 | 166 | 719 |
| *2.0%* | Engineering During Construction | 1,039 | 312 | 30% | 1,351 | 2.7% | 1,067 | 320 | 1,387 | 2015Q3 | 6.4% | 1,135 | 341 | 1,476 |
| *0.2%* | Surveys - Hydro | 80 | 24 | 30% | 104 | 2.7% | 82 | 25 | 107 | 2015Q3 | 6.4% | 87 | 27 | 114 |
| *0.2%* | Surveys - Land | 80 | 24 | 30% | 104 | 2.7% | 82 | 25 | 107 | 2015Q3 | 6.4% | 87 | 27 | 114 |
| *0.1%* | Soil Boring & Testing | 70 | 21 | 30% | 91 | 2.7% | 72 | 22 | 94 | 2014Q1 | 3.6% | 75 | 23 | 98 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 3,118 | 935 | 30% | 4,053 | 2.7% | 3,202 | 960 | 4,162 | 2015Q3 | 6.4% | 3,407 | 1,022 | 4,429 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 520 | 156 | 30% | 676 | 2.7% | 534 | 160 | 694 | 2015Q3 | 6.4% | 568 | 170 | 738 |
| | **CONTRACT COST TOTALS:** | 61,678 | 18,497 | | **80,175** | | 63,347 | 18,996 | 82,343 | | | 67,270 | 20,177 | **87,447** |

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #10 - Neches River Channel Sta 0+00 to 292+00 | | | | | | | | | | | | | |
| 02 | RELOCATIONS | 7,729 | 2,319 | 30% | 10,048 | 2.8% | 7,949 | 2,385 | 10,334 | 2012Q3 | 0.9% | 8,017 | 2,405 | 10,422 |
| 12 | NAVIGATION PORTS & HARBORS | | | | | | | | | | | | | |
| | Non-Fed Cost | 1,398 | 419 | 30% | 1,817 | 2.7% | 1,436 | 430 | 1,866 | 2013Q3 | 2.7% | 1,475 | 442 | 1,917 |
| | Federal cost | 63,864 | 19,159 | 30% | 83,023 | 2.7% | 65,591 | 19,677 | 85,268 | 2013Q3 | 2.7% | 67,351 | 20,205 | 87,556 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 72,991 | 21,897 | 30% | 94,888 | | 74,976 | 22,492 | 97,468 | | | 76,843 | 23,052 | 99,895 |
| 01 | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| | Non-Fed Cost | 110 | 28 | 25% | 138 | 2.7% | 113 | 29 | 142 | 2012Q3 | 0.9% | 114 | 29 | 143 |
| | Federal cost | 85 | 21 | 25% | 106 | 2.7% | 87 | 22 | 109 | 2012Q3 | 0.9% | 88 | 22 | 110 |
| 22 | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| 30 | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 730 | 219 | 30% | 949 | 2.7% | 750 | 225 | 975 | 2012Q3 | 0.9% | 756 | 227 | 983 |
| *1.0%* | Planning & Environmental Compliance | 730 | 219 | 30% | 949 | 2.7% | 750 | 225 | 975 | 2012Q3 | 0.9% | 756 | 227 | 983 |
| *5.0%* | Engineering & Design | 3,650 | 1,095 | 30% | 4,745 | 2.7% | 3,748 | 1,125 | 4,873 | 2012Q3 | 0.9% | 3,780 | 1,135 | 4,915 |
| *1.0%* | Engineering Tech Review & VE | 730 | 219 | 30% | 949 | 2.7% | 750 | 225 | 975 | 2012Q3 | 0.9% | 756 | 227 | 983 |
| *1.0%* | Contracting & Reprographics | 730 | 219 | 30% | 949 | 2.7% | 750 | 225 | 975 | 2012Q3 | 0.9% | 756 | 227 | 983 |
| *2.0%* | Engineering During Construction | 1,460 | 438 | 30% | 1,898 | 2.7% | 1,499 | 450 | 1,949 | 2013Q3 | 2.7% | 1,539 | 462 | 2,001 |
| *0.3%* | Surveys - Hydro | 213 | 64 | 30% | 277 | 2.7% | 219 | 66 | 285 | 2013Q3 | 2.7% | 225 | 68 | 293 |
| *0.3%* | Surveys - Land | 213 | 64 | 30% | 277 | 2.7% | 219 | 66 | 285 | 2013Q3 | 2.7% | 225 | 68 | 293 |
| *0.2%* | Soil Boring & Testing | 179 | 54 | 30% | 233 | 2.7% | 184 | 55 | 239 | 2012Q3 | 0.9% | 186 | 55 | 241 |
| 31 | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 4,379 | 1,314 | 30% | 5,693 | 2.7% | 4,498 | 1,350 | 5,848 | 2013Q3 | 2.7% | 4,619 | 1,386 | 6,005 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 730 | 219 | 30% | 949 | 2.7% | 750 | 225 | 975 | 2013Q3 | 2.7% | 770 | 231 | 1,001 |
| | **CONTRACT COST TOTALS:** | 86,929 | 26,070 | | **112,999** | | 89,293 | 26,780 | 116,073 | | | 91,413 | 27,416 | **118,829** |

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #11 - Neches River Channel Sta 292+00 to 716+00 | | | | | | | | | | | | | |
| 02 | RELOCATIONS | 15,680 | 4,704 | 30% | 20,384 | 2.8% | 16,126 | 4,838 | 20,964 | 2016Q3 | 8.3% | 17,469 | 5,241 | 22,710 |
| 12 | NAVIGATION PORTS & HARBORS | | | | | | | | | | | | | |
| | Non-Fed Cost | 5,237 | 1,571 | 30% | 6,808 | 2.7% | 5,379 | 1,613 | 6,992 | 2017Q1 | 9.3% | 5,879 | 1,763 | 7,642 |
| | Federal cost | 76,728 | 23,018 | 30% | 99,746 | 2.7% | 78,803 | 23,640 | 102,443 | 2017Q1 | 9.3% | 86,123 | 25,836 | 111,959 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 97,645 | 29,293 | 30% | 126,938 | | 100,308 | 30,091 | 130,399 | | | 109,471 | 32,840 | 142,311 |
| 01 | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| | Non-Fed Cost | 233 | 58 | 25% | 291 | 2.7% | 239 | 60 | 299 | 2016Q1 | 7.4% | 257 | 64 | 321 |
| | Federal cost | 127 | 32 | 25% | 159 | 2.7% | 130 | 33 | 163 | 2016Q1 | 7.4% | 140 | 35 | 175 |
| 22 | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| 30 | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 976 | 293 | 30% | 1,269 | 2.7% | 1,003 | 301 | 1,304 | 2016Q3 | 8.3% | 1,087 | 326 | 1,413 |
| *1.0%* | Planning & Environmental Compliance | 976 | 293 | 30% | 1,269 | 2.7% | 1,003 | 301 | 1,304 | 2016Q3 | 8.3% | 1,087 | 326 | 1,413 |
| *5.0%* | Engineering & Design | 4,882 | 1,465 | 30% | 6,347 | 2.7% | 5,014 | 1,505 | 6,519 | 2016Q3 | 8.3% | 5,432 | 1,630 | 7,062 |
| *1.0%* | Engineering Tech Review & VE | 976 | 293 | 30% | 1,269 | 2.7% | 1,003 | 301 | 1,304 | 2016Q3 | 8.3% | 1,087 | 326 | 1,413 |
| *1.0%* | Contracting & Reprographics | 976 | 293 | 30% | 1,269 | 2.7% | 1,003 | 301 | 1,304 | 2016Q3 | 8.3% | 1,087 | 326 | 1,413 |
| *2.0%* | Engineering During Construction | 1,953 | 586 | 30% | 2,539 | 2.7% | 2,006 | 602 | 2,608 | 2017Q1 | 9.3% | 2,192 | 658 | 2,850 |
| *0.3%* | Surveys - Hydro | 278 | 83 | 30% | 361 | 2.7% | 286 | 85 | 371 | 2017Q1 | 9.3% | 313 | 93 | 406 |
| *0.3%* | Surveys - Land | 278 | 83 | 30% | 361 | 2.7% | 286 | 85 | 371 | 2017Q1 | 9.3% | 313 | 93 | 406 |
| *0.3%* | Soil Boring & Testing | 327 | 98 | 30% | 425 | 2.7% | 336 | 101 | 437 | 2016Q3 | 8.3% | 364 | 109 | 473 |
| 31 | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 5,859 | 1,758 | 30% | 7,617 | 2.7% | 6,017 | 1,806 | 7,823 | 2017Q1 | 9.3% | 6,576 | 1,974 | 8,550 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 976 | 293 | 30% | 1,269 | 2.7% | 1,003 | 301 | 1,304 | 2017Q1 | 9.3% | 1,096 | 329 | 1,425 |
| | **CONTRACT COST TOTALS:** | 116,464 | 34,921 | | **151,385** | | 119,637 | 35,873 | 155,510 | | | 130,502 | 39,129 | **169,631** |

****** TOTAL PROJECT COST SUMMARY ******



****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #12 - Neches River Channel Sta 292+00 to 716+00 | | | | | | | | | | | | | |
| **12** | NAVIGATION PORTS & HARBORS | | | | | | | | | | | | | |
| | Non-Fed Cost | 8,065 | 2,420 | 30% | 10,485 | 2.7% | 8,283 | 2,485 | 10,768 | 2013Q3 | 2.7% | 8,505 | 2,552 | 11,057 |
| | Federal cost | 77,046 | 23,114 | 30% | 100,160 | 2.7% | 79,129 | 23,739 | 102,868 | 2013Q3 | 2.7% | 81,253 | 24,376 | 105,629 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 85,111 | 25,534 | 30% | 110,645 | | 87,412 | 26,224 | 113,636 | | | 89,758 | 26,928 | 116,686 |
| **01** | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| | Non-Fed Cost | 943 | 236 | 25% | 1,179 | 2.7% | 968 | 242 | 1,210 | 2012Q3 | 0.9% | 976 | 244 | 1,220 |
| | Federal cost | 97 | 24 | 25% | 121 | 2.7% | 100 | 25 | 125 | 2012Q3 | 0.9% | 101 | 25 | 126 |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 851 | 255 | 30% | 1,106 | 2.7% | 874 | 262 | 1,136 | 2013Q1 | 1.8% | 889 | 267 | 1,156 |
| *1.0%* | Planning & Environmental Compliance | 851 | 255 | 30% | 1,106 | 2.7% | 874 | 262 | 1,136 | 2013Q1 | 1.8% | 889 | 267 | 1,156 |
| *5.0%* | Engineering & Design | 4,256 | 1,277 | 30% | 5,533 | 2.7% | 4,371 | 1,312 | 5,683 | 2013Q1 | 1.8% | 4,448 | 1,335 | 5,783 |
| *1.0%* | Engineering Tech Review & VE | 851 | 255 | 30% | 1,106 | 2.7% | 874 | 262 | 1,136 | 2013Q1 | 1.8% | 889 | 267 | 1,156 |
| *1.0%* | Contracting & Reprographics | 851 | 255 | 30% | 1,106 | 2.7% | 874 | 262 | 1,136 | 2013Q1 | 1.8% | 889 | 267 | 1,156 |
| *2.0%* | Engineering During Construction | 1,702 | 511 | 30% | 2,213 | 2.7% | 1,748 | 525 | 2,273 | 2013Q3 | 2.7% | 1,795 | 539 | 2,334 |
| *0.2%* | Surveys - Hydro | 153 | 46 | 30% | 199 | 2.7% | 157 | 47 | 204 | 2013Q3 | 2.7% | 161 | 48 | 209 |
| *0.2%* | Surveys - Land | 153 | 46 | 30% | 199 | 2.7% | 157 | 47 | 204 | 2013Q3 | 2.7% | 161 | 48 | 209 |
| *0.2%* | Soil Boring & Testing | 153 | 46 | 30% | 199 | 2.7% | 157 | 47 | 204 | 2013Q1 | 1.8% | 160 | 48 | 208 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 5,107 | 1,532 | 30% | 6,639 | 2.7% | 5,245 | 1,573 | 6,818 | 2013Q3 | 2.7% | 5,386 | 1,615 | 7,001 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 851 | 255 | 30% | 1,106 | 2.7% | 874 | 262 | 1,136 | 2013Q3 | 2.7% | 897 | 269 | 1,166 |
| | **CONTRACT COST TOTALS:** | 101,930 | 30,527 | | **132,457** | | 104,685 | 31,352 | 136,037 | | | 107,399 | 32,167 | **139,566** |

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer

PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #13 - Dredging Sabine Lake | | | | | | | | | | | | | |
| **06** | FISH & WILDLIFE FACILITIES | 21,496 | 6,449 | 30% | 27,945 | 2.7% | 22,077 | 6,623 | 28,700 | 2016Q2 | 7.8% | 23,808 | 7,142 | 30,950 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 21,496 | 6,449 | 30% | **27,945** | | 22,077 | 6,623 | 28,700 | | | 23,808 | 7,142 | 30,950 |
| **01** | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| **22** | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 215 | 64 | 30% | 279 | 2.7% | 221 | 66 | 287 | 2015Q4 | 6.9% | 236 | 71 | 307 |
| *1.0%* | Planning & Environmental Compliance | 215 | 64 | 30% | 279 | 2.7% | 221 | 66 | 287 | 2015Q4 | 6.9% | 236 | 71 | 307 |
| *5.0%* | Engineering & Design | 1,075 | 322 | 30% | 1,397 | 2.7% | 1,104 | 331 | 1,435 | 2015Q4 | 6.9% | 1,180 | 354 | 1,534 |
| *1.0%* | Engineering Tech Review & VE | 215 | 64 | 30% | 279 | 2.7% | 221 | 66 | 287 | 2015Q4 | 6.9% | 236 | 71 | 307 |
| *1.0%* | Contracting & Reprographics | 215 | 64 | 30% | 279 | 2.7% | 221 | 66 | 287 | 2015Q4 | 6.9% | 236 | 71 | 307 |
| *2.0%* | Engineering During Construction | 430 | 129 | 30% | 559 | 2.7% | 442 | 132 | 574 | 2016Q2 | 7.8% | 477 | 142 | 619 |
| *0.6%* | Surveys - Hydro | 130 | 39 | 30% | 169 | 2.7% | 134 | 40 | 174 | 2016Q2 | 7.8% | 145 | 43 | 188 |
| *0.6%* | Surveys - Land | 130 | 39 | 30% | 169 | 2.7% | 134 | 40 | 174 | 2016Q2 | 7.8% | 145 | 43 | 188 |
| *0.4%* | Soil Boring & Testing | 76 | 23 | 30% | 99 | 2.7% | 78 | 24 | 102 | 2015Q4 | 6.9% | 83 | 26 | 109 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 1,290 | 387 | 30% | 1,677 | 2.7% | 1,325 | 397 | 1,722 | 2016Q2 | 7.8% | 1,429 | 428 | 1,857 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 215 | 64 | 30% | 279 | 2.7% | 221 | 66 | 287 | 2016Q2 | 7.8% | 238 | 71 | 309 |
| | **CONTRACT COST TOTALS:** | 25,701 | 7,708 | | **33,409** | | 26,399 | 7,917 | 34,316 | | | 28,449 | 8,533 | **36,982** |

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #14 - Channel to Orange | | | | | | | | | | | | | |
| **06** | FISH & WILDLIFE FACILITIES | 907 | 272 | 30% | 1,179 | 2.7% | 932 | 279 | 1,211 | 2013Q1 | 1.8% | 948 | 284 | 1,232 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 907 | 272 | 30% | **1,179** | | 932 | 279 | 1,211 | | | 948 | 284 | 1,232 |
| **01** | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| **22** | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 9 | 3 | 30% | 12 | 2.7% | 9 | 3 | 12 | 2012Q3 | 0.9% | 9 | 3 | 12 |
| *1.0%* | Planning & Environmental Compliance | 9 | 3 | 30% | 12 | 2.7% | 9 | 3 | 12 | 2012Q3 | 0.9% | 9 | 3 | 12 |
| *5.0%* | Engineering & Design | 45 | 14 | 30% | 59 | 2.7% | 47 | 14 | 61 | 2012Q3 | 0.9% | 47 | 14 | 61 |
| *1.0%* | Engineering Tech Review & VE | 9 | 3 | 30% | 12 | 2.7% | 9 | 3 | 12 | 2012Q3 | 0.9% | 9 | 3 | 12 |
| *1.0%* | Contracting & Reprographics | 9 | 3 | 30% | 12 | 2.7% | 9 | 3 | 12 | 2012Q3 | 0.9% | 9 | 3 | 12 |
| *2.0%* | Engineering During Construction | 18 | 5 | 30% | 23 | 2.7% | 19 | 5 | 24 | 2013Q1 | 1.8% | 19 | 5 | 24 |
| *0.2%* | Surveys - Land | 40 | 12 | 30% | 52 | 2.7% | 41 | 12 | 53 | 2013Q1 | 1.8% | 42 | 12 | 54 |
| *0.7%* | Soil Boring & Testing | 153 | 46 | 30% | 199 | 2.7% | 157 | 47 | 204 | 2012Q3 | 0.9% | 158 | 47 | 205 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 54 | 16 | 30% | 70 | 2.7% | 56 | 16 | 72 | 2013Q1 | 1.8% | 57 | 16 | 73 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 9 | 3 | 30% | 12 | 2.7% | 9 | 3 | 12 | 2013Q1 | 1.8% | 9 | 3 | 12 |
| | **CONTRACT COST TOTALS:** | 1,263 | 380 | | **1,643** | | 1,297 | 388 | 1,685 | | | 1,316 | 393 | **1,709** |

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: LPP SNWW Feasibility Report
LOCATION: Sabine-Neches Waterway, Texas & LA
This Estimate reflects the scope and schedule in feasibility report; Project Feasibility Report

DISTRICT: Galveston District
POC: Jackie Lockhart, Cost Engineer
PREPARED: 7-Oct-09

Estimate Prepared: 2009(Jul - Sep)
Effective Price Level: 2011(Oct - Dec)

Program Year (Budget EC): 2012
Effective Price Level Date: 1 OCT 11

FULLY FUNDED PROJECT ESTIMATE

| WBS NUMBER | Civil Works Feature & Sub-Feature Description | COST ($K) | CNTG ($K) | CNTG (%) | TOTAL ($K) | ESC (%) | COST ($K) | CNTG ($K) | TOTAL ($K) | Mid-Point Date | ESC (%) | COST ($K) | CNTG ($K) | FULL ($K) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contract #15 - GIWW East of Orange | | | | | | | | | | | | | |
| **06** | FISH & WILDLIFE FACILITIES | 37,205 | 11,162 | 30% | 48,367 | 2.7% | 38,211 | 11,464 | 49,675 | 2014Q3 | 4.5% | 39,943 | 11,984 | 51,927 |
| | **CONSTRUCTION ESTIMATE TOTALS:** | 37,205 | 11,162 | 30% | **48,367** | | 38,211 | 11,464 | 49,675 | | | 39,943 | 11,984 | 51,927 |
| **01** | LANDS AND DAMAGES | - | - | | - | | - | - | - | - | | | | |
| **22** | FEASIBILITY STUDIES | | | | | | | | | - | | | | |
| **30** | PLANNING, ENGINEERING & DESIGN | | | | | | | | | | | | | |
| *1.0%* | Project Management | 372 | 112 | 30% | 484 | 2.7% | 382 | 115 | 497 | 2014Q1 | 3.6% | 396 | 119 | 515 |
| *1.0%* | Planning & Environmental Compliance | 372 | 112 | 30% | 484 | 2.7% | 382 | 115 | 497 | 2014Q1 | 3.6% | 396 | 119 | 515 |
| *5.0%* | Engineering & Design | 1,860 | 558 | 30% | 2,418 | 2.7% | 1,911 | 573 | 2,484 | 2014Q1 | 3.6% | 1,980 | 594 | 2,574 |
| *1.0%* | Engineering Tech Review & VE | 372 | 112 | 30% | 484 | 2.7% | 382 | 115 | 497 | 2014Q1 | 3.6% | 396 | 119 | 515 |
| *1.0%* | Contracting & Reprographics | 372 | 112 | 30% | 484 | 2.7% | 382 | 115 | 497 | 2014Q1 | 3.6% | 396 | 119 | 515 |
| *2.0%* | Engineering During Construction | 744 | 223 | 30% | 967 | 2.7% | 764 | 229 | 993 | 2014Q3 | 4.5% | 799 | 239 | 1,038 |
| *0.6%* | Surveys - Hydro | 133 | 40 | 30% | 173 | 2.7% | 137 | 41 | 178 | 2014Q3 | 4.5% | 143 | 43 | 186 |
| *0.6%* | Surveys - Land | 133 | 40 | 30% | 173 | 2.7% | 137 | 41 | 178 | 2014Q3 | 4.5% | 143 | 43 | 186 |
| *0.7%* | Soil Boring & Testing | 153 | 46 | 30% | 199 | 2.7% | 157 | 47 | 204 | 2014Q1 | 3.6% | 163 | 49 | 212 |
| **31** | CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | |
| *6.0%* | Construction Management | 2,232 | 670 | 30% | 2,902 | 2.7% | 2,293 | 688 | 2,981 | 2014Q3 | 4.5% | 2,397 | 719 | 3,116 |
| | Project Operation: | | | | | | | | | - | | | | |
| *1.0%* | Project Management | 372 | 112 | 30% | 484 | 2.7% | 382 | 115 | 497 | 2014Q3 | 4.5% | 399 | 120 | 519 |
| | **CONTRACT COST TOTALS:** | 44,321 | 13,299 | | **57,620** | | 45,520 | 13,658 | 59,178 | | | 47,551 | 14,267 | **61,818** |

ATTACHMENT 13.5 – ITR Certification of Cost Estimate

**SABINE-NECHES WATERWAY CHANNEL IMPROVEMENTS**
**USACE - GALVESTON DISTRICT**
**DRAFT FEASIBILITY REPORT**

**COST ENGINEERING DX TPCS CERTIFICATION**

As of 19 October 2009, the Walla Walla District, Cost Engineering Directory of Expertise (Dx) for Civil Works, certifies the feasibility level Sabine-Neches Waterway Channel Improvement Project developed by Galveston District for the values:

| | |
|---|---|
| 2012 Budget Amount: | $1,100,935,000 |
| Fully Funded Amount: | $1,174,621,000 |

The Walla Walla Cost Dx representatives have provided an adequate Agency Technical Review (ATR) of the 2012 Budget and Total Project Cost, studying the project scope, report, cost estimates, schedules, escalation, and contingencies in accordance with ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

19Oct09
**DATE**

**Kim Callan, PE, CCE, PM1**
**CH, Cost Engineering Dx**
**Walla Walla District**

ATTACHMENT 13.6 – 50 year O&M

# SABINE NECHES WATERWAY
## 50 Year O&M Cost Estimates
## FEASIBILITY REPORT
## October 2009 Price Levels

16-Jul-09

| | Cont 1, Sect D | Cont 1, Sect C | Cont 2, Sect B | Cont 2, Sect C | Cont 3, Sect 1 | Cont 4, Sect 2 | Cont 4, Sect 3 | Cont 5, Sect 4 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **O&M Costs** | | | | | | | | |
| Year 1 | | | | | | | 23,146,350 | |
| Year 2 | | | | | | 14,195,088 | 23,146,350 | |
| Year 3 | | | | | | | 23,146,350 | |
| Year 4 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 5 | | | | | | | 23,146,350 | 11,491,050 |
| Year 6 | | | | | | 14,195,088 | 23,146,350 | |
| Year 7 | | | | | | | 23,146,350 | |
| Year 8 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 9 | | | | | | | 23,146,350 | |
| Year 10 | | | | | | 14,195,088 | 23,146,350 | 11,491,050 |
| Year 11 | | | | | | | 23,146,350 | |
| Year 12 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 13 | | | | | | | 23,146,350 | |
| Year 14 | | | | | | 14,195,088 | 23,146,350 | |
| Year 15 | | | | | | | 23,146,350 | 11,491,050 |
| Year 16 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 17 | | | | | | | 23,146,350 | |
| Year 18 | | | | | | 14,195,088 | 23,146,350 | |
| Year 19 | | | | | | | 23,146,350 | |
| Year 20 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | 11,491,050 |
| Year 21 | | | | | | | 23,146,350 | |
| Year 22 | | | | | | 14,195,088 | 23,146,350 | |
| Year 23 | | | | | | | 23,146,350 | |
| Year 24 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 25 | | | | | | | 23,146,350 | 11,491,050 |
| Year 26 | | | | | | 14,195,088 | 23,146,350 | |
| Year 27 | | | | | | | 23,146,350 | |
| Year 28 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 29 | | | | | | | 23,146,350 | |
| Year 30 | | | | | | 14,195,088 | 23,146,350 | 11,491,050 |
| Year 31 | | | | | | | 23,146,350 | |
| Year 32 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 33 | | | | | | | 23,146,350 | |
| Year 34 | | | | | | 14,195,088 | 23,146,350 | |
| Year 35 | | | | | | | 23,146,350 | 11,491,050 |
| Year 36 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 37 | | | | | | | 23,146,350 | |

# SABINE NECHES WATERWAY
## 50 Year O&M Cost Estimates
## FEASIBILITY REPORT
## October 2009 Price Levels

16-Jul-09

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year 38 | | | | | | 14,195,088 | 23,146,350 | |
| Year 39 | | | | | | | 23,146,350 | |
| Year 40 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | 11,491,050 |
| Year 41 | | | | | | | 23,146,350 | |
| Year 42 | | | | | | 14,195,088 | 23,146,350 | |
| Year 43 | | | | | | | 23,146,350 | |
| Year 44 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 45 | | | | | | | 23,146,350 | 11,491,050 |
| Year 46 | | | | | | 14,195,088 | 23,146,350 | |
| Year 47 | | | | | | | 23,146,350 | |
| Year 48 | 3,951,450 | 4,729,563 | 4,642,063 | 4,706,563 | 7,168,800 | 14,195,088 | 23,146,350 | |
| Year 49 | | | | | | | 23,146,350 | |
| Year 50 | | | | | | 14,195,088 | 23,146,350 | 11,491,050 |
| | | | | | | | | |
| **TOTAL O&M:** | **$ 47,417,400** | **$ 56,754,756** | **$ 55,704,756** | **$ 56,478,756** | **$ 86,025,600** | **$ 354,877,200** | **$ 1,157,317,500** | **$ 114,910,500** |

# SABINE NECHES WATERWAY
## 50 Year O&M Cost Estimates
## FEASIBILITY REPORT
## October 2009 Price Levels

16-Jul-09

| O&M Costs | Cont 6, Sect 5 | Cont 6, Sect 6 | Cont 7, Sect 7 & 8 | Cont 8, Sect 9 | Cont 9, Sect 10 |
|---|---|---|---|---|---|
| Year 1 | | | | | |
| Year 2 | | | 11,674,475 | 13,483,950 | |
| Year 3 | 5,998,834 | 3,795,355 | 11,781,573 | | |
| Year 4 | | | 11,674,475 | 13,483,950 | 15,633,038 |
| Year 5 | | | | | |
| Year 6 | 5,998,834 | 3,795,355 | 25,865,236 | 13,483,950 | |
| Year 7 | | | | | |
| Year 8 | | | 11,674,475 | 13,483,950 | 13,555,575 |
| Year 9 | 5,998,834 | 3,795,355 | 11,781,573 | | |
| Year 10 | | | 11,674,475 | 13,483,950 | |
| Year 11 | | | | | |
| Year 12 | 5,998,834 | 4,640,280 | 25,265,523 | 13,483,950 | 13,555,575 |
| Year 13 | | | | | |
| Year 14 | | | 12,810,570 | 13,483,950 | |
| Year 15 | 5,998,834 | 4,601,556 | 11,781,573 | | |
| Year 16 | | | 11,674,475 | 13,483,950 | 13,555,575 |
| Year 17 | | | | | |
| Year 18 | 5,998,834 | 5,271,667 | 25,265,523 | 13,483,950 | |
| Year 19 | | | | | |
| Year 20 | | | 11,674,475 | 13,483,950 | 15,633,038 |
| Year 21 | 5,998,834 | 3,795,355 | 11,781,573 | | |
| Year 22 | | | 12,924,638 | 13,483,950 | |
| Year 23 | | | | | |
| Year 24 | 5,998,834 | 3,795,355 | 25,265,523 | 13,483,950 | 13,555,575 |
| Year 25 | | | | | |
| Year 26 | | | 11,674,475 | 13,483,950 | |
| Year 27 | 5,998,834 | 3,795,355 | 11,781,573 | | |
| Year 28 | | | 12,810,570 | 13,483,950 | 13,555,575 |
| Year 29 | | | | | |
| Year 30 | 5,998,834 | 3,795,355 | 25,865,236 | 13,483,950 | |
| Year 31 | | | | | |
| Year 32 | | | 11,674,475 | 13,483,950 | 13,555,575 |
| Year 33 | 5,998,834 | 4,640,280 | 11,781,573 | | |
| Year 34 | | | 11,674,475 | 13,483,950 | |
| Year 35 | | | | | |
| Year 36 | 5,998,834 | 5,271,667 | 25,265,523 | 13,483,950 | 13,555,575 |
| Year 37 | | | | | |
| Year 38 | | | 11,674,475 | 13,483,950 | |
| Year 39 | 5,998,834 | 3,795,355 | 11,781,573 | | |

# SABINE NECHES WATERWAY
## 50 Year O&M Cost Estimates
## FEASIBILITY REPORT
## October 2009 Price Levels

16-Jul-09

| | | | | | |
|---|---|---|---|---|---|
| Year 40 | | | 12,810,570 | 13,483,950 | 15,633,038 |
| Year 41 | | | | | |
| Year 42 | 5,998,834 | 3,795,355 | 25,265,523 | 15,946,526 | |
| Year 43 | | | | | |
| Year 44 | | | 11,674,475 | 13,483,950 | 13,555,575 |
| Year 45 | 5,998,834 | 3,795,355 | 11,781,573 | | |
| Year 46 | | | 11,674,475 | 13,483,950 | |
| Year 47 | | | | | |
| Year 48 | 5,998,834 | 3,795,355 | 25,865,236 | 13,483,950 | 13,555,575 |
| Year 49 | | | | | |
| Year 50 | | | 11,674,475 | 13,483,950 | |
| | | | | | |
| **TOTAL O&M:** | **$ 95,981,344** | **$ 66,174,355** | **$ 501,300,430** | **$ 339,561,326** | **$ 168,899,289** |

# SABINE NECHES WATERWAY
## 50 Year O&M Cost Estimates
## FEASIBILITY REPORT
## October 2009 Price Levels

16-Jul-09

| O&M Costs | Sect 11 | Sect 12 | 13 | 14 | 15 | 16 | 17 | Sect 18 | Ch to |
|---|---|---|---|---|---|---|---|---|---|
| Year 1 | | | | | | | | | |
| Year 2 | | | | | | | | | |
| Year 3 | 3,468,888 | 2,548,425 | 6,984,125 | | | | | | |
| Year 4 | | | | 6,781,075 | | | | | |
| Year 5 | | | | | | | | | 1,300,948 |
| Year 6 | 3,468,888 | 3,404,112 | 6,957,700 | | 6,471,263 | 11,980,713 | 2,570,550 | 14,148,036 | |
| Year 7 | | | | | | | | | |
| Year 8 | | | | 6,781,075 | | | | | |
| Year 9 | 3,468,888 | 2,548,425 | 6,957,700 | | | | | | |
| Year 10 | | | | | | | | | 1,300,948 |
| Year 11 | | | | | | | | | |
| Year 12 | 4,291,626 | 2,548,425 | 6,957,700 | 6,781,075 | 6,471,263 | 11,980,713 | 2,570,550 | 9,102,051 | |
| Year 13 | | | | | | | | | |
| Year 14 | | | | | | | | | |
| Year 15 | 3,468,888 | 2,548,425 | 6,957,700 | | | | | | 1,300,948 |
| Year 16 | | | | 6,781,075 | | | | | |
| Year 17 | | | | | | | | | |
| Year 18 | 3,468,888 | 3,404,112 | 6,957,700 | | 6,471,263 | 11,980,713 | 2,570,550 | 10,265,926 | |
| Year 19 | | | | | | | | | |
| Year 20 | | | | 6,781,075 | | | | | 1,300,948 |
| Year 21 | 3,468,888 | 2,548,425 | 6,957,700 | | | | | | |
| Year 22 | | | | | | | | | |
| Year 23 | | | | | | | | | |
| Year 24 | 3,468,888 | 2,548,425 | 6,957,700 | 6,781,075 | 6,471,263 | 11,980,713 | 3,939,400 | 8,068,850 | |
| Year 25 | | | | | | | | | 1,300,948 |
| Year 26 | | | | | | | | | |
| Year 27 | 4,350,638 | 2,548,425 | 6,957,700 | | | | | | |
| Year 28 | | | | 6,781,075 | | | | | |
| Year 29 | | | | | | | | | |
| Year 30 | 3,468,888 | 3,404,112 | 6,957,700 | | 6,884,838 | 11,980,713 | 2,570,550 | 11,159,575 | 1,300,948 |
| Year 31 | | | | | | | | | |
| Year 32 | | | | 7,484,001 | | | | | |
| Year 33 | 3,468,888 | 2,548,425 | 9,005,826 | | | | | | |
| Year 34 | | | | | | | | | 1,300,948 |
| Year 35 | | | | | | | | | |
| Year 36 | 4,526,938 | 2,548,425 | 6,957,700 | 7,484,001 | 6,471,263 | 11,980,713 | 2,570,550 | 8,068,850 | |
| Year 37 | | | | | | | | | |
| Year 38 | | | | | | | | | |
| Year 39 | 3,468,888 | 2,548,425 | 6,957,700 | | | | | | |

# SABINE NECHES WATERWAY
## 50 Year O&M Cost Estimates
## FEASIBILITY REPORT
## October 2009 Price Levels

16-Jul-09

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year 40 | | | | 7,484,001 | | | | | |
| Year 41 | | | | | | | | | |
| Year 42 | 3,468,888 | 3,404,112 | 6,957,700 | | 6,471,263 | 11,980,713 | 2,570,550 | 11,252,425 | |
| Year 43 | | | | | | | | | |
| Year 44 | | | | 7,484,001 | | | | | |
| Year 45 | 3,468,888 | 2,548,425 | 6,957,700 | | | | | | |
| Year 46 | | | | | | | | | |
| Year 47 | | | | | | | | | |
| Year 48 | 3,468,888 | 2,548,425 | 9,005,826 | 7,484,001 | 6,884,838 | 11,980,713 | 2,570,550 | 8,068,850 | |
| Year 49 | | | | | | | | | |
| Year 50 | | | | | | | | | |
| | | | | | | | | | |
| **TOTAL O&M:** | **$ 58,264,746** | **$ 44,197,548** | **$ 115,445,877** | **$ 84,887,530** | **$ 52,597,254** | **$ 95,845,704** | **$ 21,933,250** | **$ 80,134,563** | **$ 9,106,636** |

# Appendix 4

# Real Estate Plan

# GALVESTON DISTRICT
# REAL ESTATE PLAN

**SABINE-NECHES WATERWAY TEXAS & LOUISIANA**

**CHANNEL IMPROVEMENT PROJECT**

**JEFFERSON COUNTY, TEXAS & CAMERON PARISH, LOUISIANA**

**March 2011**

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**CESWG-RE**

CESWG-PE-PL
Project Manager: Byron D. Williams
CESWG-RE-A
Prepared by: Salvatore Arcidiacono/Randy Richardson/Carlos Hidalgo
CESWG-RE
Submitted by: Orlando Rosas

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**REAL ESTATE PLAN**
**SABINE-NECHES WATERWAY**
**CHANNEL IMPROVEMENT PROJECT**
**JEFFERSON COUNTY, TEXAS**

**1. General Background.** This Real Estate Plan (REP) is the real estate work product of the U.S. Army Corps of Engineers, Galveston District, Real Estate Division (the "District") that supports project plan formulation for the Sabine-Neches Waterway Channel Improvement Project ("CIP"). It identifies and describes the lands, easements, and rights-of-way (LER) required for the construction, operation and maintenance of the proposed project, including those required for relocations, borrow material, and dredged or excavated material disposal. The REP also identifies and describes the facility/utility relocations that are necessary to implement the CIP. Further, the REP describes the estimated LER value, together with the estimated administrative and incidental costs attributable to providing project LER, and the acquisition process.

**2. Project Type & Applicability.** The feasibility study was conducted in response to the 5 June 1997 congressional resolution from the Committee on Environmental and Public Works, House of Representatives. The resolution states:

*"The Secretary of the Army shall review previous reports on the Sabine-Neches Waterway published as Senate Document No. 80, 83rd Congress, Second Session: House Document No. 553, 87th Congress, Second Session; and other pertinent reports to determine the feasibility of modifying the channels serving the ports of Beaumont, Port Arthur, and Orange, Texas in the interest of commercial navigation."*

**3. Project Location.** The Sabine-Neches Waterway is an approximate 64 existing mile federally authorized and maintained waterway located in Jefferson/Orange Counties in southeast Texas and Cameron Parish, Louisiana. The area surrounding the waterway is generally referred to as the "Golden Triangle" and is delineated by three major Texas seaports of Port Arthur, Beaumont and Orange. The Sabine-Neches Waterway provides deep-water navigation to these seaports, as well as for some shallow-draft tributary channels. The Sabine Pass, Sabine Lake, and Sabine River together form part of the boundary between the states of Texas and Louisiana. *(See Exhibit "C" Map Sheet PA Index)*

**4. Scope and Content.** The Sabine-Neches Waterway is a system of artificially widened and/or deepened channels that have been dredged from offshore through portions of the Sabine River and Lake, and the Neches River in Texas. The waterway is made up of 7 existing project reaches. From the Gulf of Mexico working upstream the reaches are: 1) Sabine Bank Channel, 2) Sabine Pass Outer Bar Channel, 3) Sabine Pass Jetty Channel, 4) Sabine Pass Channel, 5) Port Arthur Canal, 6) Sabine Neches Canal and 7) Neches River Channel. *(See Exhibit "C" Map Sheet PA Index).* The only connection with the Gulf of Mexico is a long narrow pass called Sabine Pass through which all tidal interchange occurs. Sabine Pass has been stabilized by jetties that extend more than 4 miles into the Gulf of Mexico. These jetties were constructed for navigational purposes. Proposed channel will have 8 reaches.

The feasibility report focused on alternatives from 45 feet to 50 feet for deepening of the Sabine-Neches Waterway from offshore to the Port of Beaumont. The alternatives were to deepen either 45, 46, 47, 48, 49, or 50 feet from the Gulf to Port of Beaumont, with up to 8 turning basins and selective widening. The Recommended Plan consists of a 49-foot deep navigation channel from the Gulf to the Port of Beaumont, with selective widening and 4 turning/anchorage basins.

**5. Purpose** The purpose of the REP is to identify the real estate requirements for the CIP and to estimate the costs of acquisition. The plan will also identify the estate to be acquired in the various tracts. In 2002, the local sponsor, the Jefferson County Navigation District, was renamed the Jefferson County Waterway and Navigation District (JCWND) and in 2007 the JCWND was renamed to the Sabine Neches Navigation District (SNND); the designation which is used throughout this report. The SNND already owns a majority of the lands needed for the CIP. The Sponsor will receive credit for the fair market value of any additional lands required, at the time they are made available to the Government for construction. The Sponsor will also receive credit for the administrative costs of acquisition for all lands acquired within 5 (five) years preceding the signing of the Project Cooperation Agreement (PCA).

**6. Real Estate Requirements.** The CIP Sponsor is required to furnish the lands, easements, and rights of way (LER) for the proposed cost-shared project. The real estate requirements must support construction as well as operation and maintenance of the project after completion. Of the eight reaches for the CIP starting with reaches one and two, **Sabine Bank Channel and Sabine Bank Extension**, all of the dredged material from this reach Sta53+000 to Sta165+000 will be deposited in offshore placement areas "A", "B","C","D", and offshore Site No. 1, *(See Exhibit "C" Map Sheet PA Index).* Reach three, **Sabine Pass Outer Bar Channel,** Sta53+000 to Sta0+000; all of the dredged material from this reach will be deposited in offshore Sites No. 2 and 3. *(See Exhibit "C" Map Sheet PA Index)* Reach four, **Sabine Pass Jetty Channel**, Sta0+000 to Sta215+29; the dredged material from this reach will all be deposited in offshore Site No. 4. *(See Exhibit "C" Map Sheet PA Index)* All of the placement areas which will be used for these three reaches are in navigable water and will be used by virtue of Navigation Servitude; therefore no real estate interests will be required. Reach five, **Sabine Pass Channel**, Sta0+000 to Sta295+00; the dredged material from this reach will be deposited in Placement Area Nos. 5 North, 5 South, 5C and 5B, an upland site containing 1,025.00 acres. This placement area will be acquired in fee. *(See Exhibit "C" Map Sheet PA 9).* Reach six, **Port Arthur Canal,** Sta0+00 to Sta326+24; the dredged material from this reach will be deposited in Placement areas 8 and 9, two upland sites. Placement area No. 8 contains 3,571.00 acres and is available by virtue Navigation Servitude, therefore no real estate interests is required. Placement area No. 9 contains 381.00 acres and is at the intersection of the Port Arthur Canal and the Gulf Intracoastal Waterway. Placement area 9a contains 166 acres will be acquired in fee. *(See Exhibit "C" Map Sheet PA 10).* Reach seven, **Sabine-Neches Canal**, Sta0+00 to Sta592+91; the dredged material from this reach will be deposited in Placement areas 8 and 11. These placement areas are along the Sabine- Neches Canal and were in navigable waters at one time. These Placement areas are now upland sites and are available by virtue of Navigation Servitude. Placement area 8 contains 3,571.00 acres and Placement area 11 contains 2,173.00 acres *(See Exhibit "C" Map Sheet PA 10 & 11).*

**Neches River Channel** is broken down into three reaches. Sta0+00 to Sta292+00, the material dredged from this reach will be deposited into placement areas 12, 13, 14, and 16 which total 1,051.00 acres and 17 which has 324 acres of upland placement areas. All of these placement areas with the exception of area 17 are owned by the local sponsor and therefore no real estate interests will be required. Placement area 17 will be acquired in fee. The second reach, Sta292+00 to Sta716+00, the material dredged from this reach will be deposited in placement areas 18, 18A, 21, 23, 23A and 24 which total 1,744.00 acres of upland placement areas. All of these areas are owned by the sponsor and therefore no real estate interests will be required. The third reach, Sta716+00 to Sta980+00, the material dredged from this reach will be deposited in placement areas 24A-187 acres, 25-643 acres, 25A-172 acres, 26-201 acres, 27A-129 acres, 27C-87 acres and 27D-55 acres. All these areas with the exception of placement area 26 and 27A, C and D are all owned by the local sponsor and therefore no real estate interests will be required. Placement areas 26 and 27A, C and D will be acquired in fee. *(See Exhibit "C" Map Sheet PA 14)*. Within these three reaches, there are 4 turning basins of which only two will require the acquisition of land totaling 12.10 acres that will be acquired in perpetual channel improvement easement. *(See Exhibit "C" Map Sheet PA 14)*. All of the placement areas currently owned by the local sponsor were acquired for the original SNWW project under a local cooperation agreement which required the sponsor to provide all LERRDs necessary for the project.

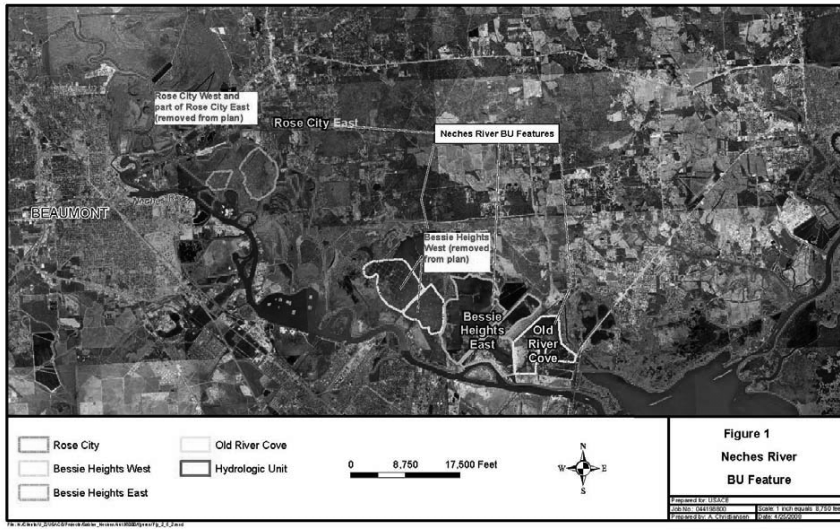
All DMMP beneficial use (BU) features proposed for inclusion in the DMMP of the Preferred Alternative are described in Table 2.4-13. Three former marsh areas on the Neches River (Rose City East, Bessie Heights East, and Old River Cove) would be combined into one large management feature called the Neches River BU Feature (see Figure 2.5-2). In the Gulf Shore BU Feature, maintenance material would be used to nourish Gulf shorelines at Texas and Louisiana Points (see Figure 2.5-3). The DMMP BU features are not being pursued as separable elements of an ecosystem restoration plan under Section 204 or 207 authorities. They are not ecosystem restoration measures, and as such, do not target a specific historical condition for the level of restoration. They are least-cost, environmentally acceptable placement features and are included as GNF of the DMMP.

The Neches River BU Feature would take advantage of new work material provided by the channel deepening project to build hydraulic containment levees within degraded, former marsh areas at Rose City East, Bessie Heights East, and Old River Cove. Each of these areas is referred to as a component of the overall Neches River BU Feature. Marsh would be created in each component using only new work, or a combination of new work and maintenance material. The Old River Cove component would be filled during initial construction with new work material, alone. In the Bessie Heights East component, maintenance material would be placed incrementally in 7 maintenance cycles over 28 years. At the Rose City East component, new work material would be used to construct containment levees and ridges, and then the marsh would be completed with the placement of maintenance material during the first maintenance cycle following construction. For the Neches River BU Feature as a whole, 2,853 acres of emergent marsh would be restored in areas that are now open water; 871 acres of improved shallow water habitat would be created by the formation of shallower ponds and interconnecting channels within the restored marshes; and 1,234 acres of existing fringing marsh would be nourished

Table 2.4-13
DMMP BU Features, SNWW Preferred Alternative

| Beneficial Use Features | No. | Description | Size of Influence Area |
|---|---|---|---|
| Rose City East (component of Neches River BU Measure) | TX 3-1 East | Restoring 345 acres fresh marsh, 72 acres of shallow water, and nourishing 151 acres of existing marsh in two construction events. New work material from Neches River Channel will be used to restore 225-acre marsh, construct hydraulic containment levees and higher elevation features. Maintenance material from the first maintenance cycle will be used to restore an additional 120 acres of marsh. | Influence area – 568 acres |
| Bessie Heights East (component of Neches River BU Measure) | TX 5-2 | Restores 679 acres of brackish and 1,190 acres of intermediate marsh, 660 acres of shallow water habitat and nourishes 651 acres of existing marsh. Marsh will be constructed with maintenance material from Neches River Channel for 28 years. New work material is used to build hydraulic containment levee. | Influence area – 3,180 acres |
| Old River Cove (component of Neches River BU Measure) | TX 6-1 | Restores 639 acres of brackish marsh, 139 acres of shallow water habitat, and nourishes 432 acres of existing marsh with new work material from Neches River Channel. New work material used to construct hydraulic containment levee. | Influence area – 1,210 acres |
| Gulf Shore BU Feature (Texas and Louisiana Points) | TX 8-11 LA 5-2/6-2 | Nourish 3 miles of Gulf shoreline on both sides of Sabine Pass, from 0.5 to 3.5 miles from East and West Jetties, using maintenance material from Sabine Pass Channel. Unconfined placement of maintenance material along shoreline every 3 years for 50-year period of analysis (8 placement episodes). Assume 50:50 split of material between Texas and Louisiana accomplished by alternating placement in Texas and Louisiana. | Affected shoreline 6.0 miles total |

by winnowing fine-grained material from unconfined flows of dredged material effluent. The size of the Neches River BU Feature components and the magnitude of their ecological benefits are made possible by the large amounts of dredged material which would be generated by the proposed project, and extensive opportunities for beneficial use in the project area. The Gulf Shore Nourishment Feature would use material from regular maintenance dredging of the eastern section of the Sabine Pass Channel to nourish eroding marsh, and possibly create new saline marsh, along a total of 6 miles of shoreline on both sides of Sabine Pass at Louisiana and Texas Points. Material would be hydraulically pumped along a 3-mile reach of shoreline, from 0.5 to 3.5 miles from each jetty. The unconfined placement of material during each 3-year dredging cycle would alternate between Texas and Louisiana, so that materials would be placed on each state's shoreline every 6 years, for a total of 16 placement events over the 50-year period of analysis. Historic dredging records indicate that the material from Sabine Pass would average 51 percent silt, 31 percent clay, and 18 percent sand. The material would be hydraulically pumped into the near shore zone and some material would be expected to flow over existing marsh while the remainder flows into the nearshore waters. This mix of materials does not contain typical beach quality sand; however, resource agencies, which are listed in Table 1.6-1 of the FEIS, have ageed that returning the material to the littoral system would have a net beneficial effect, regardless of the material type.




The estates for the above mentioned tracts to be acquired are listed as below:

**Fee Estate-** Estate No. 1 Fee for Placement Areas
*The fee simple title to (the land described in Schedule A) (Tract Nos. 5, 9, 17, 26, 27A, C and D), subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines; excepting and excluding from the taking all interests in coal, oil and gas or other minerals which are outstanding in parties other than surface owners and all appurtenant rights for the exploration, development and removal of said coal, oil and gas so excluded.*

**Channel Improvement Easement-** Estate No. 8 for Turning Basins
*A perpetual assignable right and easement to construct, operate, and maintain channel improvement works on, over, and across (the land described in Schedule A) (Tracts 1 through 8) for turning basins and for the purposes as authorized by the Act of Congress approved Water Resources Development Act 1999 (P.L. 106-53 SEC. 556), including the right to clear, cut fell, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and /or other obstructions there from; to excavate; dredge, cut away, and remove any or all of said land and to place thereon dredged or excavated material; and for such other purposes as may be required in connection with said work of improvement; reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.*

**7. Borrow Material.** The proposed CIP does not require any borrow material.

**8. Access/Staging Area.** The proposed CIP does not require any access/staging areas. All of the proposed work will be performed within the existing right-of-way of the Sabine-Neches Waterway and existing roads and highways within the project area. No credit will be allowed for access/staging areas since these areas have already been provided for the previous project.

**9. Recreation Features.** The proposed project does not have any recreation features.

**10. Induced Flooding.** There is no induced flooding anticipated due to the construction of the project. The proposed CIP will be constructed within the existing right-of-way of the Sabine-Neches Waterway.

**11. Mitigation and DMMP BU sites.** The proposed CIP contains several mitigation and DMMP BU sites located within the project area. These sites consist of marsh creation, marsh nourishment and shore nourishment. Exhibit C shows the labeled sites on the Texas side and on the Louisiana side. *(See Exhibit "C" Map Sheet M 1).*

**12. Federally Owned Land & Existing Federal Project.** Some of the DMMP BU and mitigation sites are located on federally-owned land. The Gulf Shore BU Feature will nourish shoreline owned by the Texas Point National Wildlife Refuge. Two of the mitigation sites (LA 2-18B and LA 2Add B) are located in the Sabine National Wildlife Refuge.

**13. Navigation Servitude.** Navigation Servitude emanated from the Commerce Clause of the Constitution of the United States, Article I; Section 8, Clause 3. The servitude gives the Federal Government the right to use the "Navigable Waters" of the United States without compensation for navigation projects. These are non-transferable rights, and are not considered interest in real property. The CIP has 3,003 acres of mitigation and 3,294 acres of marsh restoration sites. These sites are marsh areas and are under the mean high water mark. Therefore, there is no real estate requirements associated with the mitigation effort, marsh restoration sites, or nourishment areas since the Government will exercise Navigation Servitude on the required submerged lands. A separate contract will be let for the construction of these sites.

**14. Public Law 91-646 Relocations.** There are no residential houses, businesses, or farms that would be required for relocation associated with PL 91-646.

**15. Assessment of Project Sponsor Land Acquisition Capabilities.** The sponsor has the authority and capability to furnish lands, easements and rights of way in accordance with the Feasibility Cost-Sharing Agreement. The sponsor is highly capable of performing the real estate acquisition required by this project. A copy of the capability assessment is attached as *Exhibit "A".*

**16. Baseline Cost Estimate for Real Estate.** The cost estimate below reflects estimated Federal and Non-Federal real estate costs for the proposed 8 reaches which consists of a total of 14 contracts (see cost estimate) for the proposed navigation project. These costs

include land payments, acquisition administrative costs, surveying, mapping and administrative costs. The real estate costs for the CIP are estimated below:

**REAL ESTATE**

**01/02 LANDS AND DAMAGES/RELOCATIONS**

**CONSTRUCTION CONTRACT #1 -NON-FEDERAL COSTS**
**Sabine Bank Sta. 165+000 to 132+000**

| | Amount |
|---|---|
| Utility Relocations (50% of total Utility Relocations) | $834,500 |
| | |
| Contingency (33%) | $275,500 |
| | |
| Total Costs | $1,110,000 |

**CONSTRUCTION CONTRACT #3 -NON-FEDERAL COSTS**
**Sabine Bank Sta. 95+734 to 53+000**

| | Amount |
|---|---|
| Utility Relocations (50% of total Utility Relocations) | $497,500 |
| | |
| Contingency (33%) | $164,000 |
| | |
| Total Costs | $661,500 |

**CONSTRUCTION CONTRACT #4 -NON-FEDERAL COSTS**
**Sabine Pass Outer Bar Jetty Channel Sta. 53+000 to 0+000**

| | Amount |
|---|---|
| Utility Relocations (50% of total Utility Relocations) | $828,500 |
| | |
| Contingency (33%) | $273,500 |
| | |
| Total Costs | $1,102,000 |

**CONSTRUCTION CONTRACT #6 -NON-FEDERAL COSTS**
**Sabine Pass Channel Sta. 0+00 to 295+60**

| | Amount |
|---|---|
| Land Payments (MCACES line 11501) | $700,000 |
| Incidental Land Acquisition Expenses (total of MCACES lines 102, 103,105,112,113, 117) | $127,000 |
| Utility Relocations (50% of total Utility Relocations) | $1,468,000 |
| | |
| Contingency (25%-30%) | $647,500 |
| | |
| Total Costs | $2,942,500 |

**CONSTRUCTION CONTRACT #6 -FEDERAL COSTS**
**Sabine Pass Channel Sta. 0+00 to 295+60**

| | Amount |
|---|---|
| Administrative Expenses for Assistance, Review and Approval of NFS Land Acquisition (total of MCACES lines 102, 103,105,112, 113, 117) | $102,000 |
| | |
| Contingency (25%) | $26,000 |
| | |
| Total Costs | $128,000 |

**CONSTRUCTION CONTRACT #7 -NON-FEDERAL COSTS**
**Port Arthur Channel Sta. 0+00 to 326+24**

| | Amount |
|---|---|
| Land Payments (MCACES line 11501) | $560,000 |
| Incidental Land Acquisition Expenses (total of MCACES lines 102, 105,112,113,117) | $79,000 |
| | |
| Contingency (25%) | $159,750 |
| | |
| Total Costs | $799,000 |

**CONSTRUCTION CONTRACT #7 -FEDERAL COSTS**
**Port Arthur Channel Sta. 0+00 to 326+24**

| | Amount |
|---|---|
| Administrative Expenses for Assistance, Review and Approval of NFS Land Acquisition (total of MCACES lines 102, 105,108,112, 113, 117) | $64,000 |
| | |
| Contingency (25%) | $16,000 |
| | |
| Total Costs | $80,000 |

**CONSTRUCTION CONTRACT #8 & 9 -NON-FEDERAL COSTS**
**Sabine-Neches Canal Sta. 0+00 to 592+91**

| | Amount |
|---|---|
| Incidental Land Acquisition Expenses (total of MCACES lines 112,113,117) | $140,000 |
| Utility Relocations (50% of total Utility Relocations) | $627,500 |
| | |
| Contingency (25%-30%) | $224,000 |
| | |
| Total Costs | $991,500 |

**CONSTRUCTION CONTRACT #8 & 9 -FEDERAL COSTS**
**Sabine-Neches Canal Sta. 0+00 to 592+91**

| | Amount |
|---|---|
| Administrative Expenses for Assistance, Review and Approval of NFS Land Acquisition (total of MCACES lines 108, 112, 113, 117) | $120,000 |
| | |
| Contingency (25%) | $30,000 |
| | |
| Total Costs | $150,000 |

**CONSTRUCTION CONTRACT #10 -NON-FEDERAL COSTS**
**Neches River Channel Sta. 0+00 to 292+00**

| | Amount |
|---|---|
| Land Payments (MCACES line 11501) | $20,000 |
| Incidental Land Acquisition Expenses (total of MCACES lines 112,113,117) | $90,000 |
| Utility Relocations (50% of total Utility Relocations) | $3,864,500 |
| | |
| Contingency (25% - 30%) | $1,187,500 |
| | |
| Total Costs | $5,162,000 |

**CONSTRUCTION CONTRACT #10 -FEDERAL COSTS**
**Neches River Channel Sta. 0+00 to 292+00**

| | Amount |
|---|---|
| Administrative Expenses for Assistance, Review and Approval of NFS Land Acquisition (total of MCACES lines 108, 112, 113, 117) | $85,000 |
| | |
| Contingency (25%) | $21,000 |
| | |
| Total Costs | $106,000 |

**CONSTRUCTION CONTRACT #11 -NON-FEDERAL COSTS**
**Neches River Channel Sta. 292+00 to 716+00**

| | Amount |
|---|---|
| Land Payments (MCACES line 11501) | $135,000 |
| Incidental Land Acquisition Expenses (total of MCACES lines 102,105,112,113,117) | $98,000 |
| Utility Relocations (50% of total Utility Relocations) | $7,840,000 |
| | |
| Contingency (25% - 30%) | $2,410,000 |
| | |
| Total Costs | $10,483,000 |

**CONSTRUCTION CONTRACT #11 -FEDERAL COSTS**
**Neches River Channel Sta. 292+00 to 716+00**

| | Amount |
|---|---|
| Administrative Expenses for Assistance, Review and Approval of NFS Land Acquisition (total of MCACES lines 102,105,108, 112, 113, 117) | $127,000 |
| | |
| Contingency (25%) | $32,000 |
| | |
| Total Costs | $159,000 |

**CONSTRUCTION CONTRACT #12 -NON-FEDERAL COSTS**
**Neches River Channel Sta. 716+00 to 980+00**

| | Amount |
|---|---|
| Land Payments (MCACES line 11501) | $775,000 |
| Incidental Land Acquisition Expenses (total of MCACES lines 102,105,112,113,117) | $168,000 |
| | |
| Contingency (25% - 30%) | $236,000 |
| | |
| Total Costs | $1,179,000 |

**CONSTRUCTION CONTRACT #12 -FEDERAL COSTS**
**Neches River Channel Sta. 716+00 to 980+00**

| | Amount |
|---|---|
| Administrative Expenses for Assistance, Review and Approval of NFS Land Acquisition (total of MCACES lines 102,105, 112, 113, 117) | $97,000 |
| | |
| Contingency (25%) | $24,000 |
| | |
| Total Costs | $121,000 |

**Note:** There are some administrative costs, both Federal and non-Federal costs, for utility relocations that are not presented separately in the tables. For those tables, the administrative costs for utility relocations are included as part of the contingency for that contract.

| | |
|---|---|
| **TOTAL--NON-FEDERAL LER plus UTILITY RELOCATION COSTS** | **$24,430,500** |
| LER Costs | $3,617,000 |
| Utility Relocation Costs | $20,813,500 |
| **TOTAL -- FEDERAL COSTS** | **$744,000** |

**17. Acquisition Schedule.** The acquisition of the LER necessary for the CIP is the responsibility of the sponsor, however, for the current project, the Sponsor owns all the lands required with the exception of six tracts which they are in the process of acquiring. Therefore, there is no need for an acquisition schedule. Significant time delays may be encountered if condemnation proceedings are required for land acquisitions.

**18. Mineral Activity.** Sabine Lake and the surrounding area along with the mitigation and the marsh restoration sites have considerable mineral activity. Mineral rights have not been transferred with property in the project area. Mineral rights need not be acquired with any lands required for the project. The State of Texas owns the mineral rights in most of the submerged lands in the project area. The Government's surface rights in the submerged lands required for the project emanates from the navigation servitude. The Navigation Servitude is the dominant estate and takes precedence over the mineral estate in the required submerged lands.

**19. Relocation of Facilities/Utilities.** A total of 104 pipelines have been identified crossing the SNWW navigation channels. Of the 104 pipelines, 46 require adjustment to meet the minimum required vertical and horizontal clearances for the Channel Improvement Project (CIP). (See Exhibit "D").

Pursuant to Section 101(a) of the Water Resources Development Act of 1986 (WRDA 86), as amended, the Sponsor is responsible for performing, or assuring the performance, of all relocations, including utility relocations, which are necessary for the CIP. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government.

Because the recommended plan consists of a 48-foot deep navigation channel, the CIP is a deep draft project. Therefore, in accordance with Section 101(a)(4) of WRDA 86, for all relocations of pipelines that are classified as "utility relocations," one-half of the cost of each such relocation shall be borne by the owner of the facility being relocated and one-half of the cost of each such relocation shall be borne by the Sponsor.

Consistent with the legislative history for Section 101 of WRDA 86, any pipeline, cable, or related facility located within the channel that must be relocated for the CIP is considered a utility relocation for the purpose of applying the cost sharing rule in Section 101(a)(4) of WRDA 86, as amended.

The Galveston District has concluded preliminarily that 41 of the 46 lines located within the channel must be relocated. Applying the definition of "utility" discussed above, such 41 relocations are classified as utility relocations for which the Sponsor must perform or assure performance with relocation costs to be shared equally between the Sponsor and the pipeline owners pursuant to Section 101(a)(4) of WRDA 86. Such relocation costs will not include any cost for upgrading or improving such facilities, which is to be borne by the facility owner.

If, following authorization of the CIP, the Sponsor is unable to reach an agreement with a pipeline owner as to the relocation of a particular pipeline, the Sponsor may request that the Corps exercise the navigation servitude, and revoke any existing Section 10 permit, to compel the owner to remove its line. The Corps will exercise the navigation servitude if the Sponsor has made a good-faith effort to negotiate with the pipeline owner for relocation of the line and

the Sponsor has made a showing that it has no authority to compel the relocation of the facility by the pipeline owner.

The exercise by the Corps of the navigation servitude, however, would not affect the cost-sharing formula for utility relocations established by the Congress in Section 101(a)(4) of WRDA 86. The Corps will not exercise the navigation servitude unless the Sponsor agrees in writing that such action will be at no cost to the Federal Government and will not affect the Sponsor's responsibility for payment of relocation costs under Section101(a)(4) . In addition, the Sponsor will be responsible for payment of the Corps' administrative costs associated with exercise of the navigation servitude.

For relocations that are not classified as "utility relocations," whether the Sponsor owes compensation to the facility owner turns on principles of just compensation under State law and whether any permits, licenses, or rights-of-way instruments have special provisions that as a matter of law may offset what compensation may otherwise be due. For such relocations, the Sponsor will negotiate with the pipeline or facility owners as to the amount of compensation that is required. As in the case of utility relocations, these relocations will be accomplished at no cost to the Federal Government.

The Galveston District also has concluded preliminarily that it will not be necessary to relocate 5 of the 46 lines because they are no longer necessary. Although such lines will need to be removed to construct the CIP, no replacement lines will be necessary. If an owner of such a line can be located, the Sponsor will contact the owner to reach a determination as to whether the owner has an interest in the existing line for which compensation is owed by the Sponsor. If the owner has a compensable interest, the Sponsor, as part of its requirement to provide lands, easements, and rights-of-way required for the CIP, will be responsible for acquiring this interest, at no cost to the Federal Government. The Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) of WRDA 86 for the value of the interest acquired, and the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the CIP, with the costs of the removal shared by the Corps and Sponsor as part of the costs of the general navigation features. If no compensation is owed to the owner of the line, or if the owner cannot be located, then the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the CIP, with the costs of the removal shared by the Corps and Sponsor as part of the costs of the general navigation features.

The Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) for the value of relocations provided under Section 101(a)(3) and for the costs of utility relocations borne by the Sponsor under Section 101(a)(4). Such credit will include any payment made by the Sponsor to the Corps associated with the Corps' exercise of the navigation servitude.

**20. <u>HTRW or Other Environmental Contaminants.</u>** HTRW is suspected in the vicinity of placement area 17 (Neches River Channel). Sponsor shall perform, or ensure performance of, any investigations for hazardous substances that the Government or the sponsor determines to be necessary to identify the existence and extent of any hazardous substances regulated under CERCLA (42 U.S.C. Sections 9601-9675), that may exist in, on, or under lands, easements and rights-of-way that the Government determines to be necessary for the construction or operation and maintenance of the general navigation

features. All cost for such investigations shall be included in total cost of construction of the general navigation features and cost shared in the Project Cooperation Agreement (PCA).

**21. Attitudes of the Landowner.** The sponsor is the owner of the majority of the CIP lands. As owners they are supportive and in favor of the project. No resistance to the project by the landowner is expected.

**22. Sponsor Notification of Risks.** A letter was transmitted to the Sabine Neches Navigation District (formerly Jefferson County Waterway and Navigation District) on the 24 of February 2003, advising them if for any reason, the Project Cooperation Agreement (PCA) never gets signed or if Congress fails to authorize or fund the CIP, any land they acquired or money they spent in their effort to acquire land will be at their sole risk. *(See Exhibit "B")*

**EXHIBIT "A"**

APPENDIX 12-E

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? (yes/~~no~~)
b. Does the sponsor have the power of eminent domain for this project? (yes/~~no~~)
c. Does the sponsor have "quick-take" authority for this project? (~~yes~~/no)
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? (yes/~~no~~)
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? (yes/~~no~~)

II. Human Resources Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? (~~yes~~/no)
b. If the answer to II.a. is "yes," has a reasonable plan been developed to provide such training? (yes/~~no~~)
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? (yes/~~no~~)
d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? (yes/~~no~~)
e. Can the sponsor obtain contractor support, if required in a timely fashion? (yes/~~no~~)
f. Will the sponsor likely request USACE assistance in acquiring real estate? (yes/~~no~~) (If "yes," provide description)
    1. Condemnation of tract in Louisiana that has been ongoing for 7-8 years.
    2. Use of Navigational Servitude in pipeline removals and relocations.

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? (yes/~~no~~)
b. Has the sponsor approved the project/real estate schedule/milestones? (yes/~~no~~)

IV. Overall Assessment:

**a.** Has the sponsor performed satisfactorily on other USACE projects? **YES**

APPENDIX 12-E

b. With regard to this project, the sponsor is anticipated to be: (highly capable / fully capable / moderately capable / marginally capable / insufficiently capable. If sponsor is believed to be "insufficiently capable", provide explanation. **HIGHLY CAPABLE**

V. Coordination:

a. Has this assessment been coordinated with the sponsor? (yes/~~no~~) **YES**

b. Does the sponsor concur with this assessment? (yes/~~no~~) (If "no", provide explanation) **YES**

Prepared by:

Randall Reese
General Manager
Sabine-Neches Navigation District

Reviewed and approved by:

Orlando Rosas
Chief, Real Estate Division

**EXHIBIT "B"**

February 24, 2003

Real Estate Division

Subject: Proposed Sabine Neches Waterway Project, Jefferson County, Texas

Mr. Paul Beard
Chairman
Jefferson County Navigation District
P.O. Box 778
Nederland, Texas 77627

Dear Mr. Beard:

It is our understanding, that you may begin acquiring rights-of-way and relocating pipelines in connection with the Sabine Neches Waterway Project prior to execution of the Project Cooperation Agreement (PCA) with the Federal Government. We appreciate your support for this proposed project but our regulations require us to inform you that **IF FOR ANY REASON, THE PCA NEVER GETS SIGNED OR IF CONGRESS FAILS TO AUTHORIZE OR FUND THE PROJECT, ANY LAND YOU ACQUIRED OR ANY MONEY YOU SPEND IN YOUR EFFORTS TO ACQUIRE LAND WILL BE AT THE SOLE RISK OF THE JEFFERSON COUNTY NAVIGATION DISTRICT.** Furthermore, for any property that qualifies for Federal participation in the project, your acquisition efforts must be in compliance with all of the provisions of P.L. 91-646, the Federal Relocation Assistance Law.

It has recently been determined that relocation of pipelines or utilities are considered as part of the Lands, Easements, and Rights-of-Way (LERRS) and can be accomplished prior to PCA execution at the sole risk of the Sponsor. It is also required that all relocations be supported by engineering cost estimates that meet project requirements as well as attorney's reports or opinions verifying that the pipeline or utility companies have compensable interests in the real property.

Please ensure that good records are kept regarding purchase price and real estate administrative expenses such as title evidence, surveys and appraisal fees. This will be necessary for you to receive credit in the event of Federal Authorization. Be advised that regulations dictate that credit will not be given for real estate administrative costs for properties acquired 5 years prior to execution of a PCA.

If you have any questions on any of the above please call Mr. Sal Arcidiacono of my staff at (409) 766-3803.

Sincerely,

Richard W. Harrison
Chief Real Estate Division

CF:
CESWG-PM-J, Ms. Lizette Richardson

**EXHIBIT "C"**

# SABINE-NECHES WATERWAY
# TEXAS & LOUISIANA
# CHANNEL IMPROVEMENT PROJECT
# REAL ESTATE MAPS 2006

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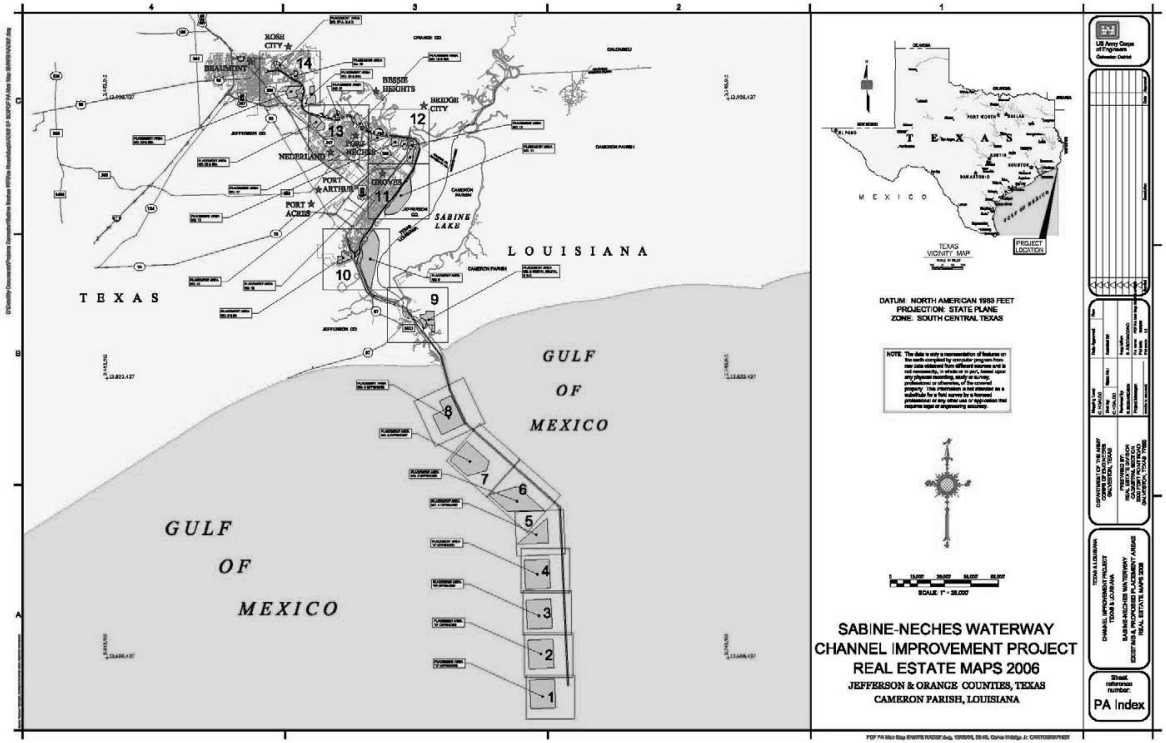
UNITED STATES ARMY CORPS
OF
ENGINEERS
GALVESTON DISTRICT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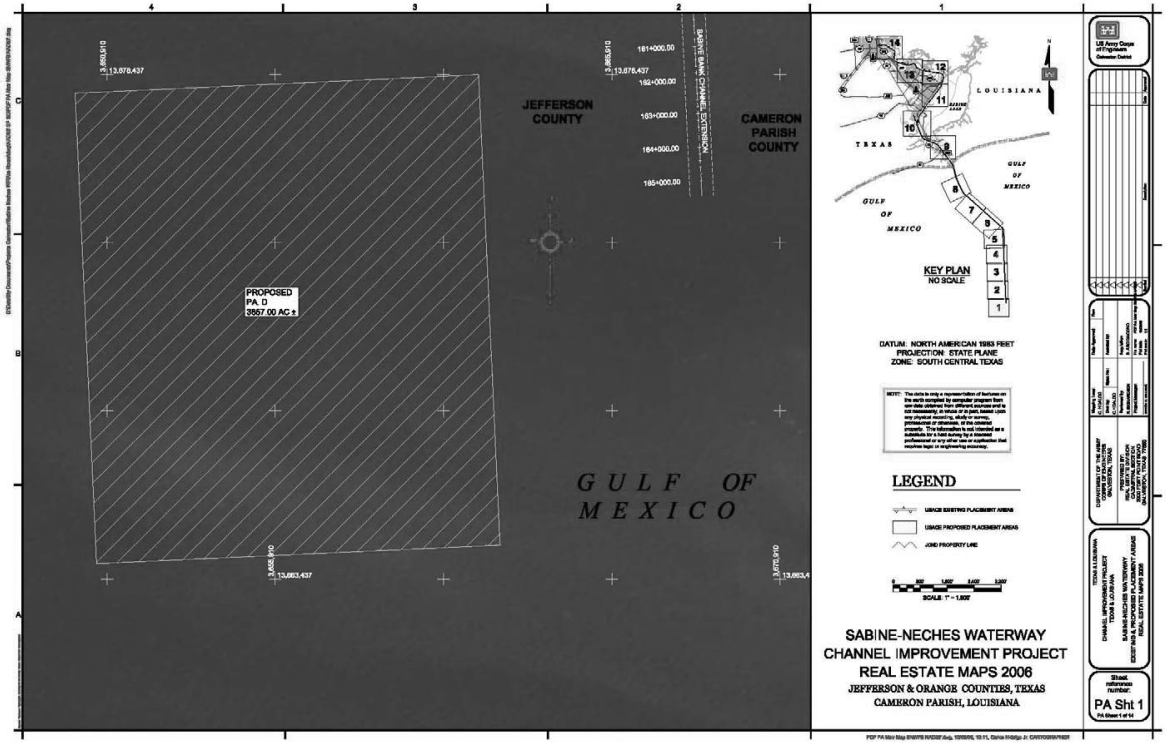
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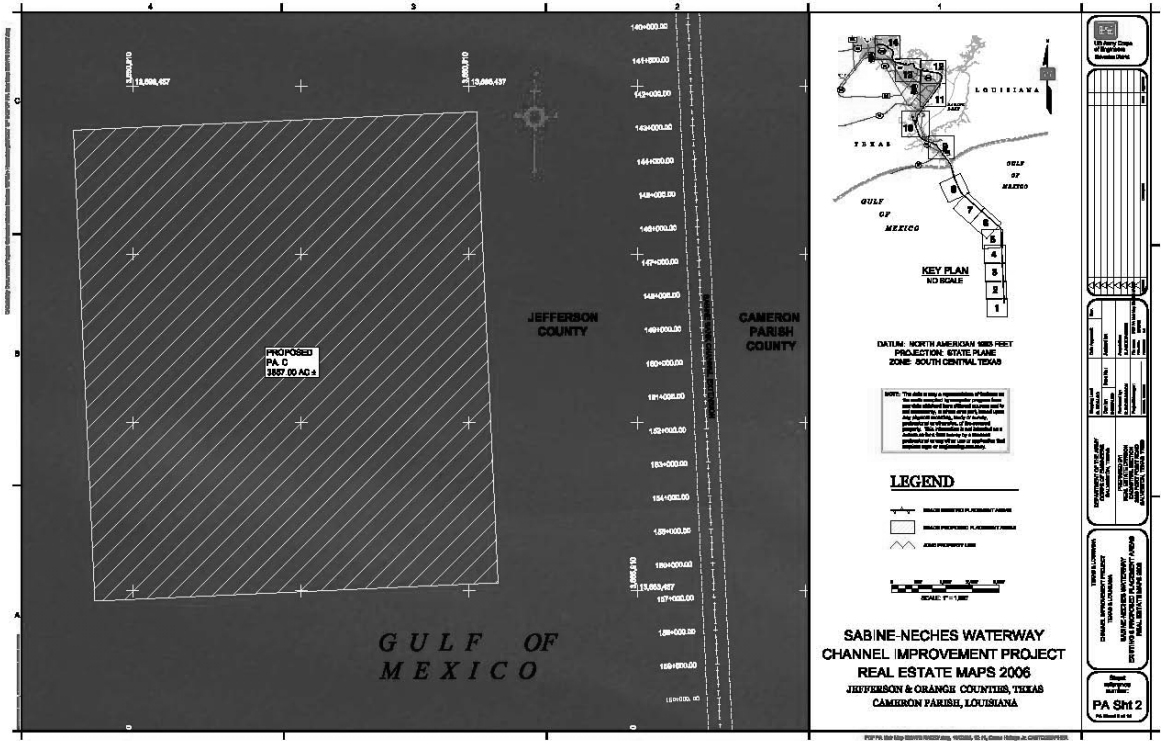
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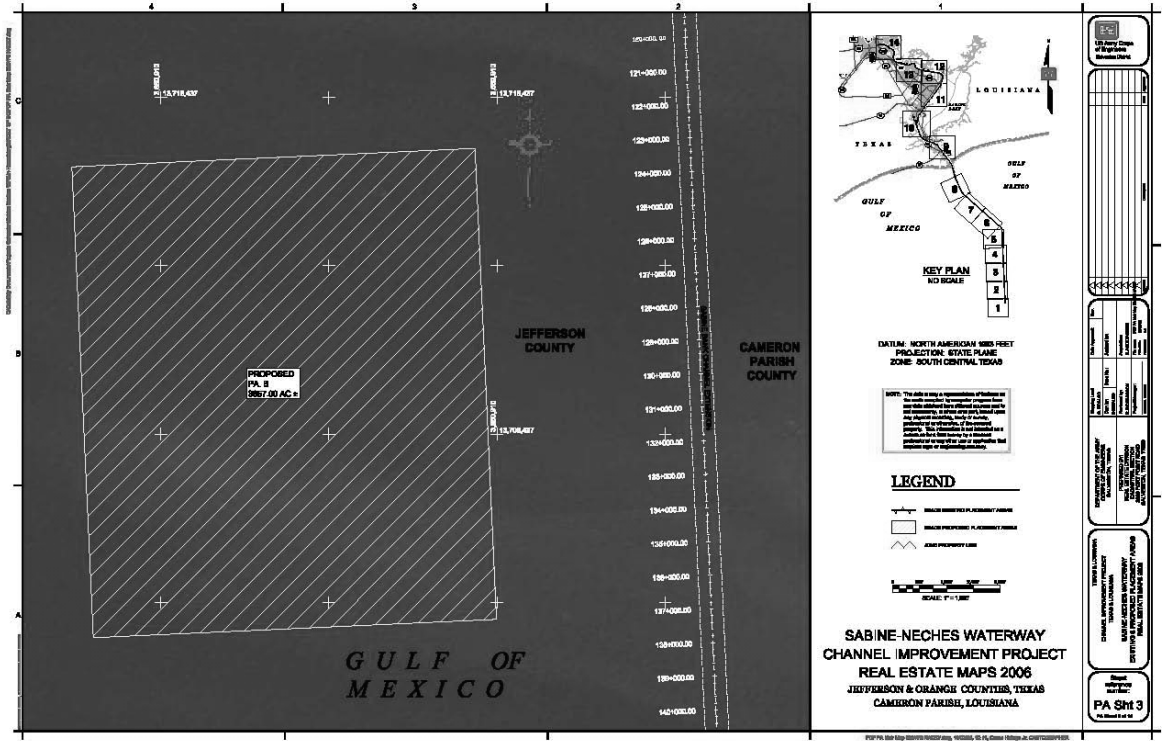
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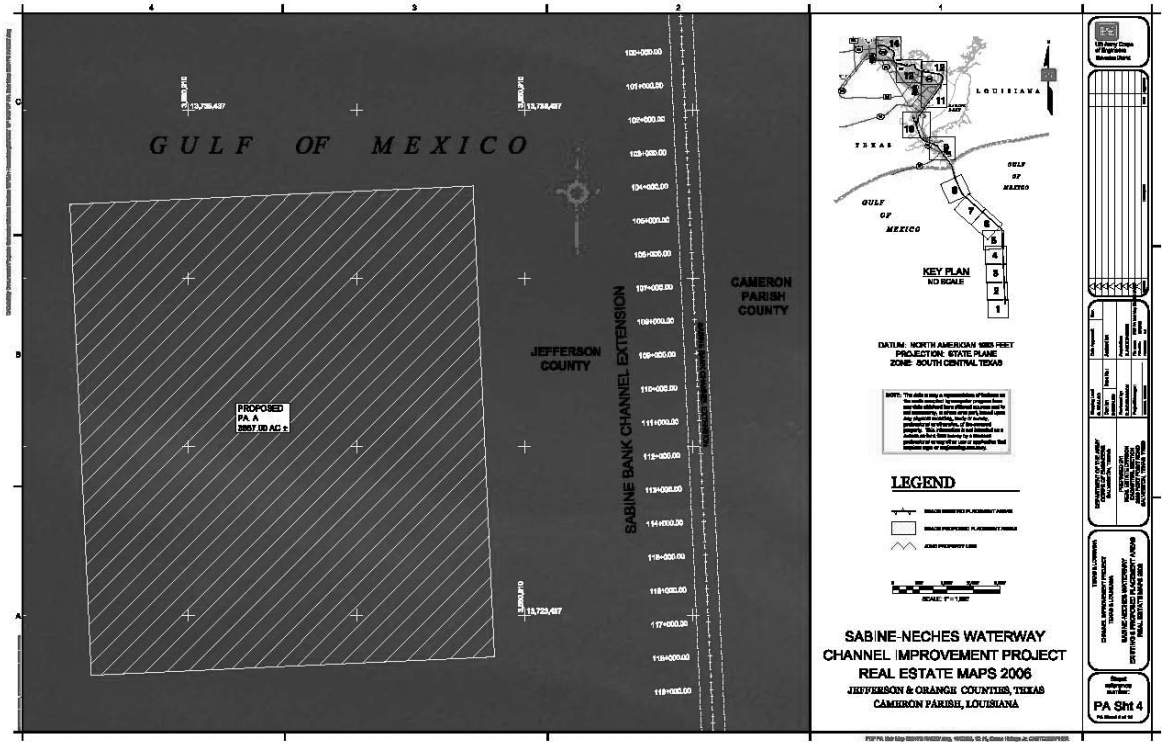
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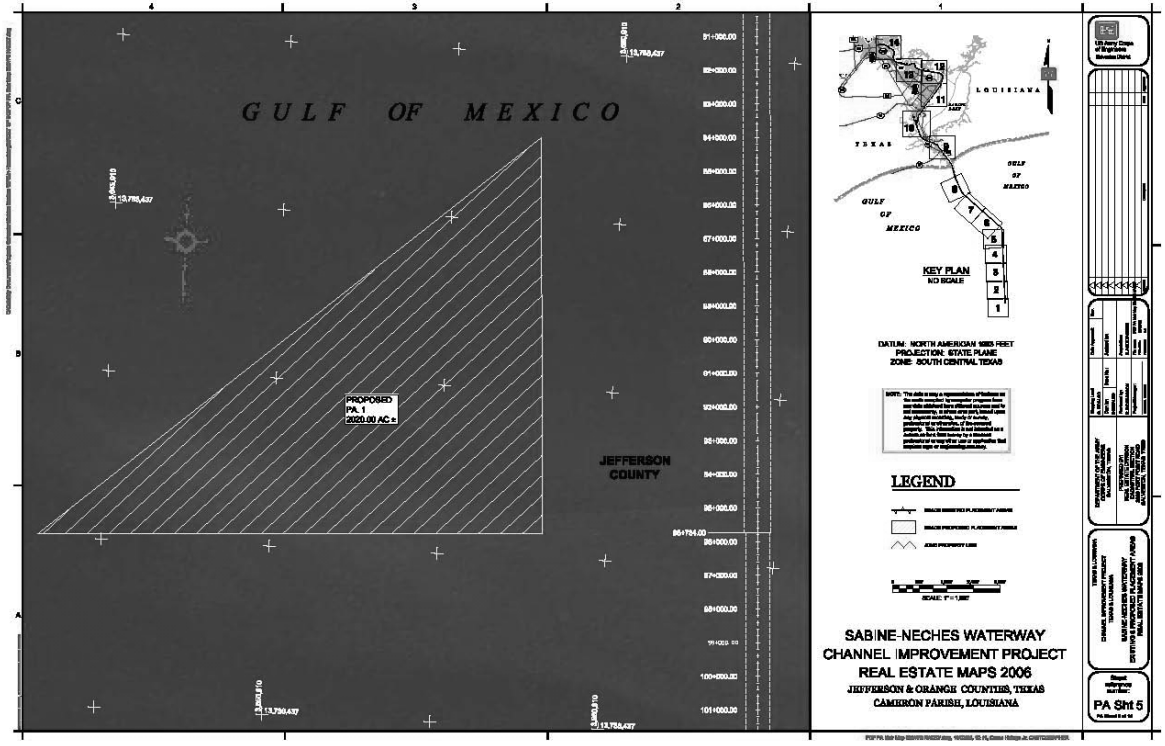
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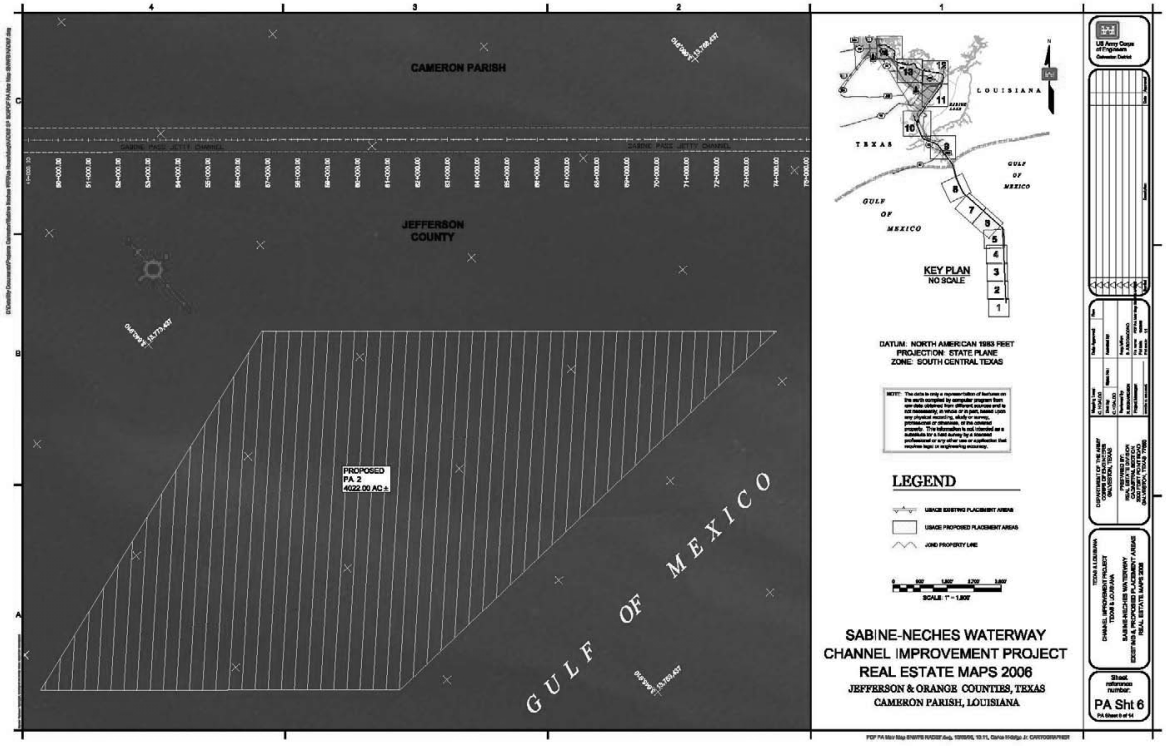
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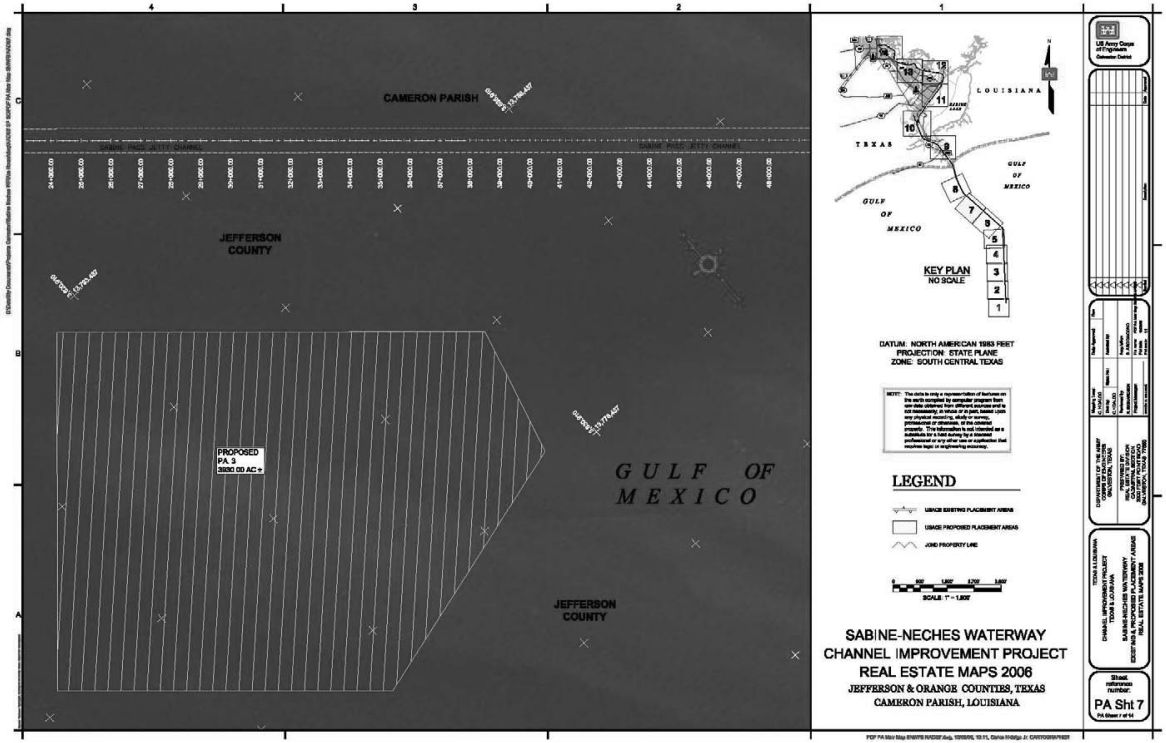
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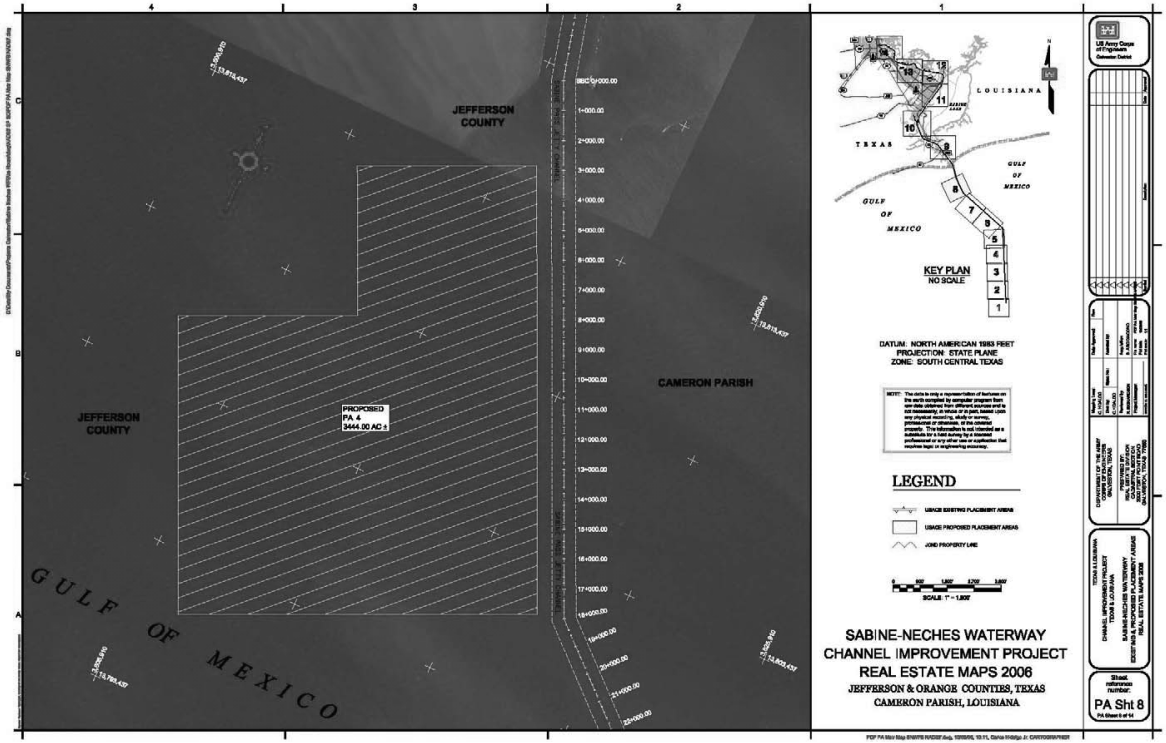
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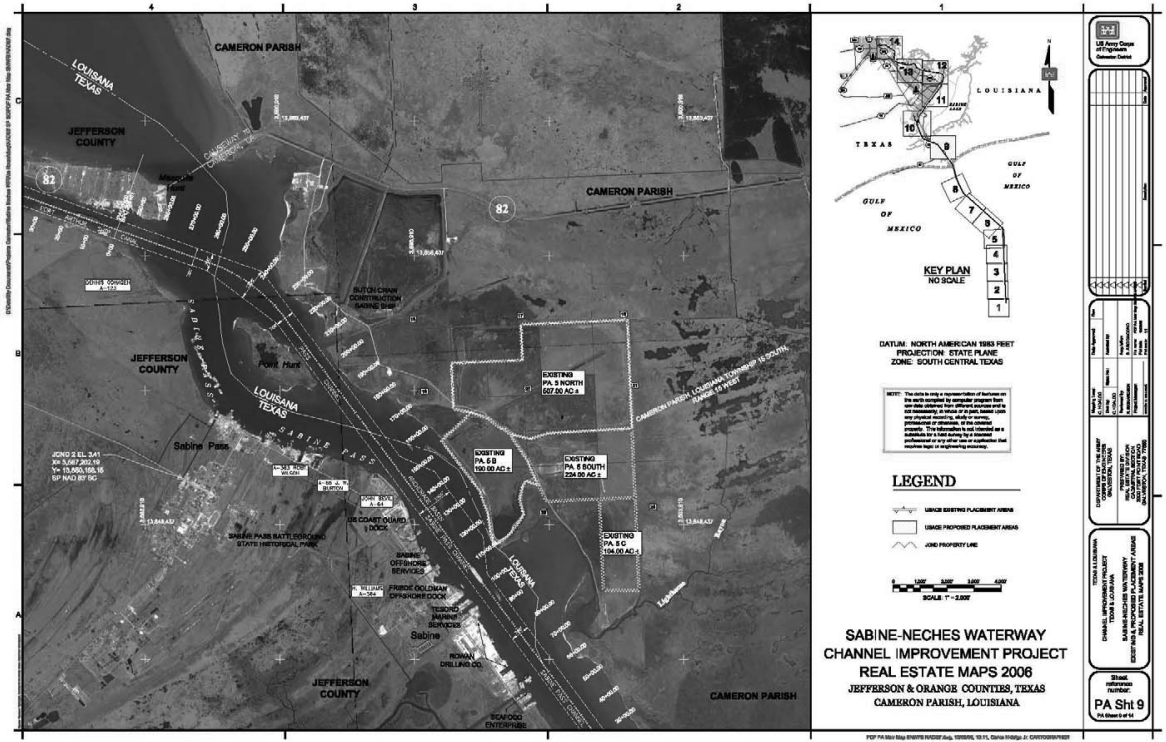
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SABINE PASS
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BUTCH CRAIN CONSTRUCTION SABINE DOCK
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EXISTING PA. 6 B 100.00 AC ±
EXISTING PA. 6 SOUTH 224.00 AC ±
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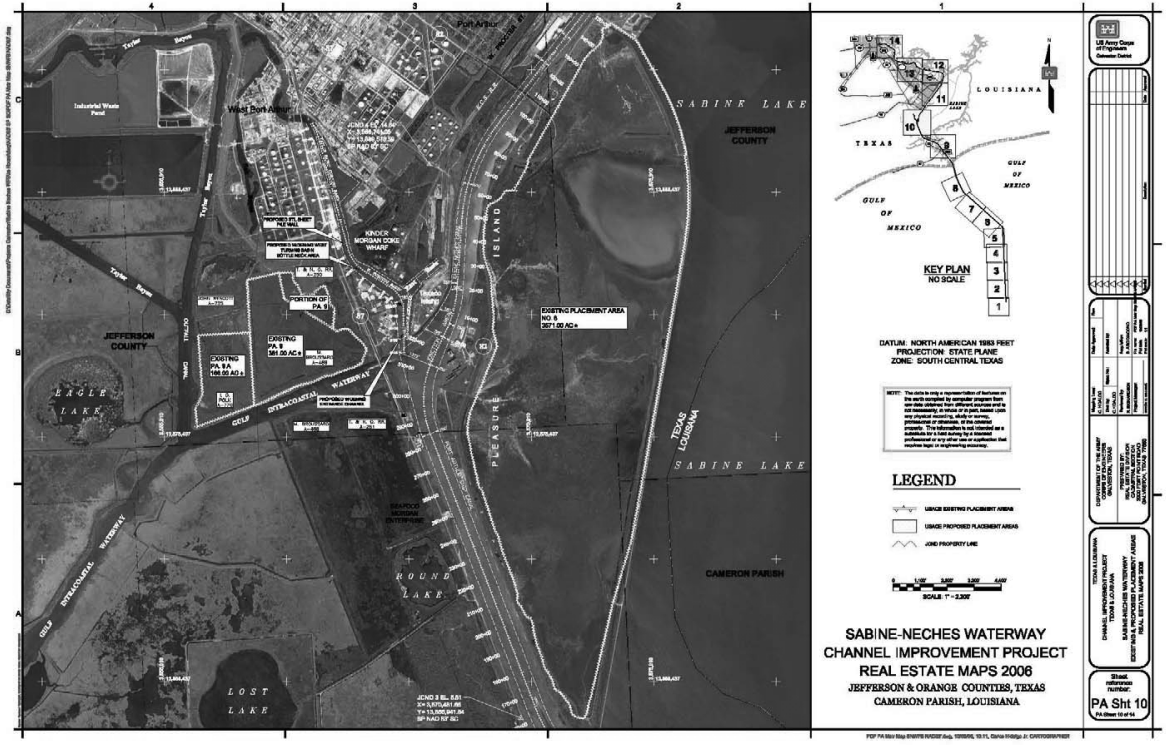
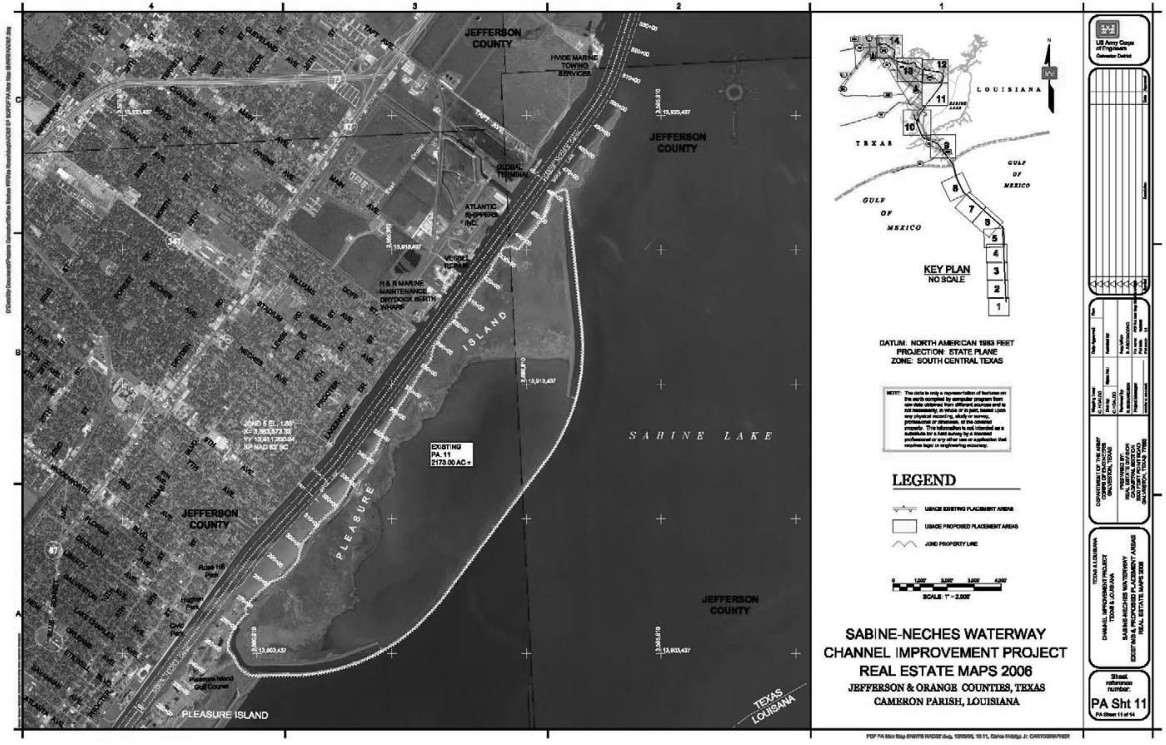
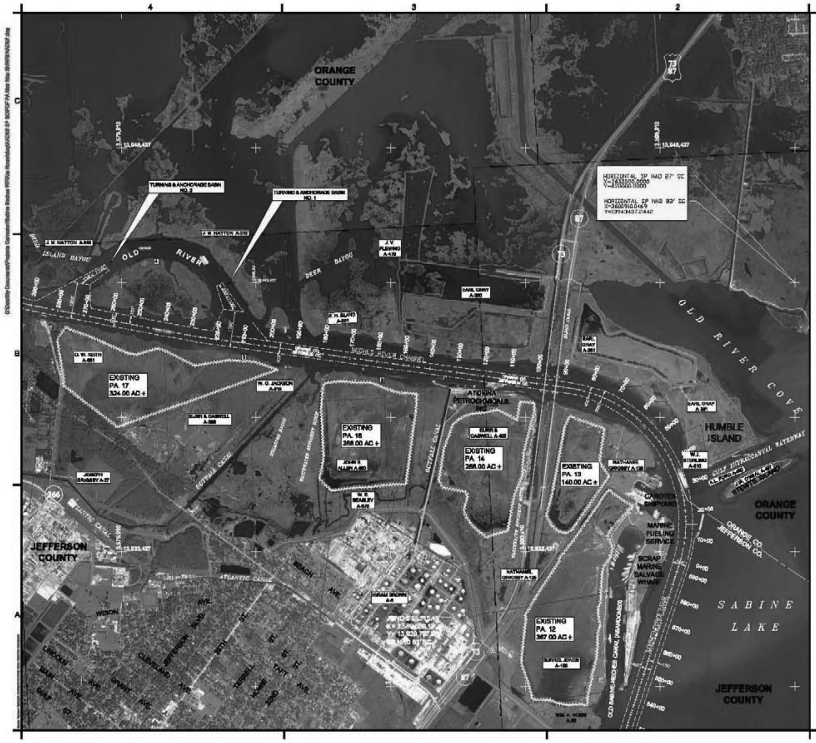
Sabine
ROWAN DRILLING CO.
STANFORD ENTERPRISE
LOUISIANA
NORTH TEXAS
KEY PLAN
NO SCALE
LOUISIANA
TEXAS
GULF OF MEXICO
DATUM: NORTH AMERICAN 1983 FEET
PROJECTION: STATE PLANE
ZONE: SOUTH CENTRAL TEXAS
LEGEND
USACE EXISTING PLACEMENT AREAS
USACE PROPOSED PLACEMENT AREAS
JOINT PROPERTY LINE
SCALE: 1" = 2,000'
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT
REAL ESTATE MAPS 2006
JEFFERSON & ORANGE COUNTIES, TEXAS
CAMERON PARISH, LOUISIANA
US Army Corps of Engineers
Galveston District
TEXAS & LOUISIANA
CHANNEL IMPROVEMENT PROJECT
SABINE-NECHES WATERWAY
EXISTING PLACEMENT AREAS
REAL ESTATE MAPS 2006
Sheet reference number:
PA Sht 9


Port Arthur
West Port Arthur
Industrial Waste Pond
Taylor Bayou
SABINE LAKE
JEFFERSON COUNTY
KINDER MORGAN COKE WHARF
PROPOSED FILL SHEET PILE WALL
PROPOSED MORGAN-KIRBY TURNING BASIN BOTTLE INDICATORS
PORTION OF PA 1
EXISTING PA 9 581.05 AC ±
EXISTING PA 9A 166.03 AC ±
EXISTING PLACEMENT AREA NO. 6 2071.00 AC ±
PROPOSED WIDENING EXPANSION CHANNEL
GULF INTRACOASTAL WATERWAY
PLEASURE ISLAND
TEXAS
LOUISIANA
SABINE LAKE
CAMERON PARISH
EAGLE LAKE
ROUND LAKE
LOST LAKE
LOUISIANA
TEXAS
GULF OF MEXICO
KEY PLAN
NO SCALE
DATUM: NORTH AMERICAN 1983 FEET
PROJECTION: STATE PLANE
ZONE: SOUTH CENTRAL TEXAS
LEGEND
USACE EXISTING PLACEMENT AREAS
USACE PROPOSED PLACEMENT AREAS
JCND PROPERTY LINE
SCALE: 1" = 2,300'
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT
REAL ESTATE MAPS 2006
JEFFERSON & ORANGE COUNTIES, TEXAS
CAMERON PARISH, LOUISIANA
US Army Corps of Engineers
Galveston District
TEXAS & LOUISIANA
CHANNEL IMPROVEMENT PROJECT
TOOR & LOUISIANA
SABINE-NECHES WATERWAY
GULF INTRACOASTAL WATERWAY
REAL ESTATE MAPS 2006
Sheet reference number:
PA Sht 10
PA Sheet 10 of 94


JEFFERSON COUNTY
HYDE MARINE TOWING SERVICES
GLOBAL TERMINAL
ATLANTIC SUPPLY INC.
H & R MARINE MAINTENANCE CRYOCOOK NORTH WHARF
PLEASURE ISLAND
SABINE LAKE
EXISTING PA. 11 2173.00 AC.±
PLEASURE ISLAND
TEXAS
LOUISIANA
KEY PLAN
NO SCALE
LOUISIANA
TEXAS
GULF OF MEXICO
DATUM: NORTH AMERICAN 1983 FEET
PROJECTION: STATE PLANE
ZONE: SOUTH CENTRAL TEXAS
LEGEND
USACE EXISTING PLACEMENT AREAS
USACE PROPOSED PLACEMENT AREAS
JOINT PROPERTY LINE
SCALE: 1" = 2,000'
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT
REAL ESTATE MAPS 2006
JEFFERSON & ORANGE COUNTIES, TEXAS
CAMERON PARISH, LOUISIANA
US Army Corps of Engineers
Galveston District
TEXAS & LOUISIANA
CHANNEL IMPROVEMENT PROJECT
SABINE-NECHES WATERWAY
JEFFERSON & ORANGE COUNTIES, TEXAS
CAMERON PARISH, LOUISIANA
REAL ESTATE MAPS 2006
Sheet reference number:
PA Sht 11
PA Sheet 11 of 94



DATUM: NORTH AMERICAN 1983 FEET
PROJECTION: STATE PLANE
ZONE: SOUTH CENTRAL TEXAS

NOTE: The data is only a representation of features on the earth compiled by computer aided drafting from use data obtained from different sources and is not necessarily, in whole or in part, based upon any physical recording, study or survey, professional or otherwise, of the cited property. The information is not intended as a substitute for a survey by a registered professional or any other job or application that requires legal or engineering accuracy.

## LEGEND

USACE EXISTING PLACEMENT AREAS

USACE PROPOSED PLACEMENT AREAS

JOINT PROPERTY LINE

0 1,000' 2,000' 3,000' 4,000'
SCALE: 1" = 2,000'

# SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT REAL ESTATE MAPS 2006

JEFFERSON & ORANGE COUNTIES, TEXAS
CAMERON PARISH, LOUISIANA

US Army Corps of Engineers
Galveston District

TEXAS & LOUISIANA
CHANNEL IMPROVEMENT PROJECT
SABINE-NECHES WATERWAY
ECONOMIC REVALUATION REPORT
REAL ESTATE MAPS 2006

Sheet reference number:
PA Sht 12
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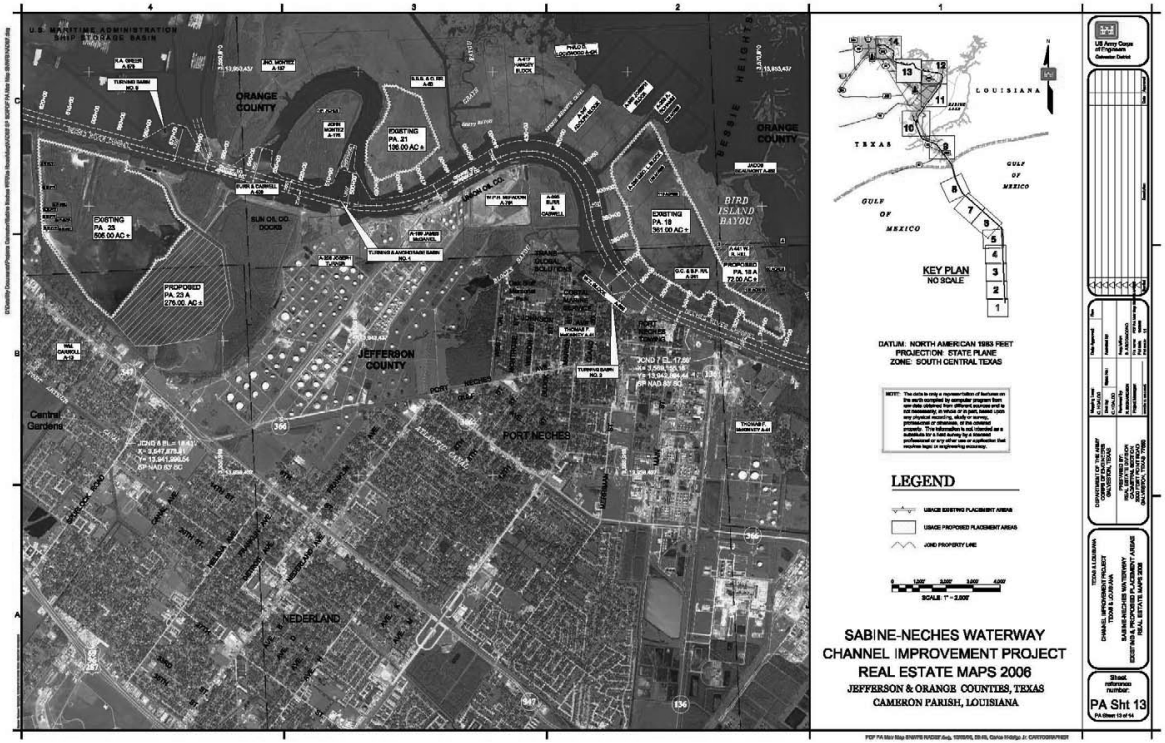
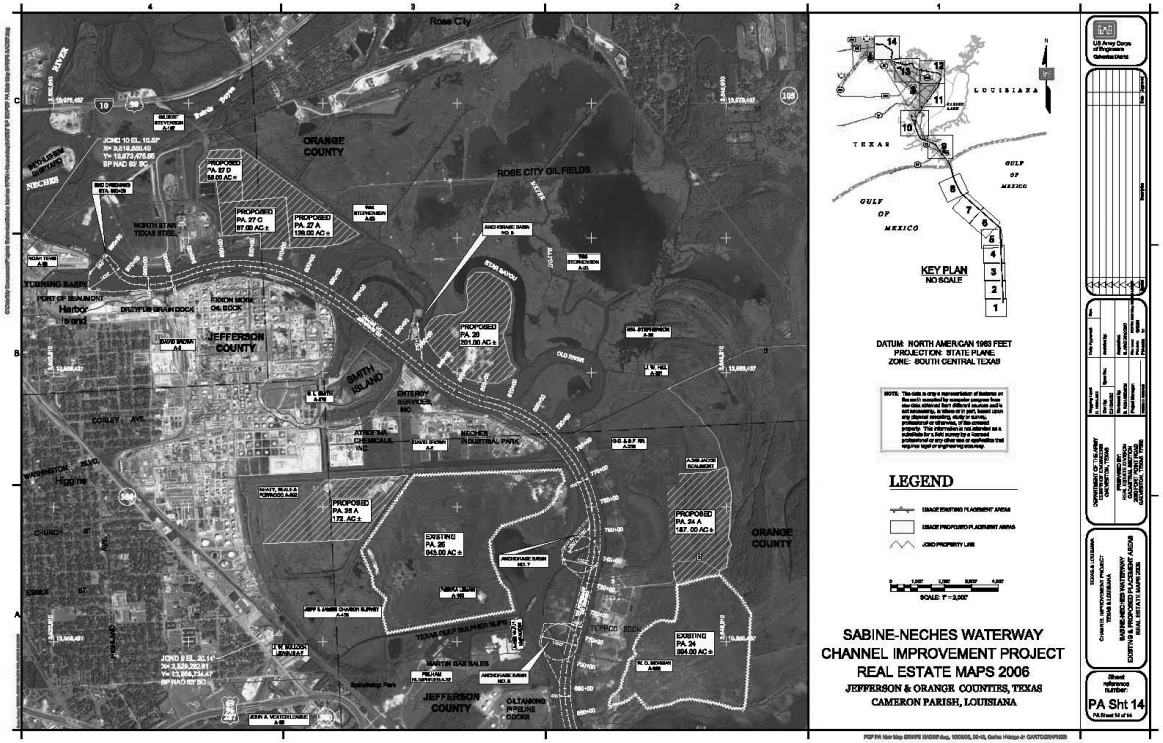

U.S. MARITIME ADMINISTRATION SHIP STORAGE BASIN
ORANGE COUNTY
JEFFERSON COUNTY
PORT NECHES
NEDERLAND
Central Gardens
BIRD ISLAND BAYOU
EXISTING PA. 21 156.00 AC ±
EXISTING PA. 22 506.00 AC ±
EXISTING PA. 19 561.00 AC ±
PROPOSED PA. 23 A 276.00 ACS
PROPOSED PA. 18 A 72.00 AC ±
SUN OIL CO. DOCKS
TURNING & ANCHORAGE BASIN NO. 1
TURNING BASIN NO. 2
TURNING BASIN NO. 3
JCND 7 EL.-17.00
JCND 6 EL.-18.00
LOUISIANA
TEXAS
GULF OF MEXICO
KEY PLAN
NO SCALE
DATUM: NORTH AMERICAN 1983 FEET
PROJECTION: STATE PLANE
ZONE: SOUTH CENTRAL TEXAS
LEGEND
USACE EXISTING PLACEMENT AREAS
USACE PROPOSED PLACEMENT AREAS
JCND PROPERTY LINE
SCALE: 1" = 2,000'
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT
REAL ESTATE MAPS 2006
JEFFERSON & ORANGE COUNTIES, TEXAS
CAMERON PARISH, LOUISIANA
US Army Corps of Engineers
Galveston District
TEXAS & LOUISIANA
CHANNEL IMPROVEMENT PROJECT
SABINE-NECHES WATERWAY
JEFFERSON & ORANGE COUNTIES, TEXAS
REAL ESTATE MAPS 2006
Sheet reference number:
PA Sht 13
PA Sheet 13 of 54


Rose City
ORANGE COUNTY
ROSE CITY OIL FIELDS
NORTH STAR TEXAS STEEL
TURNING BASIN
PORT OF BEAUMONT
Harbor Island
JEFFERSON COUNTY
SMITH ISLAND
ATHENA CHEMICALS, INC.
MECHES INDUSTRIAL PARK
PROPOSED PA. 27 D 58.00 AC ±
PROPOSED PA. 27 C 57.00 AC ±
PROPOSED PA. 27 A 128.00 AC ±
PROPOSED PA. 28 591.00 AC ±
PROPOSED PA. 28 A 175 AC ±
PROPOSED PA. 24 A 187.00 AC ±
EXISTING PA. 26 845.00 AC ±
EXISTING PA. 24 394.00 AC ±
JCND 10 EL. 10.00'
JCND 9 EL. 20.14'
LOUISIANA
TEXAS
GULF OF MEXICO
KEY PLAN
NO SCALE
DATUM: NORTH AMERICAN 1983 FEET
PROJECTION: STATE PLANE
ZONE: SOUTH CENTRAL TEXAS
LEGEND
USAGE EXISTING PLACEMENT AREAS
USAGE PROPOSED PLACEMENT AREAS
JCND PROPERTY LINE
SCALE: 1" = 2,000'
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT
REAL ESTATE MAPS 2006
JEFFERSON & ORANGE COUNTIES, TEXAS
CAMERON PARISH, LOUISIANA
US Army Corps of Engineers Galveston District
PA Sht 14

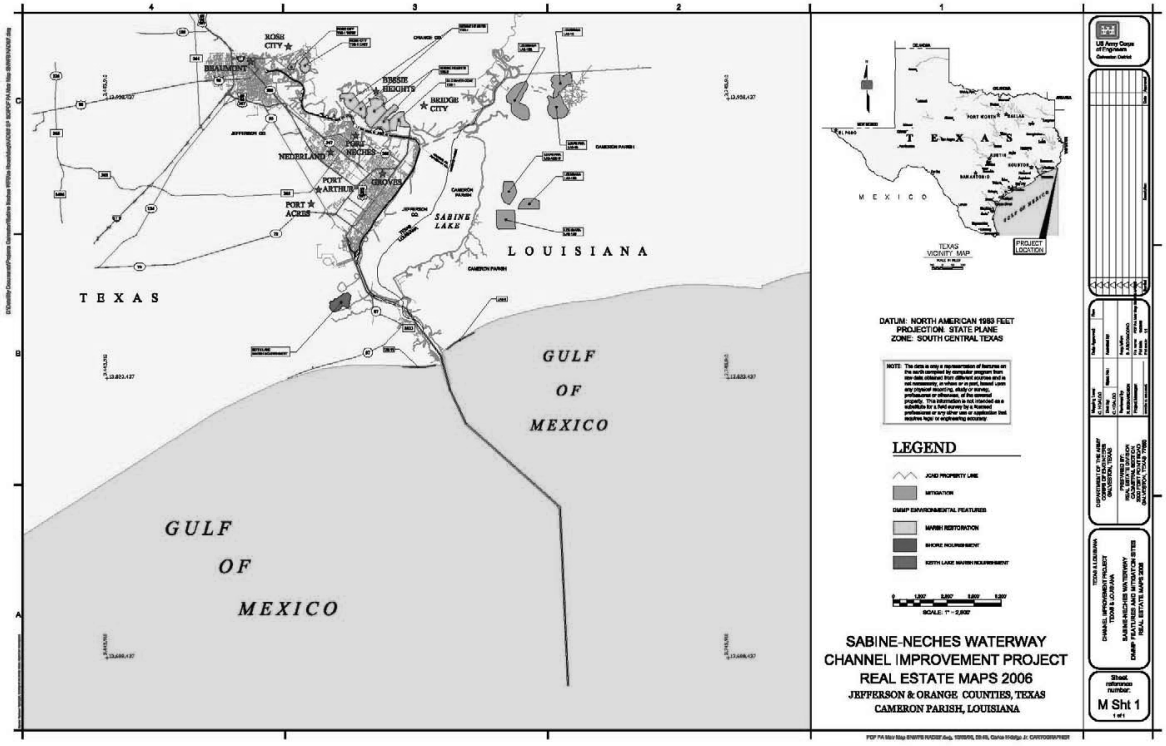

BEAUMONT
KOSH CITY
BRIDGE CITY
NEDERLAND
PORT NECHES
PORT ARTHUR
GROVES
PORT ACRES
SABINE LAKE
TEXAS
LOUISIANA
GULF OF MEXICO
GULF OF MEXICO
MEXICO
TEXAS
TEXAS VICINITY MAP
PROJECT LOCATION
DATUM: NORTH AMERICAN 1983 FEET
PROJECTION: STATE PLANE
ZONE: SOUTH CENTRAL TEXAS
LEGEND
ACAD PROPERTY LINE
MITIGATION
DMMP ENVIRONMENTAL FEATURES
MARSH RESTORATION
SHORE NOURISHMENT
SIXTH LAKE MARSH NOURISHMENT
SCALE: 1" = 2,000'
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT
REAL ESTATE MAPS 2006
JEFFERSON & ORANGE COUNTIES, TEXAS
CAMERON PARISH, LOUISIANA
US Army Corps of Engineers
Galveston District
TEXAS & LOUISIANA
CHANNEL IMPROVEMENT PROJECT
SABINE-NECHES WATERWAY
DMMP PLACEMENT SITE INVENTORY
REAL ESTATE MAPS 2006
Sheet reference number:
M Sht 1
1 of 1

**EXHIBIT "D"**

# SNWW PIPELINES

| STATION | OWNER | DESCRIPTION/ STATUS | SIZE (inches) | DEPTH (feet) |
|---|---|---|---|---|
| 184+65 | Air Liquide Large Industries U.S. L.P. | NITROGEN | 8 | 50 |
| 184+65 | Air Liquide Large Industries U.S. L.P. | OXYGEN | 8 | 50 |
| 184+65 | Air Liquide Large Industries U.S. L.P. | SPARE | 8 | 50 |
| 294+61 | Air Products & Chemical, Inc. | HYDROGEN GAS | 10 | 51 |
| 185+65 | Ameripol Synpol Corporation | BUTADIENE | 4 | 52 |
| 180+00 | Chevron Phillips Chemical Company, LLC | ETHYLENE GAS | 8 | ? |
| 185+65 | Chevron Pipe Line Co. | ETHYLENE GAS | 8 | 52 |
| 293+52 | Chevron Pipe Line Co. | GAS | 18 | 53 |
| 294+24 | Chevron Pipe Line Co. | ETHYLENE | 16 | 50 |
| 183+40 | City of Port Arthur | WATER/ INACTIVE | 10 | ? |
| 546+32 | Colonial Pipeline Company | REFINED PRODUCTS | 36 | 48 |
| 544+68 | Colonial Pipeline Company | REFINED PRODUCTS | 40 | 52 |
| 291+26 | DCP Midstream, LLC | NATURAL GAS | 8 | 58 |
| 294+56 | DCP Midstream, LLC | PETROLEUM | 8 | 50 |
| 671+65 | DCP Midstream, LLC | NATURAL GAS/ DUPLICATE | 30 | 52 |
| 152+000 | Dynegy Midstream Services, L.P. | STATUS UNKNOWN | ? | ? |

# SNWW PIPELINES (cont'd)

| STATION | OWNER | DESCRIPTION/ STATUS | SIZE (inches) | DEPTH (feet) |
|---|---|---|---|---|
| 659+50 | E.I. DuPont de Nemours | PROPYLENE | 4 | 50 |
| 291+26 | E.I. DuPont de Nemours | ETHANES | 8 | 58 |
| 659+50 | E.I. DuPont de Nemours | ETHYLENE GAS | 8 | 50 |
| 591+70 | El Paso Corporation | INACTIVE | 6 | 50 |
| 788+55 | Entergy Texas, Inc. | WATER/ INACTIVE | 18 | 50 |
| 667+35 | Enterprise Products Partners, L.P. | SPARE | 30 | 55 |
| 667+70 | Enterprise TE Products Pipeline Company LLC | REFINED PRODUCTS | 20 | 52 |
| 667+70 | Enterprise TE Products Pipeline Company LLC | REFINED PRODUCTS | 20 | 52 |
| 667+35 | Enterprise TE Products Pipeline Company LLC | SPARE | 8 | 55 |
| 659+50 | Enterprise TE Products Pipeline Company LLC | REFINED PRODUCTS | 8 | 50 |
| 287+37 | Explorer Pipeline Company | REFINED PRODUCTS | 12 | 55 |
| 291+26 | Flint Hills Resources Port Arthur LLC | ETHYLENE | 8 | 58 |
| 4+000 | Gulf South Pipeline Company, L.P. | NATURAL GAS | 16 | 61 |
| 659+50 | Investa, B.V. | HYDROGEN GAS | 8 | 50 |
| 659+50 | Investa, B.V. | AMMONIA | 4 | 50 |
| 291+26 | Kinder Morgan Tejas Pipeline, L.L.C. | NATURAL GAS | 24 | 50 |
| 242+33 | Kinder Morgan Tejas Pipeline, LLC | NATURAL GAS | 30 | 55 |

# SNWW PIPELINES (cont'd)

| STATION | OWNER | DESCRIPTION/ STATUS | SIZE (inches) | DEPTH (feet) |
|---|---|---|---|---|
| 99+30 | Kinder Morgan Tejas Pipeline, LLC | NATURAL GAS/ INACTIVE | 16 | 45 |
| 291+26 | Kinder Morgan Tejas Pipeline, LLC | NATURAL GAS | 26 | 50 |
| 288+46 | Kinder Morgan Texas Pipeline, L.P. | NATURAL GAS | 20 | 50 |
| 288+46 | Kinder Morgan Texas Pipeline, L.P. | NATURAL GAS | 16 | 50 |
| 666+50 | Kinder Morgan Texas Pipeline, L.P. | INACTIVE | 8 | ? |
| 664+32 | Maritime Administration | Power | ? | 51 |
| 294+02 | Shell Pipeline Company, L.P. | CRUDE OIL | 22 | 50 |
| 294+76 | Shell Pipeline Company, L.P. | PETROLEUM/ IDLE | 6 | 50 |
| 667+35 | Texas Oil & Chemical Co., Inc. | SPARE | 12 | 55 |
| 56+582 | Targa NGL Pipeline Company, LLC | NATURAL GAS | 10 | 61 |
| 82+500 | Targa NGL Pipeline Company, LLC | NATURAL GAS Liquids | 12 | 61 |
| 25+000 | Tennessee Gas Pipeline Company | NATURAL GAS | 30 | 61 |
| 185+65 | TPC Group, Inc. | BUTADIENE | 4 | 52 |

# FINAL ENVIRONMENTAL IMPACT STATEMENT
# FOR
# SABINE-NECHES WATERWAY
# CHANNEL IMPROVEMENT PROJECT
# SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

## VOLUME II

COOPERATING AGENCIES:

U.S. ENVIRONMENTAL PROTECTION AGENCY
U.S. DEPARTMENT OF THE INTERIOR – FISH AND WILDLIFE SERVICE
U.S. DEPARTMENT OF COMMERCE – NATIONAL MARINE FISHERIES SERVICE
TEXAS GENERAL LAND OFFICE
LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

March 2011

## ABSTRACT

## FINAL ENVIRONMENTAL IMPACT STATEMENT PROPOSED SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

The responsible agency for this action is the U.S. Army Corps of Engineers, Galveston District (USACE). The non-Federal sponsor is the Sabine Neches Navigation District (SNND). The U.S. Environmental Protection Agency, U.S. Department of the Interior – Fish and Wildlife Service, U.S. Department of Commerce – National Marine Fisheries Service, Texas General Land Office, and the Louisiana Department of Wildlife and Fisheries are cooperating agencies.

Abstract: This Final Environmental Impact Statement (FEIS) was prepared as required by the National Environmental Policy Act (NEPA) to present an evaluation of potential impacts of the proposed Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). The proposed SNWW CIP is intended to improve the efficiency of the deep-draft navigation system while protecting the area's environmental resources. The FEIS addresses the potential direct, indirect, and cumulative impacts of the proposed project on the human environment, as identified during the public interest review, including placement of dredged material. All factors that may be relevant to the proposed project were considered, including plans for construction and operations, dredged material management and opportunities for beneficial uses, hydrology, salinity, and storm surges, terrestrial and aquatic habitats, endangered species, essential fish habitat, hazardous materials, air quality, shoreline erosion, cultural resources, socioeconomic considerations, safety, and economic effects. The alternatives analysis evaluated the No-Action, 3 nonstructural, and 120 structural alternatives. A recommended plan was selected that would deepen the SNWW to Beaumont to 48 feet and extend the Sabine Bank Channel an additional 13.2 miles, taper the Sabine Bank Channel from 800 feet wide (Station 23+300) to 700 feet wide (Station 25+800) through the end of the Sabine Bank Channel extension, deepen and widen Taylor Bayou channels and turning basins, and construct 3 new anchorage/turning basins on the Neches River. Beneficial use features and mitigation measures have been developed that effectively avoid or mitigate all environmental impacts. The public response to the findings of the Draft EIS have been addressed in the FEIS.

Comments on this FEIS must be postmarked by April 4, 2011.

For further information, contact:
Janelle Stokes
U.S. Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229
Phone: 409.766.3039
e-mail: janelle.s.stokes@usace.army.mil

## ES.1 INTRODUCTION AND AUTHORITY

The U.S. Army Corps of Engineers (USACE) has joined in an agreement with the Sabine Neches Navigation District (SNND) to prepare a Final Feasibility Report (FFR) and a Final Environmental Impact Statement (FEIS) for proposed improvements to the Sabine-Neches Waterway (SNWW). The proposed SNWW Channel Improvement Project (CIP) is intended to improve the efficiency of the deep-draft navigation system while protecting the area's coastal and estuarine resources. As authorized by the Senate Committee on Environment and Public Works Resolution, dated June 5, 1997, USACE has reviewed previous USACE reports on the SNWW and other pertinent reports to determine the feasibility of modifying the channels serving the Port of Beaumont and the Port of Port Arthur, Texas. The lead agency for the FEIS is USACE, with several cooperating agencies. This FEIS was prepared as required by the National Environmental Policy Act to present an evaluation of potential impacts associated with the proposed CIP.

## ES.2 PURPOSE AND NEED

The purpose of the proposed CIP is to improve the transportation efficiency of the SNWW's deep-draft navigation system, while protecting the quality of the area's coastal and estuarine resources. Proposed channel improvements will support industry at ports within the SNWW navigation channel system, which are critical in the Nation's economy and military defense. Depth restrictions of the existing SNWW channel configuration and congestion in the channel prevent it from efficiently accommodating predicted future increases in crude oil imports. In addition to existing crude oil and petrochemical product facilities on the SNWW, one liquefied natural gas (LNG) facility began operations in 2008, and construction of a second facility is nearing completion; a third has received regulatory approval. In 2007, the Port of Beaumont handled about half of the military cargo deployed to and from the war in Iraq. The existing, congested SNWW cannot handle this level of increased use without compromising efficiency. Deep-draft vessels and barge traffic are restricted by narrow channel widths leading to constraints such as daylight-only and one-way sailing restrictions in specific reaches. Given the trend towards shorter, wider vessels and the congestion in the channel, deepening the channel could alleviate some of the congestion by allowing vessels to be more fully loaded and reducing the number of lightened and lightering vessels. The need to improve the SNWW must be weighed against the potential to affect significant environmental resources. The study area contains approximately 480 square miles of sensitive coastal habitats that are plagued by a high rate of wetland loss and extensive losses of interior coastal wetlands. These high rates of land loss provide opportunities to use dredged material beneficially for wetland restoration.

## ES.3 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

Analysis of alternatives that could potentially meet the purpose and need for the proposed action included a systematic evaluation and consideration of environmental factors. Based on a three-phase screening

process (preliminary screening, second screening, and final screening of alternatives), nonstructural and structural alternatives were identified and evaluated relative to a No-Action Alternative. The No-Action Alternative carried forward for evaluation provides a basis against which all other alternative plans are measured. Thus, under the No-Action Alternative, the Federal Government and the non-Federal sponsor would not implement the proposed CIP. The 40-foot SNWW navigation channel would not be improved, and the objectives of improving the navigational efficiency of the waterway would not be met. Additionally, under the No-Action Alternative, benefits associated with proposed beneficial uses of dredged material for the proposed CIP would be substantially reduced. Nonstructural alternatives evaluated were (1) an alternative mode of commodity transport (i.e., an offshore oil terminal), (2) a vessel traffic system, and (3) modification of pilot rules. None of these alternatives increased the efficiency objective for all waterway users and were eliminated from further consideration.

Through the three-phase screening process, over 120 different combinations of various channel depths and widths were considered, with six depths (45, 46, 47, 48, 49, and 50 feet) evaluated in detail. The detailed evaluation included an economic evaluation to identify alternatives that maximized National Economic Development (NED) benefits, consistent with protecting the environment. Project benefits were based on reductions in transportation costs generated from more-efficient vessel loading and from reductions in vessel delays. The width of the channel was evaluated with a vessel simulation model conducted by the USACE Engineer Research and Design Center (ERDC) with input from the Sabine Pilots Association. Following the selection of a preferred channel alternative, a detailed evaluation of alternatives for the management of dredged material and the mitigation of ecological impacts was conducted. Least-cost analysis of dredged material placement and an incremental cost analysis of mitigation alternatives were conducted to select recommended placement and mitigation measures. The analysis of alternative dredged material placement7 components was performed in conjunction with planning for the avoidance and mitigation of impacts from channel improvements so that dredged material could be given a priority for potential use in mitigation efforts. Dredged material placement alternatives considered in the detailed evaluation included:

- Neches River Beneficial Use (BU) Feature
- Gulf Shore BU Feature
- Existing Active and Inactive Upland Placement Features (PAs)
- New upland PAs
- Existing Ocean Dredged Material Disposal Sites (ODMDSs)
- New ODMDSs

The Preferred Alternative proposes to increase the authorized depth of the channel from 40 to 48 feet along the entire 64-mile-long existing channel and add a 13.2-mile extension to the offshore channels into the Gulf of Mexico. The offshore navigation channels, known collectively as the Entrance Channel, are divided into the Extension Channel, the Sabine Bank Channel, the Sabine Pass Outer Bar Channel, and the Sabine Pass Jetty Channel. They would be deepened from 42 to 50 feet. The inshore channels (the Sabine Pass Jetty Channel, Sabine Pass Channel, Port Arthur and Sabine-Neches canals, and the Neches

River Channel) would be deepened from 40 feet to 48 feet. No modifications to the existing Sabine Pass Jetties are contemplated in conjunction with this project. Potential rehabilitation of the jetties is currently being studied, with the goal of preparing a long-range plan of modification needed to ensure that the jetties continue to function appropriately to support the Federal navigation channel.

Except for the one channel reach just beyond the jetties, the bottom width of the offshore Entrance Channel would be 700 feet wide. Since the existing Sabine Bank Channel is 800 feet wide, the bottom width of the deepened channel would be reduced to 700 feet wide. However, high currents passing around the mouth of the jetties require that the bottom width of the Sabine Pass Outer Bar Channel remain 800 feet wide, and therefore the deepened channel would be tapered to connect to the 700-foot Entrance Channel. With the exception of the Taylor Bayou basins and channels, the inshore channels would retain their existing 500 to 400 foot widths. The Taylor Bayou basins and channels would be widened to improve maneuverability for vessels using that facility. Neither the Sabine-Neches Canal nor the Neches River Chanel would be systematically widened, but navigation efficiency would be improved with bend easings in both reaches and the addition or enlargement of turning and anchorage basins on the Neches River Channel. Project dimensions for the Preferred Alternative are provided in Table ES-1.

Table ES-1
Project Dimensions for Preferred Alternative

| Reach | Station | to | Station | Bottom Width (feet) | Project Depth (feet) |
|---|---|---|---|---|---|
| Extension Channel | 165+443 | | 95+734 | 700 | 50 |
| Sabine Bank Channel | 95+734 | | 25+800 | 700 | 50 |
| Sabine Bank Channel | 25+800 | | 23+300 | 700–800 | 50 |
| Sabine Bank Channel | 23+300 | | 18+000 | 800 | 50 |
| Sabine Pass Outer Bar Channel | 18+000 | | 0+000 | 800 | 50 |
| Sabine Pass Jetty Channel | –214+88 | | 0+00 | 800–500 | 48 |
| Sabine Pass Channel | 0+00 | | 296+25 | 1355–500 | 48 |
| Port Arthur Canal | 0+00 | | 325+84 | 1660–500 | 48 |
| Sabine-Neches Canal | 0+00 | | 592+94 | 1050–400 | 48 |
| Neches River Channel | 0+00 | | 980+00 | 400–1413 | 48 |
| **Taylor Bayou** | | | | | |
| Entrance Channel | 0+00 | | 25+27 | 406–764 | 48 |
| East Turning Basin | 0+00 | | 17+65 | 532–354 | 48 |
| West Turning Basin | 25+27 | | 41+30 | 776 | 48 |
| Connecting Channel | 41+30 | | 71+50 | 470–250 | 48 |
| Taylor Bayou Turning Basin | 71+50 | | 106+25 | 1000 | 48 |

A total of 104 pipelines have been identified crossing the SNWW navigation channels. Of the 104 pipelines, 46 require adjustment to meet the minimum required vertical and horizontal clearances for the SNWW CIP. Bridge supports for the Martin Luther King Bridge over the Sabine-Neches Canal would be hardened because of the proximity of the new channel cut; supports for the Rainbow and Veterans Memorial bridges would not be affected. Bridge fender systems for all three bridges would be removed

and replaced to accommodate the new channel dimensions. The Port Arthur Hurricane Flood Protection Levee and utility power lines would not be affected.

Dredged material produced by construction of the Preferred Alternative and during maintenance dredging over the 50-year period of analysis would be managed in accordance with the Dredged Material Management Plan (DMMP). PAs proposed in the DMMP consist of upland PAs, ODMDSs, and BU features. Construction of the Preferred Alternative is expected to yield approximately 98 million cubic yards (mcy) of new-work dredged material. Maintenance dredging over the 50-year period of analysis is expected to yield approximately 650 mcy of dredged material. Dredged material will be placed in 16 existing upland PA features and 2 new expansion cells at existing upland PAs (18A and 24A). For the Entrance Channel, material will be placed in four existing and four proposed ODMDS features. Beneficial uses of dredged material in the DMMP consist of the Neches River BU Feature (Rose City East, Bessie Heights East, and Old River Cove) and the Gulf Shore BU Feature at Texas and Louisiana Points. Figures 2.4-1a–g in the FEIS show all the DMMP placement features proposed as part of the Preferred Alternative.

The Neches River and Gulf Shore BU features use dredged material beneficially to avoid and minimize all environmental impacts in Texas and some impacts in Louisiana. Compensatory mitigation in the form of marsh restoration is proposed for all unavoidable environmental impacts in Louisiana.

## ES.4 POTENTIAL ENVIRONMENTAL IMPACTS

The FEIS addresses the potential impacts of the proposed project on human and environmental issues identified during the public interest review, including placement of dredged material. All factors that may be relevant to the proposed project were considered. Among those factors are salinity effects, effects to marshes and wetland forests, effects on threatened and endangered species, shoreline erosion, water and sediment quality, hazardous materials, air quality, cultural resources, socioeconomic effects, energy needs, safety, and in general, the welfare of the people of the United States. The following provides a brief description of potential impacts that were identified.

### Physiography and Geology

Impacts on local geology during dredging and dredged material placement associated with the Preferred Alternative would include redistribution of existing sediment, potential increase of local scouring and shoaling rates, reduced erosion of inshore channel shorelines, and reduced erosion rates at Gulf shoreline nourishment areas compared to the No-Action Alternative. While local changes would occur to bathymetry and topography during construction and operation of the proposed project, these alterations would be expected to have negligible impacts on the regional physiography of the submerged and subaerial portions of the study area. No impacts associated with geologic hazards are expected, and impacts on local geology are expected to be minimal.

## Water Quality

USACE has received Section 401 State Water Quality Certification from Texas and Louisiana for this action. Both states have determined that the requirements for water quality certification have been met and have concluded that the placement of fill material will not violate water quality standards of either state. The Preferred Alternative is the least environmentally damaging practicable alternative. It would result in little, if any, difference in long-term inland turbidity or dissolved oxygen levels when compared to the No-Action Alternative. Short-term increases in turbidity may be caused by the unconfined flow of dredged material during construction of BU features and mitigation measures. There would be temporary, minor impacts from ocean placement at the new ODMDSs. Proposed channel improvements should increase safety, thus decreasing the probability of a spill.

## Sediment Quality

Surficial sediments to be dredged during construction of the offshore Extension Channel have been determined to be suitable for ocean placement. Additionally, shoaled sediments and the construction material that would be dredged from the SNWW during construction of the Preferred Alternative was determined to be of sufficient quality to be used for beneficial uses.

Although the quantity of maintenance material dredged from the inland reaches of the SNWW is expected to increase significantly compared to the No-Action Alternative, the source of the maintenance material would not change, and the method of placement would not change, except that more of the maintenance material would be used beneficially. Past testing of maintenance material has indicated no cause for concern.

## Hydrology

Under the Preferred Alternative, there would be a deeper channel that would allow a greater amount of tidal circulation and exchange with the Gulf and cause only a minimal increase of water surface elevation. Salinity would increase in much of the system by a maximum of about 2 parts per thousand, and the salinity wedge in the SNWW navigation channel would extend farther upstream in the Neches River. It is not expected to have an effect on freshwater inflows to the Sabine-Neches system. However, because the amount of tidal exchange would be slightly increased, the inflows would be conveyed to the Gulf marginally faster than would be the case in the No-Action Alternative. In regards to sediment transport, the Preferred Alternative would slightly reduce the net westward littoral transport on the Texas side and the net eastern littoral transport on the Louisiana side. The changes in sediment transport, while very small, can be expected to have some effect on the rates of Gulf shoreline erosion. Under the Preferred Alternative, there is a slight increase in the Gulf shoreline erosion rate between 0.5 mile and 3.5 miles from each jetty, but shoreline nourishment in the DMMP would replace shoreline that would be lost. The Preferred Alternative should also reduce the rate of erosion on inland channels relative to the No-Action Alternative by reducing the number of predicted vessel trips.

Because clay barrier layers are anticipated to prevent contact between water or elutriate from construction and maintenance dredged material and groundwater, no adverse effects are anticipated to the lower unit of the Chicot, any portion of the Evangeline, or the massive portions of the upper Chicot aquifers. Therefore, no adverse effects are anticipated to occur to groundwater wells documented in the project area counties.

The potential for proposed project features to increase storm surge impacts in the study area was analyzed with a storm surge sensitivity analysis. The greatest changes would occur north of Port Arthur along the Neches River due primarily to the proposed increase in depth of the navigation channel. All changes are local, and there are no project-induced increases in surges away from the immediate vicinity of the navigation channel. Changes in peak surge on the order of inches could occur with the project but should not cause any significant change in interior flooding.

## Hazardous, Toxic, and Radioactive Waste (HTRW)

Findings of the HTRW survey indicate that there may be potential for encountering contaminated material during construction of the project, especially near industrial facilities that have not yet completed remediation efforts. Encountering contaminated material could increase project cost and/or lost time. However, based upon recent chemical analyses of water and sediment collected from within the channels, the potential for encountering contaminated material during dredging operations is considered minimal. The potential for oil and gas wells and petroleum pipelines to impact the project area is also minimal. A capped landfill has been found in PA 17 that is unrelated to dredged material or dredging activities. Issues related to possibly hazardous materials in the landfill must be resolved by the non-Federal sponsor before the PA can be used. Alternate PAs are available should this issue not be resolved in time for use.

## Air Quality

Construction activities associated with the proposed CIP would result in emissions from combustion products from project dredging, support, and reuse/disposal equipment. Pollutant emissions from construction and dredging activities may result in short-term impacts on air quality in the immediate vicinity of the project site. Emissions of volatile organic compounds for the activities subject to USACE responsibility are exempt from a General Conformity Determination because they are below the 100-ton-per-year (tpy) threshold. Estimated nitrogen oxide ($NO_x$) emissions for activities subject to USACE responsibility would exceed the conformity threshold of 100 tpy for all years of construction. Therefore, USACE prepared a General Conformity Determination for $NO_x$ emissions, which was submitted to the Texas Commission on Environmental Quality (TCEQ), U.S. Environmental Protection Agency (EPA), and other air pollution control agencies, as appropriate, to ensure conformity of this project with the State Implementation Plan (SIP). The TCEQ has provided written concurrence that emissions from the Preferred Alternative are conformant with the Texas SIP for the Beaumont-Port Arthur region (Appendix A1). Based on the TCEQ's comments, the USACE has prepared a Final General Conformity Determination for the proposed SNWW CIP (Appendix F).

## Noise

The Preferred Alternative is not expected to result in long-term noise impacts because no permanent noise sources would be installed as part of this project and elevated noise levels would be short term, occurring during construction and maintenance dredging activities. Short-term impacts could be considered potentially significant at noise-sensitive land uses within 600 feet of dredging activities. Elevated noise levels are expected to be no different from those currently experienced during maintenance dredging activities. Therefore, no increase in noise impacts over levels associated with the No-Action Alternative is expected.

## Vegetation

The Preferred Alternative would either directly or indirectly impact more than 220,000 acres of aquatic habitats in Texas and Louisiana. In Texas, negative impacts to productivity would occur over approximately 39,000 acres with a resulting loss of 412 Average Annual Habitat Units (AAHUs). The majority (380 AAHUs) are indirect productivity impacts that would occur to approximately 33,500 acres of intertidal marsh and swamp due to small increases in salinity from the proposed channel deepening. Direct impacts (32 AAHUs) are associated with the conversion of 86 acres of fresh marsh to upland PA 24A.

In Louisiana, negative indirect impacts to productivity would occur to approximately 182,000 acres of intertidal marsh due to small increases in salinities from the proposed channel deepening. The resulting total loss would be 1,709 AAHUs. No productivity or land loss impacts to Louisiana swamps are expected to occur.

The DMMP BU features (Neches River BU Feature in Texas and the Gulf Shore BU Feature in both Texas and Louisiana) would provide benefits that offset all impacts (–412 AAHUs) of the proposed plan in Texas and partially offset impacts in Louisiana. In Texas, construction of the Neches River BU Feature and the Texas portion of the Gulf Shore BU Feature would produce benefits totaling 1,068 AAHUs. Therefore, there would be a net gain of 656 AAHUs, which more than offsets all negative impacts that would occur in Texas. In Louisiana, the Gulf Shore BU Feature would provide benefits totaling 210 AAHUs. Given total Louisiana impacts of 1,709 AAHUs, there would be a net loss of 1,499 remaining in Louisiana after offsetting benefits of the Louisiana portion of the Gulf Shore BU Feature are applied.

After benefits of the BU features are applied to the project as a whole, the Preferred Alternative would result in the loss of 843 AAHUs over the future with-project condition. However, because the ecological benefits of the DMMP BU features would be primarily in Texas, additional compensatory mitigation beyond the total project loss of 843 AAHUs is proposed so that impacts in Louisiana would be compensated in Louisiana. The additional mitigation in Louisiana would result in a net gain of 338 AAHUs for the project as a whole and compensate for all losses in Louisiana with the exception of losses that would occur to Federal lands in the Sabine National Wildlife Refuge (SNWR). Exclusion of

the SNWR is based upon the definition of "coastal zone" in the Coastal Zone Management Act of 1972, as amended. "Excluded from the coastal zone are lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers or agents (16 USC § 1453)." Impacts to the SNWR would be fully offset by the Texas BU feature benefits.

A 1,159 AAHU loss would occur on non-Federal lands in Louisiana after taking into consideration the benefits of the DMMP. To offset this loss, a mitigation plan has been developed that will provide an ecological gain of 1,181 AAHUs in Louisiana. The mitigation plan would restore 2,783 acres of emergent marsh, improve 957 acres of shallow-water habitat, and nourish 4,355 acres of existing marsh.

## Aquatic Ecology

The Preferred Alternative includes beneficial uses of dredged material that would restore the marsh elevations in the Neches River BU Feature. This is a large-scale feature that consists of marsh restoration in these major components: Rose City East, Bessie Heights East, and Old River Cove. These BU features are likely to have short- and long-term effects on the existing open-water communities. Shallow water or emergent marsh habitat would replace a significant portion of the open-water currently within each marsh. The marsh degradation process, which would proceed unchecked in the No-Action Alternative, would eventually adversely affect fishery productivity, while the restored marshes would improve nursery habitat and nutrient availability.

The total quantity of maintenance material from the inshore channels is expected to increase by 14 percent over the existing project, resulting in a similar increase in the duration of each maintenance dredging cycle; no change in the frequency of dredging cycles is anticipated. The total maintenance dredging quantity from the offshore channels is expected to increase by 120 percent, due to the 13.2-mile offshore channel extension and a predicted increase in the shoaling rate in existing channels. The increase in channel length and dredged material quantity will require the creation of four new ODMDSs. The types of impacts to marine communities from the Preferred Alternative would be similar to maintenance dredging impacts expected for the No-Action Alternative, including short-term, localized increases in turbidity, which may reduce primary productivity. Proposed beneficial uses of dredged material that result in benefits to marshes in the study area would also benefit finfish and shellfish. Small increases in salinity expected to occur as a result of the Preferred Alternative are not expected to directly adversely affect fauna. Impacts to benthic organisms from dredging and placement of dredged material are not expected to be significant because recolonization is rapid, although the community composition in new PAs may be slightly different from pre-project conditions. The Preferred Alternative would temporarily and locally impact Essential Fish Habitat (EFH) species because of increased turbidity, although impacts are expected to be minimal. Concurrence was provided by National Marine Fisheries Service (NMFS) on March 8, 2010 (Appendix A3). In addition, the Preferred Alternative would result in net benefits to EFH through marsh creation and benefits to submerged aquatic vegetation. No Habitat Areas of Particular Concern are located in the study area. No adverse impacts to recreationally or commercially important aquatic species are expected, and no additional impacts with respect to ballast water are anticipated.

Construction of the Willow Bayou marsh mitigation areas would use material dredged from a 1.8-mile-long borrow trench parallel to the eastern shore of Sabine Lake. An access channel (approximately 8 miles long) would also be required for the dredge to travel from the Gulf Intracoastal Waterway near the mouth of the Sabine River to the borrow trench location. The exact locations of the borrow trench and access route would be determined in consultation with the Interagency Coordination Team after preconstruction, engineering, and design bottom surveys of potential locations. One-time impacts of the borrow trench and access channel dredging include a temporary increase in turbidity and the short-term loss of benthic fauna. No impacts to oyster reef are anticipated but a preconstruction survey of the borrow trench area would be performed to check this assumption. The probability that oyster reef will be found is very low. Salinities are too low in this area of Sabine Lake to support survival of oyster spat. In the small chance that reef is found, it would be small and localized and easily avoided by changing the access route at borrow area configuration. The common Sabine Lake circulation pattern is expected to prevent the development of hypoxic conditions in the borrow trench and transport Sabine River sediment to eventually fill the trench. Construction of the Black Bayou mitigation areas would use material from regular maintenance dredging of the Sabine River Channel and approximately 18 feet of material that has accumulated since construction of the 30-foot Lake Charles Deepwater Channel. The latter coincides with the Gulf Intracoastal Waterway between the Sabine River and Lake Charles, Louisiana. One-time impacts of both dredging operations would include a temporary increase in turbidity and short-term loss of benthic fauna. These mitigation areas would fully compensate impacts of the Preferred Alternative to the biological productivity of marshes in the affected area. The dredging activities needed to construct the mitigation areas are expected to have a net beneficial effect and cause no long-term impacts to biological resources and estuarine aquatic habitats. Long-term benefits of a higher, more-stable marsh in the mitigation areas would more than offset short-term impacts to turbidity and benthic organisms.

## Wildlife

Direct impacts to wildlife from implementation of the Preferred Alternative include dredging impacts to bottom-feeding and pelagic organisms such as sea turtles, loss of habitat from one new placement area, and temporary impacts to shorebirds and their habitat from the regular placement of maintenance material on the Gulf shoreline. Indirect impacts to wildlife related to dredging and placement activities include a reduction of shorebird food supply from short-term increases in turbidity, risk of oil, chemical, or other hazardous material spill during construction, and temporary noise disturbances. However, beneficial uses of dredged material resulting in additional marsh habitat and beach nourishment would provide additional habitat for wildlife in the area.

## Threatened and Endangered Species

Hopper dredging of the Entrance Channel is likely to adversely affect but not jeopardize the continued existence of loggerhead, Kemp's ridley, hawksbill, and green sea turtles. In the Biological Opinion (BO), the NMFS authorized the incidental lethal take of four sea turtles and identified reasonable and prudent measures to be adopted during construction. Potential impacts to sea turtles from maintenance dredging are covered by the Gulf Regional BO for USACE's dredging activities. Critical Habitat for wintering

piping plovers is present in the Louisiana portion of the Gulf Shore BU Feature. The U.S. Fish and Wildlife Service (USFWS) has concurred that the BU feature may affect, but is not likely to adversely affect, the species or its Critical Habitat because the Gulf Shore BU Feature would protect existing Critical Habitat. No other adverse effects to threatened and endangered plant or animal species have been identified.

### Cultural Resources

While no specific impacts to historic properties have been identified at this time, the Preferred Alternative has the potential to adversely affect significant historic properties because numerous prehistoric and historic sites, structures, and shipwrecks are present in the project vicinity. A Historic Properties Programmatic Agreement has been negotiated and executed with the Texas and Louisiana State Historic Preservation Officers to ensure that significant historic properties are identified and mitigation, if necessary, is completed prior to project construction.

### Socioeconomic Resources

Potential impacts to socioeconomic resources from the Preferred Alternative are not expected to be significant. Small changes in population growth are expected to occur as a result of the proposed CIP, and no disproportionately high or adverse impacts are expected to occur to minority or low-income persons. Development is likely to continue at the current rate resulting in no impacts to community values or housing in the study area, although land use patterns along the SNWW may change slightly in response to channel improvements. No negative impacts to the local economy are anticipated as a result of the Preferred Alternative, and the types of employment opportunities available in the area are not expected to change from current trends. No negative impacts are expected to occur to recreational resources or aesthetics within the study area.

### Cumulative Impacts

Several past, present, and reasonably foreseeable future actions within the study area were identified for inclusion in the cumulative impacts analysis. Resources considered in the analysis included biological, ecological, physical, chemical, cultural, and socioeconomic resources for projects within the SNWW study area. Cumulative impacts from past, existing, and reasonably foreseeable projects, along with the Preferred Alternative, are not expected to have significant adverse effects within the study area. Impacts associated with the Preferred Alternative have been avoided or minimized by DMMP BU features or fully compensated by mitigation.

## ES.5 AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

USACE has evaluated the proposed SNWW CIP for consistency with the Louisiana coastal management program, and concluded that the Recommended Plan is fully consistent to the maximum extent practicable with the enforceable policies of the state's coastal management program. The Louisiana Department of Natural Resources (LDNR), Office of Coastal Management (OCM), found that the

SNWW CIP is conditionally consistent with their state program. Since conditional consistency as proposed by LDNR-OCM is not acceptable, LDNR-OCM has been notified that USACE will proceed with the project. This issue is discussed in detail in Section 6.0.

USACE coordination with the Louisiana Department of Wildlife and Fisheries (LDWF) has not been able to resolve issues related to the offset of project impacts to Federal lands with benefits from BU features in Texas, Louisiana Department of Wildlife and Fisheries (LDWF) requirements that the Recommended Plan include additional BU features, and royalty, license, and further assessment requirements concerning areas in Sabine Lake that would be affected by the removal of fill material for use in marsh mitigation. USACE has proposed that an assessment survey be completed, following the protocol established by LDWF, during the preconstruction, engineering, and design phase of the SNWW CIP.

In order for the four new ODMDSs to be approved for use, the EPA must publish a final rulemaking in the Federal Register. An FEIS for the proposed ODMDS and a Final Site Management and Monitoring Plan have been prepared and accepted by EPA for use in this rulemaking at a later date (Appendix B of the FEIS).

Coordination is ongoing with the Texas Point and Sabine National Wildlife refuges regarding construction activities related to the Gulf Shore BU Feature and proposed compensatory mitigation measures. The USFWS must determine whether these activities are compatible with the purposes of the refuges.

Issues related to hazardous materials in PA 17 (a capped landfill and other waste disposal areas within the PA) must be resolved by the non-Federal sponsor before the PA can be used as part of the Preferred Alternative. Alternative placement areas are available should PA 17 not be available for use.

## ES.6 RELATION TO ENVIRONMENTAL REQUIREMENTS

The Preferred Alternative is in full compliance with the environmental requirements applicable to this stage of the planning process. A discussion of the applicable laws can be found in Chapter 7 of the FEIS.

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## Acronyms and Abbreviations

| | |
|---|---|
| μg/L | micrograms per liter |
| $\mu g/m^3$ | micrograms per cubic meter |
| °F | degrees Fahrenheit |
| AAHU | Average Annual Habitat Unit |
| AIRData | Aerometric Information Retrieval Database |
| AIS | Automatic Identification System |
| AOA | air operations area |
| AOU | American Ornithologists' Union |
| AQCR | Air Quality Control Region |
| B.C.E. | Before the Common Era |
| B.P. | before present |
| BA | Biological Assessment |
| BEG | Bureau of Economic Geology |
| BHM | Bottomland Hardwood Model |
| BO | Biological Opinion |
| BOOTS | Bulk Oil Offshore Transfer System |
| BPA | Beaumont-Port Arthur |
| BU | Beneficial Use |
| C.E. | Common Era |
| CAA | Clean Air Act |
| CAP | Continuing Authorities Program |
| CAR | Coordination Act Report |
| CBD | central business district |
| CBRA | Coastal Barrier Resources Act |
| CCP | Comprehensive Conservation Plan |
| CE/ICA | cost effective/incremental cost analysis |
| CEPRA | Texas Coastal Erosion Planning and Response Program |
| CEQ | President's Council on Environmental Quality |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CERCLIS | Comprehensive Environmental Response Compensation and Liability Information System |
| CFR | U.S. Code of Federal Regulations |
| cfs | cubic feet per second |
| CHL | Engineering Research and Development Center's Coastal and Hydraulic Laboratory |
| CIP | Channel Improvement Project |
| CMP | Coastal Management Program |
| CNRA | coastal natural resource area |
| CO | carbon monoxide |
| CORRACT | Resource Conservation and Recovery Act Corrective Actions List |
| CW | Contaminants Workgroup |
| CWA | Clean Water Act |
| CWPPRA | Coastal Wetlands Planning, Protection and Restoration Act |

| | |
|---|---|
| cy | cubic yards |
| CZMA | Coastal Zone Management Act |
| CZMP | Coastal Zone Management Plan |
| dB | decibel |
| dBA | A-weighted sound level |
| dbh | diameter at breast height |
| DEIS | Draft Environmental Impact Statement |
| DMMP | Dredged Material Management Plan |
| DMPA | Dredged Material Placement Area |
| DO | dissolved oxygen |
| DWT | dead weight tons |
| EC | Engineer Circular |
| EFH | Essential Fish Habitat |
| EH&A | Espey, Huston & Associates, Inc. |
| EIS | Environmental Impact Statement |
| EJ | Environmental Justice |
| EMCM | Emergent Marsh Community Model |
| EnvWG | Environmental Workgroup |
| EO | Executive Order |
| EPA | U.S. Environmental Protection Agency |
| ER | Engineer Regulation |
| ERDC | Engineering Research and Development Center |
| ERL | Effects Range Low |
| ERNS | Emergency Response Notification System |
| ESA | Endangered Species Act |
| ETJ | extraterritorial jurisdiction |
| ETRW | East Texas Regional Water |
| FERC | Federal Energy Regulatory Commission |
| FFR | Final Feasibility Report |
| FHWA | Federal Highway Administration |
| FINDS | Facility Index System |
| FONSI | Finding of No Significant Impact |
| FR | Federal Register |
| FWOP | future without-project |
| FWP | future with-project |
| GEC | Gulf Engineers and Consultants, Inc. |
| GIS | Geographic Information System |
| GIWW | Gulf Intracoastal Waterway |
| GLO | General Land Office |
| GMFMC | Gulf of Mexico Fishery Management Council |
| GNF | general navigation features |
| GSMFC | Gulf States Marine Fisheries Commission |
| GTCBT | Great Texas Coastal Birding Trail |
| Gulf | Gulf of Mexico |

| | |
|---|---|
| HAPC | Habitat Areas of Particular Concern |
| HEP | Habitat Evaluation Procedure |
| HHS | Department of Health and Human Services |
| HPPA | Historic Properties Programmatic Agreement |
| HS | hydrodynamic salinity |
| HSI | Habitat Suitability Index |
| HTRW | Hazardous, Toxic, and Radioactive Waste |
| HU | Hydrologic Unit, Hydro-Unit |
| HW | Habitat Evaluation Workgroup |
| ICT | Interagency Coordination Team |
| IH | interstate highway |
| IPCC | Intergovernmental Panel on Climate Change |
| ISO | Insurance Services Office |
| ITM | Inland Testing Manual |
| IWR-WCUS | Institute of Water Resources-Waterborne Commerce of the U.S. |
| JCDD6 | Jefferson County Drainage District No. 6 |
| JCND | Jefferson County Navigation District |
| JCWND | Jefferson County Waterway and Navigation District |
| LBG and TEA | Louis Berger Group and Toxicological & Environmental Associates |
| $LC_{50}$ | the concentration of a substance that is lethal to 50 percent of test organisms after a continuous exposure of 96 hours |
| LCA | Louisiana Coastal Areas |
| LCMP | Louisiana Coastal Management Program |
| LCPRA | Louisiana Coastal Protection and Restoration Authority |
| LCWCR/WCRA | Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority |
| LDA | Louisiana Division of Archaeology |
| LDEQ | Louisiana Department of Environmental Quality |
| $L_{dn}$ | Day-night Sound Level |
| LDNR | Louisiana Department of Natural Resources |
| LDOL | Louisiana Department of Labor |
| LDWF | Louisiana Department of Wildlife and Fisheries |
| $L_{eq}$ | equivalent sound level |
| LERR | lands, easements, rights-of-way, and relocation |
| LNG | Liquefied Natural Gas |
| LNVA | Lower Neches Valley Authority |
| LOOP | Louisiana Offshore Oil Port |
| LUST | leaking underground storage tank |
| LWQS | Louisiana Surface Water Quality Standards |
| mcy | million cubic yards |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| MGD | million gallons per day |
| MLK | Martin Luther King |
| MLLW | mean lower low water |

| | |
|---|---|
| MLT | mean low tide |
| mm | millimeters |
| MMS | Minerals Management Service |
| MPRSA | Marine Protection, Research, and Sanctuaries Act |
| MSA | Metropolitan Statistical Area |
| MSFCMA | Magnuson-Stevens Fishery Conservation and Management Act |
| MW | Modeling Workgroup |
| NAAQS | National Ambient Air Quality Standards |
| NAWMP | North American Waterfowl Management Plan |
| NBIC | National Ballast Information Clearinghouse |
| NDD | Natural Diversity Database |
| NED | National Economic Development |
| NEPA | National Environmental Policy Act |
| NFWL | National Fish and Wildlife Laboratory |
| NGA | Natural Gas Act |
| NHPA | National Historic Preservation Act |
| NMFS | National Marine Fisheries Service |
| NO | nitric oxide |
| $NO_2$ | nitrogen dioxide |
| NOAA | National Oceanic and Atmospheric Administration |
| $NO_x$ | nitrogen oxides |
| NPDES | National Pollution Discharge Elimination System |
| NPL | National Priority List |
| NPS | National Park Service |
| NRC | National Research Council |
| NRCS | Natural Resources Conservation Service |
| NRHP | National Register of Historic Places |
| NWI | National Wetlands Inventory |
| NWR | National Wildlife Refuge |
| NWRC | National Wetlands Research Center |
| O&M | Operation and Maintenance |
| $O_3$ | ozone |
| OCM | Office of Coastal Management |
| ODMDS | Ocean Dredged Material Disposal Site |
| OW | ODMDS Workgroup |
| PA | Placement Area |
| PADD | Petroleum Administration Defense District |
| PAH | polycyclic aromatic hydrocarbons |
| Pb | lead |
| PCBs | polychlorinated biphenyls |
| PCP | pentachlorophenol |
| PED | preconstruction, engineering, and design |
| PM | particulate matter |
| $PM_{10}$ | inhalable particulate matter <10 microns in diameter |

| | |
|---|---|
| $PM_{2.5}$ | fine particulate matter ≤2.5 microns in diameter |
| ppm | parts per million |
| ppt | parts per thousand |
| RCRA | Resource Conservation and Recovery Act |
| RIA | Regional Implementation Agreement |
| RRC | Texas Railroad Commission |
| RSLR | relative sea level rise |
| RSM | Regional Sediment Management |
| RW | Restoration and Beneficial Uses Workgroup |
| SAL | State Archeological Landmark |
| SAV | submerged aquatic vegetation |
| SCM | Swamp Community Model |
| SETWAC | Southeast Texas Waterways Advisory Council |
| SH | State Highway |
| SHPO | State Historic Preservation Officer |
| SI | Suitability indices |
| SIP | State Implementation Plan |
| SMMP | Site Monitoring and Management Plan |
| SNND | Sabine Neches Navigation District |
| SNWW | Sabine-Neches Waterway |
| $SO_2$ | sulfur dioxide |
| SOC | Species of Concern |
| SP | State percentage |
| SRA-LA | Sabine River Authority of Louisiana |
| SRA-TX | Sabine River Authority of Texas |
| SWL | solid waste landfill |
| SWQM | Standard Water Quality Monitoring |
| TCEQ | Texas Commission on Environmental Quality (formerly TNRCC) |
| TCMP | Texas Coastal Management Program |
| TCOON | Texas Coast Ocean Observation Network |
| TDS | total dissolved solids |
| TDSHS | Texas Department of State Health Services |
| TLO | Texas Legislature Online |
| TNHP | Texas Natural Heritage Program |
| TNRCC | Texas Natural Resource Conservation Commission |
| TOC | total organic carbon |
| TPH | total petroleum hydrocarbon |
| TPWD | Texas Parks and Wildlife Department |
| tpy | tons per year |
| TRIS | Toxic Release Inventory System |
| TSS | total suspended solids |
| TVS | total volatile solids |
| TWC | Texas Workforce Commission |
| TWDB | Texas Water Development Board |

| | |
|---|---|
| TWQS | Texas Surface Water Quality Standards |
| TxDOT | Texas Department of Transportation |
| ULCC | Ultra Large Crude Carriers |
| USACE | U.S. Army Corps of Engineers |
| USCCSP | U.S. Climate Change Science Program |
| USCG | U.S. Coast Guard |
| USDC | U.S. Department of Commerce |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| VFD | volunteer fire department |
| VLCC | Very Large Crude Carriers |
| VOC | volatile organic compound |
| VTS | Vessel Traffic Service |
| WAM | Water Availability Models |
| WMA | Wildlife Management Area |
| WQC | water quality criteria |
| WQS | water quality standards |
| WRDA | Water Resources Development Act |
| WVA | Wetland Value Assessment |

# 1.0 NEED FOR AND OBJECTIVES OF ACTION

This chapter is divided into seven sections. Section 1.1 provides information on study authorities, project sponsors, cooperating agencies, and the location of the proposed project. Section 1.2 explains the purpose for, and need of, the proposed project, and Section 1.3 describes the existing project. Section 1.4 summarizes problems, needs, and concerns expressed by the public, resource agencies, and local governments at scoping meetings early in the study. Section 1.5 identifies planning objectives for the feasibility study, and Section 1.6 describes the resource agency coordination process and team. The chapter concludes in Section 1.7 with a description of resource management opportunities for dredged material.

## 1.1 STUDY AUTHORITY AND LOCATION

The Senate Committee on Environment and Public Works Resolution, dated June 5, 1997, authorized the U.S. Army Corps of Engineers (USACE) to review previous USACE reports on the Sabine-Neches Waterway and other pertinent reports to determine the feasibility of modifying the channels serving the Ports of Beaumont, Port Arthur, and Orange, Texas, in the interests of commercial navigation. These channels are collectively named the Sabine-Neches Waterway (SNWW). The Jefferson County Navigation District (JCND), non-Federal sponsor of the existing channels to Beaumont and Port Arthur, requested that the USACE initiate a reconnaissance study of potential channel improvements in September 1998. The reconnaissance investigation resulted in a finding that there was a Federal interest in the project and recommended that the study be continued into the feasibility phase. The JCND expressed its intent to act as the non-Federal sponsor for this phase of the study. The Final Feasibility Report (FFR) for the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) will determine whether improvements to the existing Federal navigation project are justified, and provide documentation needed to request Congressional authorization and funding for construction of the project. The Sabine River Channel to Orange, Texas, was not included in this FFR due to expectations of continued low utilization of the existing 30-foot channel. In 2002, the JCND was renamed the Jefferson County Waterway and Navigation District (JCWND), and in 2007, the JCWND was renamed the Sabine Neches Navigation District (SNND); the latter designation is used throughout the remainder of this document.

In March 2000, USACE and JCND signed an agreement to prepare an FFR and a Final Environmental Impact Statement (FEIS) for the proposed CIP. The lead agency for the FEIS is the USACE, with several cooperating agencies (Appendix A1). The U.S. Environmental Protection Agency (EPA) has agreed to be a cooperating agency for purposes relating to its authority to designate Ocean Dredged Material Disposal Sites (ODMDSs). The ODMDS FEIS, attached as Appendix B, provides the environmental analysis and public review required for subsequent EPA site designation. The National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Texas General Land Office (GLO), and Louisiana Department of Wildlife and Fisheries (LDWF) have agreed to be cooperating agencies with participation limited to meetings, teleconferences, and report review. The cost of the FFR and FEIS is shared by the USACE and the JCND.

The SNWW is located on the upper Texas Gulf Coast at the Texas-Louisiana state boundary (Figure 1.1-1). Sabine Pass, Sabine Lake, and the Sabine River together form the southern section of the boundary between the two states. The area surrounding the waterway is generally referred to as the "Golden Triangle," which refers to the metropolitan area's three major cities and their ports—Beaumont, Port Arthur, and Orange, Texas. The "Golden" refers to the wealth that came from the Spindletop oil strike in Beaumont in 1901. Several smaller cities also are located in the Golden Triangle, including Nederland, Port Neches, Groves, Bridge City, Vidor, and the City of Sabine Pass.

The project area is defined as those areas that will be directly affected by construction of the CIP, i.e., the proposed dredging footprint, existing and proposed placement areas (PAs) identified in the Dredged Material Management Plan (DMMP), and mitigation areas. The CIP refers to proposed plans for navigation improvements. Details of the Preferred Alternative for these improvements are provided in Section 2.4.

The study area includes a larger area for which environmental effects of alternatives have been analyzed (Figure 1.1-2). The study area encompasses a 2,000-square-mile area that contains the smaller project area and includes the following waterbodies and adjacent coastal wetlands: Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River Channel up to the Neches River Saltwater Barrier, the Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf of Mexico (Gulf) shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf.

## 1.2 PURPOSE AND NEED

The purpose of the proposed CIP is to improve the transportation efficiency of the SNWW's deep-draft navigation system, while protecting the quality of the area's coastal and estuarine resources. Channel improvements are needed to support the SNWW's critically important role in the Nation's economy. In 2007, the SNWW ranked 4th in the Nation in total tonnage, importing 141 million short tons (Institute of Water Resources-Waterborne Commerce of the U.S. [IWR-WCUS], 2007). Individually, the Port of Beaumont ranked 5th nationally for domestic and total tonnage, and the Port of Port Arthur ranked 28th in the Nation (IWR-WCUS, 2007).

The Port of Beaumont's public docks are located on the Neches River Channel, as well as several crude petroleum and product terminals. Port Arthur's general cargo facilities are located on the Sabine-Neches Canal, and its crude petroleum and product terminals are located in the Taylor Bayou Basins. The Taylor Bayou Basins are located immediately south of Port Arthur at the junction of the Sabine-Neches Canal with the GIWW. In addition to its deep-draft traffic, the Sabine-Neches Canal serves as a through channel for shallow-draft barge traffic on the GIWW.

Sixty percent of the SNWW tonnage total comprises deep-draft movements, and the remaining 40 percent is shallow-draft GIWW traffic. There are 20 waterfront facilities in Port Arthur and 27 in Beaumont that receive and/or ship crude petroleum or petroleum/chemical products, making up the vast majority of

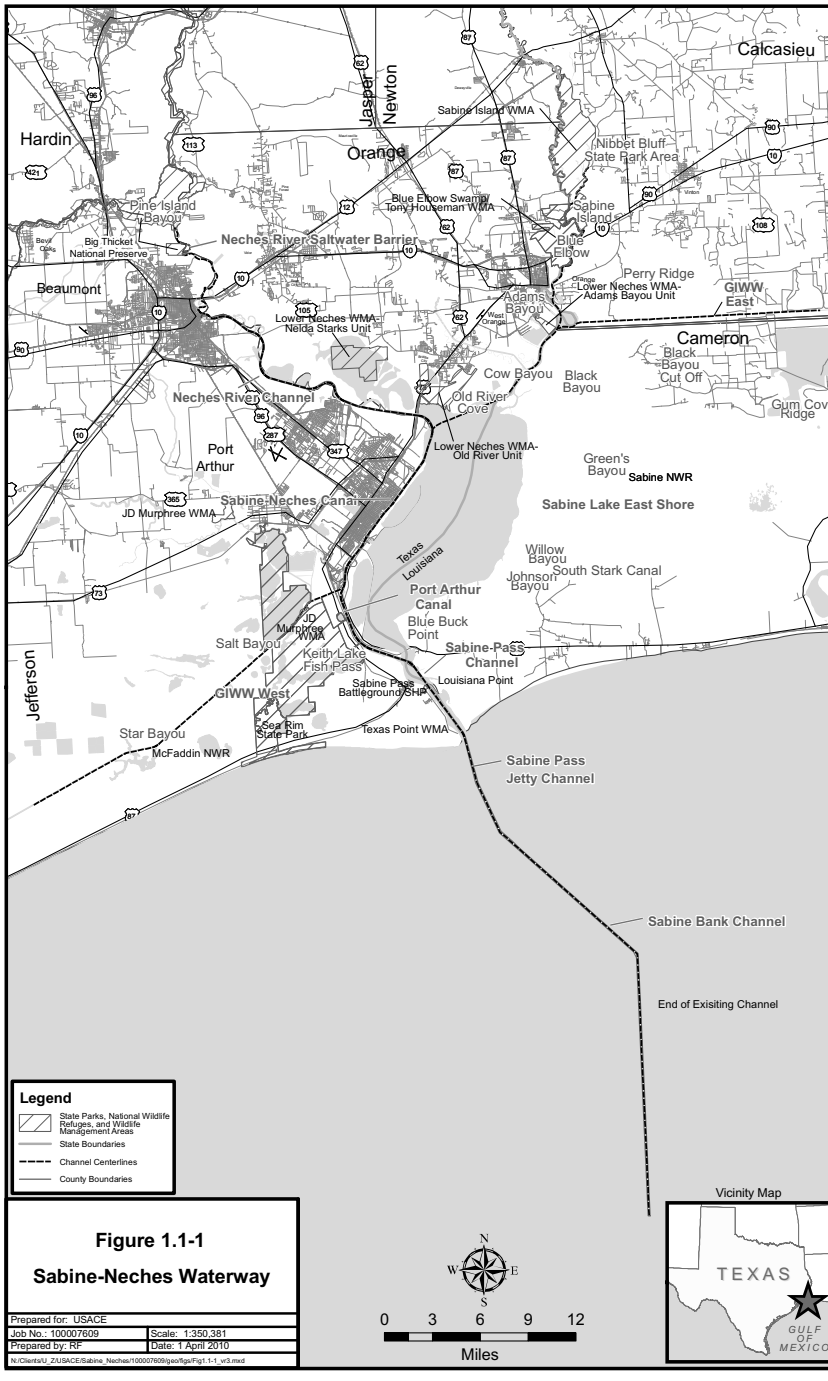


**Figure 1.1-1**

**Sabine-Neches Waterway**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1:350,381 |
| Prepared by: RF | Date: 1 April 2010 |

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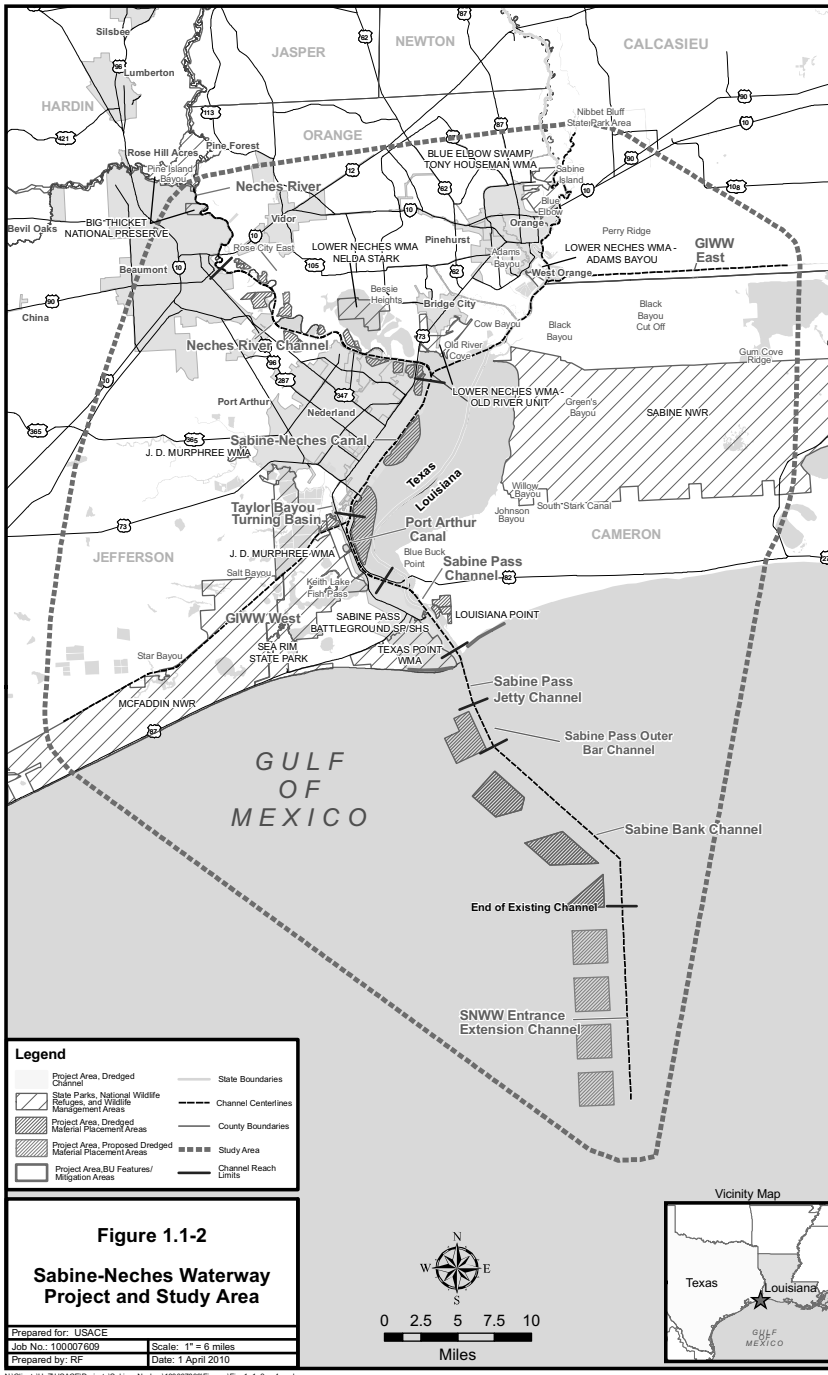


**Figure 1.1-2**

**Sabine-Neches Waterway Project and Study Area**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 6 miles |
| Prepared by: RF | Date: 1 April 2010 |

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deep-draft movements on the waterway. The SNWW refineries also supply crude oil to the U.S. Department of Energy's "Big Hill Site" in Texas and the "Hackberry Site" in the Louisiana Strategic Petroleum Reserve. The waterway is the primary means of delivery for crude oil to four major refineries in Beaumont and Port Arthur. Domestic refineries on the Gulf Coast, the East Coast, and in the Midwest rely on the SNWW for 12 to 16 percent of waterborne crude oil deliveries (Martin Associates, 2006). Refined petroleum products are shipped from the SNWW via three major pipeline systems to 21 states east of the Rockies, including states as far away as Delaware, New Jersey, and Indiana. Other significant commodities and break bulk cargoes that are handled by the SNWW ports include petroleum coke, ammonia, sulphuric acid, metallic salts, liquid sulphur, bulk grain, manufactured iron and steel products, limestone, sand and gravel, and liquefied natural gas (LNG).

The SNWW's crude petroleum imports represent 4 percent of the U.S. total and 7 percent of the U.S. Western Gulf Coast region. From 1992 through 2005, crude petroleum imports on the SNWW grew at a 7.0 percent compound annual rate, compared to a 3.6 percent growth rate for the U.S. as a whole. Overall, commodity and breakbulk tonnage for the SNWW ports has also increased over this period. Grain exports have increased marginally since the middle 1990s, and Beaumont's 2005 to 2007 wheat exports represent 5 percent of the U.S. total. The waterway imported 14 percent of 2005 to 2007 U.S. pulp and waste paper products. Approximately 10 percent of 2005 to 2007 U.S. fertilizer and fertilizer mixes were exported from Beaumont.

During the early 2000s, permits were approved for Cheniere Energy's Sabine Pass, Exxon-Mobil's Golden Pass, and Sempra's Port Arthur LNG terminals. Construction of the Sabine Pass terminal was completed in April 2008 and operations began in April 2008. The Golden Pass LNG terminal was scheduled for completion in mid-2010 but has been delayed due to Hurricane Ike cleanup activities. Construction of the permitted Port Arthur facility is dependent upon the finalization of commercial arrangements. The SNWW LNG facilities are located in the Sabine Pass Channel and Port Arthur Canal; these reaches are presently 500 feet wide and would remain so in the without-project future. LNG vessels using the SNWW would be subject to strict U.S. Coast Guard (USCG) regulations and to local pilot rules, and all LNG vessel movements would be subject to one-way traffic. Since the Sabine Pass terminal opened, throughput has been low due to increased demand in other parts of the world. Long-term expectations are for prices to stabilize and shipments to the U.S. to increase, as LNG is expected to play an increasingly important role in the natural gas industry and global energy markets in the near and long-term future. The U.S. Energy Information Administration has raised its projections for LNG imports in 2009, citing falling demand elsewhere as new global production comes online.

The existing SNWW navigation channel system is congested. The existing 40-foot project depth was designed to efficiently and safely accommodate much smaller vessels than are being used today. The current 40-foot channel was completed in the late 1960s, and at that time, crude oil tankers averaging 40,000 dead weight tons (DWT) with loaded drafts of 36 feet were common. Vessels over 90,000 DWT are now used routinely for crude oil imports to both Beaumont and Port Arthur. In addition to larger vessels, the amount of vessel traffic on the SNWW has also increased. Both the SNWW and U.S. crude oil imports have risen steadily since the 1970s. The SNWW's 2002 to 2006 crude petroleum waterborne

imports comprised 12 percent of U.S. and 18 percent of Western Gulf Coast imports. The SNWW capacity presently represents 6 percent of the U.S. total. The SNWW capacity levels for 2009 were 12 percent higher than in 2004, and 31 percent higher than in 1994. Recent increases in the SNWW refinery capacity indicate that the region will gain an increasing share of U.S. totals.

With the current channel depth, there are draft restrictions on large vessels currently utilizing the channel. A majority of the tonnage carried on the SNWW is in deep-draft vessels, and the vast majority of the deep-draft traffic is composed of crude oil and petrochemical products. However, LNG, grain, and aggregate products, such as iron ore, steel slab, limestone, sand, and gravel, are also carried in draft-constrained deep-draft vessels. Currently at the SNWW, very large crude carriers transfer tonnage at an offshore location onto one or more shuttle vessels in a process called lightering. These very large carriers cannot enter the SNWW because of their size and draft. In addition, other large crude tankers presently offload a partial load offshore to a shuttle vessel or vessels, a process called lightening. These vessels then enter the SNWW with the shuttle vessels as they are small enough to navigate the SNWW with a lighter load.

The SNWW experienced strong growth over the past decade, with total tonnage increasing from an average of 102 million short tons for 1994 to 1996 to 141 million for 2004 to 2006. As imports have increased, the number of lightering and lightened vessels and product carriers has also increased, adding to shipping delays and congestion. The total number of inbound vessels on the SNWW is projected to increase in the short term at rates comparable to or higher than regional and national trends. Recent increases in the SNWW refinery capacity indicate the region will regain an increasing share of U.S. totals.

Ships are not only requiring deeper drafts, but the sizes of the vessels are wider. The vessel beams of both Port Arthur's and Beaumont's vessels cause them to be regularly impacted by the present 500-foot width of the Sabine Pass Jetty Channel and Port Arthur Canal. The most common crude oil tankers unloading at the Taylor Bayou Basins have design drafts of 45 feet and beams of approximately 124 feet. Tankers using the Taylor Bayou Basins are smaller than those offloading at terminals on the Neches River Channel because existing width at the mouth of Taylor Bayou, and the configuration of the docks within Taylor Bayou, limits the allowable vessel size. The maximum size vessels unloading at Port of Beaumont facilities on the Neches River Channel are approximately 900 feet long, with a beam width of 164 feet.

The Sabine Pilots Association has adopted transit rules to deal with the narrow channel, and these rules result in navigation constraints. These constraints include daylight-only and one-way sailing restrictions in specific reaches. The main restrictions place limitations on the combined beam widths and drafts for vessel meetings on the waterway. A major restriction is that vessels with combined beam widths in excess of 50 percent of the channel width cannot meet. The effects of these and other navigation restrictions cause significant delays along the waterway.

As a result of these rules, inbound vessels intending to use a specific dock must wait offshore until the outbound vessel at that dock sets sail, resulting in considerable delays because of the length of the inshore channel. In addition, vessels are now wider due to new double-hull requirements and to industry changes

to wider but shorter vessels, which makes vessel-meetings more difficult. The probability of accidents and other safety problems may increase with increases in both inland barge and deep-draft vessel traffic along the waterway. Channel deepening and additional turning and anchorage basins on the Neches River Channel could alleviate some of these congestion problems by permitting existing vessels to carry more cargo into port and reduce offshore vessel waiting times.

Congestion is increased during times when the SNWW serves an important military function. One of the busiest ports for military cargo in the world is located on the SNWW. The Port of Beaumont is the Nation's busiest Strategic Port of Embarkation, and it is the second largest commercial military out-load port worldwide. For the war in Iraq, it has handled approximately one-third of all the military cargo deployed to and from the war, which is more military cargo than any other U.S. port (Military Surface Deployment and Distribution Command, 2004, 2006). The SNWW must accommodate the military's increased use of newer and larger transport ships, which are three times the size of transport ships used in 1990. The SNWW contributes to national security in one other key aspect. Two terminals on the Neches River are connected by pipelines to underground storage facilities of the U.S. Department of Energy's Strategic Petroleum Reserves at Big Hill, Texas, and West Hackberry, Louisiana.

The need for improvements to the SNWW must be weighed against possible effects to significant environmental resources. The study area contains approximately 480 square miles of sensitive coastal habitats, which have experienced a high rate of wetland loss in recent decades. In Louisiana, a net land loss of 18 percent between 1978 and 2000 has been reported in the western Chenier Plain. In Texas, the most extensive losses of interior coastal wetlands in the state have occurred in the Neches River delta. Ninety percent of the emergent marshes in the Lower Neches River delta have been converted to open water, which is more than half of the total wetland loss in the State of Texas. These high land-loss rates provide opportunities for wetland restoration with the beneficial use of dredged material.

## 1.3 EXISTING PROJECT

The existing 40-foot SNWW project is a federally authorized and maintained waterway located in Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana (see Figure 1.1-1). However, the Sabine River Channel segment of the SNWW, which provides deep-draft access to the Port of Orange, is not included in the FFR. All subsequent references to the SNWW in this report focus on the 64-mile-long channel flowing through Jefferson and Orange counties, Texas, and Cameron Parish, Louisiana. The SNWW begins offshore, follows the west side of Sabine Lake and terminates just upstream of the Beaumont Turning Basin on the Neches River.

The SNWW is a system of widened and/or deepened channels (Table 1.3-1). Working inland from the Gulf, the reaches are (1) Sabine Bank Channel, (2) Sabine Pass Outer Bar Channel, (3) Sabine Pass Jetty Channel, (4) Sabine Pass Channel, (5) Port Arthur Canal, (6) Sabine-Neches Canal, and (7) Neches River Channel. The Sabine Bank through the Sabine Pass Jetty channels is sometimes referred to collectively as the Entrance Channel. The only connection with the Gulf is Sabine Pass, a long narrow pass, through which all tidal interchange occurs. The East and West Jetties extend approximately 4.1 miles into the

Gulf. They stabilize the Pass and provide protection for ships entering the landlocked channel. Maintenance material is placed in 16 upland confined PAs and 4 ODMDSs in the Gulf. The FFR and DMMP (Appendix D) provide more-detailed descriptions and maps of the existing navigation channels and PAs.

Table 1.3-1
Existing SNWW Channel Dimensions

| Channel Reach | Authorized Depth (feet) | Bottom Width (feet) | Length (miles) |
|---|---|---|---|
| Sabine Bank Channel | 42 | 800 | 14.7 |
| Sabine Pass Outer Bar | 42 | 800 | 3.4 |
| Sabine Pass Jetty Channel | 40 | 800–500 | 4.0 |
| Sabine Pass Channel | 40 | 500–1133 | 5.6 |
| Port Arthur Canal | 40 | 500–1788 | 6.2 |
| Sabine-Neches Canal | 40 | 400–1060 | 11.3 |
| Neches River Channel | 40 | 400 | 18.6 |

In addition to deep-draft traffic, the SNWW serves as a through-channel for the shallow-draft GIWW. As it leaves Louisiana, the GIWW connects with the SNWW, approximately 3 miles below Orange, Texas, and follows the Sabine River Channel to Sabine Lake. The GIWW and Sabine River Channel cross the north end of Sabine Lake where they merge with the Sabine-Neches Canal at the mouth of the Neches River. The GIWW and Sabine-Neches Canal coincide through the confined channel reach between Pleasure Island and Port Arthur, where the GIWW connects with the Port Arthur Canal and exits the SNWW, continuing westward to Galveston Bay.

## 1.4 PROBLEMS, NEEDS, AND PUBLIC CONCERNS

To be responsive to the needs and concerns of all stakeholders and to ensure public involvement through an open, interactive process, the USACE and SNND developed a public involvement plan to be used during the feasibility phase of the SNWW CIP. The public outreach program was initiated in 2000 and included the following efforts:

- scoping meetings;
- public environmental restoration and beneficial use workshops;
- media trips;
- presentations at the Gulf of Mexico Fishery Management Council (GMFMC) Texas Habitat Protection Advisory Board;
- presentations at Southeast Texas Waterways Advisory Council (SETWAC) regular meetings;
- meetings with Sabine Pilots Association;
- presentation at the SETWAC 2007 meeting;
- meetings with SNWW industries; and

- public hearings.

A Notice of Intent to prepare a "Draft Environmental Impact Statement for Improvements to the Sabine-Neches Ship Channel Near Beaumont and Port Arthur, Texas" was published in the *Federal Register* (FR) on May 21, 2002 (67 FR 98:35801). Additionally, coordination with resource agencies was conducted through 11 meetings of the Interagency Coordination Team (ICT) and 30 technical working group meetings. More information about the ICT membership and activities is in Section 1.6. Detail about public outreach, meeting comments, and the ICT meetings and workshops can be found in Appendix A.

Existing water resource problems and needs in the study area were identified through coordination with Federal, State, and local agencies; area residents; waterway users; and the USACE and SNND. It should be noted that numerous concerns were raised during the public scoping meetings, letters received in response to those meetings, and a series of workshops with local public agencies and private organizations. The major issues and concerns identified through this process are discussed below. Summaries of the scoping meetings and copies of public comment letters are provided in Appendix A5. Some issues do not apply to the proposed CIP or are general concerns raised by the citizens of the area; these cannot be addressed in a project-specific FEIS. However, all of the concerns that are associated with the proposed CIP are addressed in this FEIS.

### 1.4.1 Navigation/Commerce

Waterway users are concerned that future increases in the Nation's dependence on imported oil and the SNWW's growing share of the import market will compound existing problems with transportation efficiency. The current 40-foot channel was completed in the late 1960s and, at that time, crude oil tankers averaging 40,000 DWT with loaded drafts of 36 feet were common. Vessels over 90,000 DWT are now used routinely for crude oil imports to both Beaumont and Port Arthur. Mother vessels in the 120,000 to 150,000 DWT range presently offload a partial load at the offshore lightering zone and then enter the SNWW along with the shuttle vessel. As imports have increased, the number of lightering vessels and product carriers has also increased, adding to shipping delays and congestion.

The existing narrow channel width creates congestion and transportation inefficiencies, resulting in potential problems with safety. Vessels are now wider due to new double-hull requirements and to industry changes to wider but shorter vessels. Wider vessels make meetings more difficult and, therefore, more dangerous. The SNWW is currently subject to transit rules, which are needed for the Sabine Pilots Association to safely guide large deep-draft tankers through the narrow channel. Increases in both inland barge and deep-draft vessel traffic along the waterway are expected to increase overall congestion and result in an increase in the likelihood of accidents. Historically, accidents on the SNWW are very low, due in large part to the existing pilot rules that minimize the probabilities of incidents involving deep-draft vessels. In 2006, two-thirds of the incidents involved shallow-draft tow transits. Overall, the ratio of incidents per transit was 1 percent or less for all transit types. Recently, installation of the Port Arthur vessel traffic service (VTS) is expected to reduce potential interactions between deep- and shallow-draft vessels.

It is believed that ship traffic through interior channel reaches contributes to existing shoreline erosion, and it is feared that a deeper channel will increase that erosion. Existing erosion is most severe along the Port Arthur and Sabine-Neches canals where the SNWW passes through a narrow, confined channel between Pleasure Island and Port Arthur. There is concern that a deeper channel would allow larger or more heavily laden vessels to use the waterway and cause additional erosion of channel shorelines.

The evaluation of alternatives other than a deeper navigation channel was urged in several comments. Suggestions included construction of a new port and pipeline terminal at the City of Sabine Pass. Others suggested that an offshore terminal similar to the Louisiana Offshore Oil Port (LOOP) be constructed. Both of these alternatives would avoid environmental impacts associated with channel improvements to the inland Port of Beaumont. It was also suggested that safety issues could be addressed by a vessel tracking and management system, rather than channel improvements.

### 1.4.2 Environmental

The primary environmental concern is the potential for the proposed CIP to increase saltwater intrusion and for higher salinity levels to further degrade marshes and cypress swamps in both Texas and Louisiana. The combined effects of subsidence and sea level rise (called relative sea level rise, or RSLR) are expected to increase the stress on existing marshes and worsen this trend. The public and resource agencies have identified severely stressed marsh areas at Texas Point and Salt Bayou in the Sabine Pass area, in the Neches River reach between Sabine Lake and Interstate Highway (IH) 10, and in the extensive marshes east of Sabine Lake. Marshes have been dying, due in large part to the combined effects of altered sediment delivery, saltwater intrusion, subsidence, and global sea level rise. Wetland loss results when sub-optimal salinities decrease biological productivity of marsh vegetation, leading to a decrease in organic matter accumulation, which, in turn, results in greater submergence because the rate of increase in marsh elevation cannot keep up with the rate of submergence due to RSLR (Day and Templet, 1989; Day et al., 1995; DeLaune et al., 1994; Nyman et al., 1993; Spalding and Hester, 2007). The death of wetland vegetation often results, followed by peat collapse, erosion, and wetland loss (DeLaune et al., 1994; Gough and Grace, 1999; Salinas et al., 1986; Visser et al., 1999; Webb and Mendelssohn, 1996). Cumulative effects of hydrologic alterations are also a concern, given that the existing project is believed to have contributed significantly to current wetland losses. Potential effects of increased salinities on cypress-tupelo swamps and bottomland hardwoods on the Neches and Sabine rivers at the upper margins of the study area have also been identified as significant potential impacts.

An associated issue is the deterioration of wildlife habitat and fishery nursery areas and the destruction of fish and wildlife resources that could occur as a result of increased wetland loss. Persistent emergent vegetation provides foraging, resting, and breeding habitat for a variety of coastal fish and wildlife species. Detritus from coastal marshes also provides a source of mineral and organic nourishment for organisms at the base of the food chain. The potential for proposed CIP impacts to oyster reef at Blue Buck Point at the mouth of Sabine Lake was also identified.

All or portions of the following federally and State-protected lands contain sensitive habitats that may be affected by the proposed CIP: the Sabine National Wildlife Refuge (NWR), the McFaddin NWR, the Texas Point NWR, the J.D. Murphree WMA, the Lower Neches WMA, the Tony Houseman WMA, and the Sabine Island WMA.

Potential impacts to threatened and endangered species are a concern, particularly dredging impacts to endangered sea turtles. The offshore channel deepening and extension will require the use of hopper dredges, which create particular hazards for sea turtles. Critical Habitat for the wintering piping plover is present in the study area.

Concern has been expressed that the proposed CIP could increase tidal amplitude and increase damage during storm surges by allowing the surge to inundate areas that have not been affected by previous storms. Potential for increased Gulf shoreline erosion is also a concern. In recent years, high shoreline erosion has caused substantial wetland losses on the Gulf shoreline from Texas Point westward to the vicinity of Sea Rim State Park.

The public has also expressed concern that dredging for the proposed CIP and the placement of dredged material will spread contaminated sediments or affect water quality. It is feared that new work dredging will release contaminants from past industrial discharges into the water column, or that areas selected for the beneficial use of dredged material could be polluted.

The beneficial use of dredged material to restore degraded marshes was encouraged by the public and resource agencies. The following sites were specifically identified as areas that could benefit: Rose City marsh, Bessie Heights marsh, Keith Lake marsh, marshes in the McFaddin NWR, east Sabine Lake marshes, and the Gulf shoreline at Texas Point and Holly Beach. Construction of a bird island in Sabine Lake was also suggested. The beneficial use of dredged material would reduce the need for new or expanded PAs and reduce potential wetland impacts.

The proposed CIP, including the Gulf ODMDSs, could impact Essential Fish Habitat (EFH) for red drum; brown, white, and pink shrimp; Spanish mackerel; and estuarine water column and mud/sand bottoms. Potential effects to nursery and foraging habitat for economically important marine fishery species such as spotted sea trout, flounder, Atlantic croaker, black drum, Gulf menhaden, striped mullet, and blue crab also need to be evaluated for adverse effects associated with proposed water control structures.

It was suggested that environmental impacts as a consequence of the proposed CIP should be avoided if possible. A lock at Sabine Pass, a sill or constriction at the mouth of Sabine Lake, and smaller water control structures in the marshes east of Sabine Lake were suggested as methods to minimize or avoid impacts. Conversely, other comments warned of the potential harmful effects of water control structures that inhibit the movement of marine organisms into and out of intertidal marshes.

### 1.4.3 Socioeconomic

The Ports of Port Arthur and Beaumont expressed concern over the socioeconomic effects of not improving the SNWW. Both are concerned that the SNWW is close to reaching its capacity for vessel traffic movement. It was urged that direct and indirect economic and social benefits of the SNWW be fully evaluated.

Considerable concern was expressed by government agencies in Louisiana that the proposed CIP would have adverse effects on their state's environment while providing no economic benefits for Louisiana. Officials at the West Calcasieu Port, Harbor, and Terminal District urged that navigation improvements be evaluated on a regionwide basis, because channel improvements in Texas could put their facilities and the Port of Lake Charles at a competitive disadvantage. Cameron Parish officials expressed support for economic development that would benefit their constituents. Cameron Parish officials were also concerned that lands suitable for commercial development at Sabine Pass were being considered for use as PAs. Developable lands are limited on the Louisiana side of the SNWW, and all are needed to promote economic development.

Jefferson County Drainage District #7 expressed concern that channel widening and deepening could affect the structural integrity of the Port Arthur Hurricane Protection Levee, pump stations, and closure structures. The Texas Department of Transportation (TxDOT) expressed concern that increased erosion could adversely affect State Highways (SH) 82 and 87. Both are located immediately adjacent to the SNWW and are affected by present channel bank erosion. Additional erosion of SH 87 could destroy the only road access to the City of Sabine Pass.

The high concentration of petrochemical refineries and terminals in the study area means that a large number of pipelines are also present. Local industries are concerned that these pipelines will be affected by the proposed channel deepening and that they will be responsible for the cost of moving these pipelines to accommodate the deeper channel.

Socioeconomic impacts on commercial fisheries are also a concern. A small, commercial shrimp fleet operating out of Sabine Pass could be adversely affected if the proposed CIP adversely affects EFH. There is also a concern that environmental impacts could adversely affect sport fishing, which is a popular activity throughout the study area.

Several members of the general public expressed concern that the cost of this project will be large, that benefits will not be sufficient to outweigh costs, and that costs will be passed on to taxpayers in the form of higher taxes.

### 1.4.4 Historic Properties

There is concern that use of PA 5 will adversely affect public access to the Sabine Lighthouse, a National Register property. A road around the perimeter of the PA is currently the only access route to the Lighthouse. Changes or enlargements to this PA could limit or remove access to this historic property.

Concern has also been expressed about the potential for proposed CIP improvements to affect the Sabine Pass Battleground Park, Fort Griffin, and associated shipwrecks. These sites and shipwrecks are associated with important battles during the U.S. Civil War.

## 1.5 PLANNING OBJECTIVES

The planning objectives of the proposed CIP include improvement in the efficiency of the deep-draft navigation system and maintaining the ecological values of the area's coastal and estuarine resources. Economic efficiency would result from the passage of more fully loaded ships, a reduction in the need for lightering and lightening, and a decrease in vessel delays. Protection of the area's coastal and estuarine resources would result from the beneficial use of dredged material and full compensation for unavoidable environmental effects.

## 1.6 INTERAGENCY COORDINATION TEAM

An ICT comprising the Federal and State resource agency representatives from Louisiana and Texas was established at the beginning of the study to advise the USACE on matters related specifically to the environmental impact review. ICT agencies and representatives are listed in Table 1.6-1. Agencies were asked to designate one official member who was authorized to speak for the agency and make decisions in the group format. Representatives from other local and State agencies or governments also participated in the ICT in an advisory capacity: Jefferson and Orange counties, Texas; Cameron and Calcasieu parishes, Louisiana. The USACE ICT members ensured that decisions were made within the framework of the USACE planning process and in compliance with Federal law and policy, including guidance such as Planning in a Collaborative Environment (Engineer Circular [EC] 1105-2-409) and the Environmental Principles (Engineer Regulation [ER] 200-1-5). Insofar as was possible, given the USACE planning, policy, and schedule constraints, important decisions related to identifying and studying potential ecological impacts, and identifying alternatives for compensatory mitigation were made by consensus within the ICT. Toward the end of the planning study, remodeling and reanalysis were conducted by the USACE to incorporate the effects of a revised plan of navigation improvements, the projected future rate of RSLR, and future freshwater inflows. Because of schedule constraints, this modeling was performed without ICT consultation. However, the results of this reanalysis were coordinated with the ICT, and no changes in the recommended ecological mitigation plan resulted from the remodeling and reanalysis.

Technical work addressing specific environmental concerns or planning objectives was done by several smaller workgroups whose members were taken from the ICT. Each of these workgroups and its purpose is discussed separately below.

- The Restoration and Beneficial Uses Workgroup (RW) was created to develop ideas for ecosystem restoration and the beneficial use of dredged material in the study area. Although ecosystem restoration is not a study purpose, ideas for potential restoration projects were explored by this workgroup. The RW also reviewed suggestions provided during the public workshops for this purpose (Gulf Engineers and Consultants, Inc. [GEC], 2002).

Table 1.6-1
SNWW ICT and Workgroup Participants

**U.S. Army Corps of Engineers**
Carolyn Murphy
Janelle Stokes
Paula Wise
Robert Hauch
Gloria Appell
John Baker
John Otis
Nancy Young
John Damm
Jackie Lockhart
Ed Reindl
Baldev Mann
Seth Jones
Kristy Morten
Frank Garcia
Richard Tomlinson
Lizette Richardson
Volker Schmidt
Gary Brown, ERDC
Steve Maynord, ERDC
Nana Parchure, ERDC
Mark Gravens, ERDC
Rao Vemulakonda, ERDC
Robert McAdory, ERDC

**Sabine Neches Navigation District**
Tom Jackson
Randall Reese
Clayton Henderson

**U.S. Environmental Protection Agency**
Mike Jansky
Barbara Keeler
Jim Herrington
Renee Ballew
Kenneth Teague
Phillip Crocker

**Texas General Land Office**
Dennis Rocha
Tammy Brooks
Juan Moya

**Texas Parks and Wildlife Department**
Woody Woodrow
Jamie Schubert
Jim Sutherlin
Mike Rezsutek
Terry Stelly
Jerry Mambretti
Jim Tolan
Nathan Kuhn

**Texas Water Development Board**
Barney Austin
Junji Matsumoto

**Texas Commission on Environmental Quality**
Robert Hansen

**Texas Department of Transportation**
Raul Cantu

**Sabine River Authority of Texas**
Jack Tatum
Gerard Sala
John Payne

**Louisiana Department of Natural Resources**
Gerry Duszynski
Kirk Rhinehart
Kyle Balkum
Dan Llewellyn
Steven Gammill

**Louisiana Department of Environmental Quality**
David Daigle

Table 1.6-1, cont'd

| | |
|---|---|
| **U.S. Fish and Wildlife Service** | **Louisiana Department of Wildlife and Fisheries** |
| Phil Glass | Fred Dunham |
| Darryl Clark | Kyle Balkum |
| Andy Loranger | Michael Harbison |
| Dean Bossert | |
| Pat Walther | **PBS&J** |
| Chris Pease | Martin Arhelger |
| Steve Reagan | Dave Buzan |
| Roy Walter | Kathy Calnan |
| Brian Cain | Andy Labay |
| Donna Anderson | Eric Monshaugen |
| | Tony Risko |
| **U.S. Natural Resource Conservation Service** | Lisa Vitale |
| Eddie Seidensticker | |
| | **Turner Collie & Braden** |
| **National Marine Fisheries Service** | Georganna Collins |
| Rusty Swafford | Carrie Eick |
| Richard Hartman | |

- The Hydrodynamic and Salinity Modeling Workgroup (MW) provided data to assist the hydrodynamic salinity (HS) modeling and verification process and reviewed modeling results as part of the impacts evaluation. The modeling was conducted by the USACE's Engineer Research and Development Center (ERDC), reported in Brown and Stokes (2009).

- The Contaminants Workgroup (CW) evaluated water and sediment quality associated with the proposed CIP, including characterization of existing conditions in the project area and the results of physical and chemical analyses conducted. This evaluation is reported in PBS&J (2004a, 2004b).

- The ODMDS Workgroup (OW) was created to advise in the preparation of the Site Designation FEIS for the proposed ODMDSs. The OW reviewed existing data, recommended additional studies, reviewed the results of physical, chemical, and biological analyses, and reviewed the ODMDS FEIS, which is attached to this FEIS as Appendix B.

- The Habitat Evaluation Workgroup (HW) reviewed and classified existing habitat, performed field evaluations to document existing conditions, and developed and applied procedures for the prediction of without and with-project conditions using the Wetlands Value Assessment (WVA) ecological model. The HW also reviewed results of the ecological modeling and report, which is provided as Appendix C to the FEIS.

## 1.7 RESOURCE MANAGEMENT OPPORTUNITIES

Dredged material is now viewed as a regionally significant resource that can be put to positive use, rather than a waste by-product of channel improvements. The principles of Regional Sediment Management

(RSM) were applied to ensure that the dredged material arising from the SNWW CIP would be viewed as valuable resource, integral to economic viability and environmental sustainability of the region (Martin, 2002). In developing the DMMP for the project, this study searched for opportunities to achieve savings by coordinating projects, identified opportunities for beneficial use, and sought ways to contribute to coastal watershed goals related to sediment management. The large quantities of dredged material that would be generated by the proposed CIP created an ideal opportunity for the exploration of the beneficial use of dredged material. A series of public workshops and extensive ICT consultation evaluated a wide array of opportunities to use dredged material beneficially (GEC, 2002; Turner Collie & Braden, 2003). Potential uses of dredged material that were evaluated for this study included estuarine hydrologic and habitat restoration and ways to keep sediment in the system such as Gulf shoreline nourishment and offshore feeder berms. A complete description of alternatives for regional sediment management of the SNWW CIP dredged material is provided in Chapter 2.

# 2.0 ALTERNATIVES

This chapter is divided into five sections. The first discusses the history and process used in formulating alternatives that address planning objectives. Section 2.2 presents the preliminary screening of nonstructural and structural alternatives; the comparison of detailed structural alternatives follows in Section 2.3. Section 2.4 summarizes the results of the detailed screening and provides a full description of the Preferred Alternative. Section 2.5 describes and evaluates alternatives for the management of dredged material arising from construction and maintenance of the Preferred Alternative, and the incremental impacts and benefits of the DMMP. Placement features include beneficial use features, upland placement areas, and ODMDSs.

## 2.1 HISTORY AND PROCESS FOR FORMULATING ALTERNATIVES

The FFR, to which this FEIS is attached, provides a detailed description of the analysis of alternatives; however, a summary of this process is provided below. In this analysis, different ways of addressing identified problems, needs, and concerns were systematically evaluated while considering environmental factors. A three-phased screening process was used to identify the Preferred Alternative: 1) preliminary alternatives screening; 2) second screening; and 3) detailed evaluation of final alternatives. During preliminary screening, the expected "No-Action" Alternative was developed for comparison with other alternatives. This alternative was carried through the subsequent planning phases for comparison to other alternatives. Nonstructural and structural alternatives that could address planning objectives were also developed. The nonstructural alternatives evaluated the use of a VTS to alleviate transportation efficiency and safety concerns, the relaxation of existing pilot rules, and an alternative mode of commodity transport. For the structural alternatives, a wide array of structural channel improvements was evaluated. Over 120 different combinations of various depths and widths were analyzed during the preliminary screening. In the second phase, a more detailed evaluation of screened alternatives was performed. The final channel widths were determined during the second screening. With the exception of selective widening or bend easing in a few areas, no changes were made to the existing width of inshore navigation channels; the width of most of the offshore navigation channels and proposed extension were reduced from the existing width of 800 to 700 feet. Six channel depths (45, 46, 47, 48, 49, and 50 feet) with the set channel widths and from three to eight potential turning/anchorage basins on the Neches River Channel (Figure 2.1-1) were selected for the final detailed analysis. In accordance with the USACE Actions for Change initiative (USACE, 2006a), potential risks and uncertainties related to engineering, economic, and environmental analysis were evaluated throughout the alternatives analysis. Descriptions of these risks are discussed in the FEIS topic areas to which they relate, and they are also summarized in the FFR.

An economic evaluation of various deepening and widening alternatives was conducted to identify alternatives that maximized National Economic Development (NED) benefits. This evaluation is presented in detail in the FFR; only a brief summary is provided here. Project benefits were based on reductions in transportation costs generated from more-efficient vessel loading and from reductions in

vessel delays. Benefits and costs were calculated for Port Arthur and Beaumont depth alternatives of 43, 45, 47, 48, 50, 52, and 55 feet, and for other separable elements of the proposed CIP. The initial selection of the widening alternatives to be evaluated was based upon the results of a vessel simulation model conducted by the ERDC with input from the Sabine Pilots Association. The alternatives were subsequently screened based upon comparison of associated vessel delay costs and the initial construction cost estimates. Channel widening and turning anchorage basin benefits for deep-draft traffic were also evaluated by estimating benefits from delay reductions using an economic traffic model developed by the ERDC. Ecological mitigation costs for the six depth alternatives were interpolated based upon changes in salinity. The detailed evaluation of final alternatives concluded with the selection of a Preferred Alternative. Detailed evaluations of alternatives for the management of dredged material and the mitigation of ecological impacts were then performed for the Preferred Alternative. This evaluation concluded with the development of a DMMP and an ecological mitigation plan. The DMMP includes measures in which dredged material is used to restore wetland habitat, avoiding and offsetting impacts of the Preferred Alternative. The evaluation of alternatives for the management of dredged material and the recommended placement plan are described later in this chapter. The evaluation of mitigation alternatives that compensate for remaining unavoidable impacts to significant habitats and resources, and the recommended mitigation plan are described in Chapter 5 of this FEIS. Least-cost analyses of dredged material placement and an incremental cost analysis of mitigation alternatives were conducted to select recommended placement and mitigation measures; these analyses are presented in the FFR.

## 2.2 PRELIMINARY AND SECOND SCREENING

### 2.2.1 No-Action Alternative

The No-Action Alternative forms the basis against which all other alternative plans are measured. Under the No-Action Alternative, the Federal Government and the non-Federal sponsor would not implement the proposed CIP and the objectives of improving the navigational efficiency of the waterway would not be met.

It is expected that imports of crude oil and petroleum products would continue to expand to keep pace with the predicted national need for these products and the projected continuing declines in U.S. production. Vessel trips would increase to accommodate the higher imports, and higher costs associated with the current lightering and vessel movement limitations would continue. Increased vessel trips would exacerbate the existing channel bank erosion caused by vessel wakes in the confined channel reaches of the SNWW. It is projected that the existing trend in wetland losses would accelerate due to RSLR and altered hydrology and salinity levels caused by the existing SNWW navigation channels, the GIWW, and canals, levees, and water control structures associated with oil and gas exploration and production, logging, fishing, and hunting lands.

The No-Action Alternative would retain the 40-foot SNWW navigation channel with no improvements. The current channel dimensions do not allow the existing fleet to use the channel efficiently. Ships are limited by the current channel depth and width and safety limitations that result in one-way and daylight-

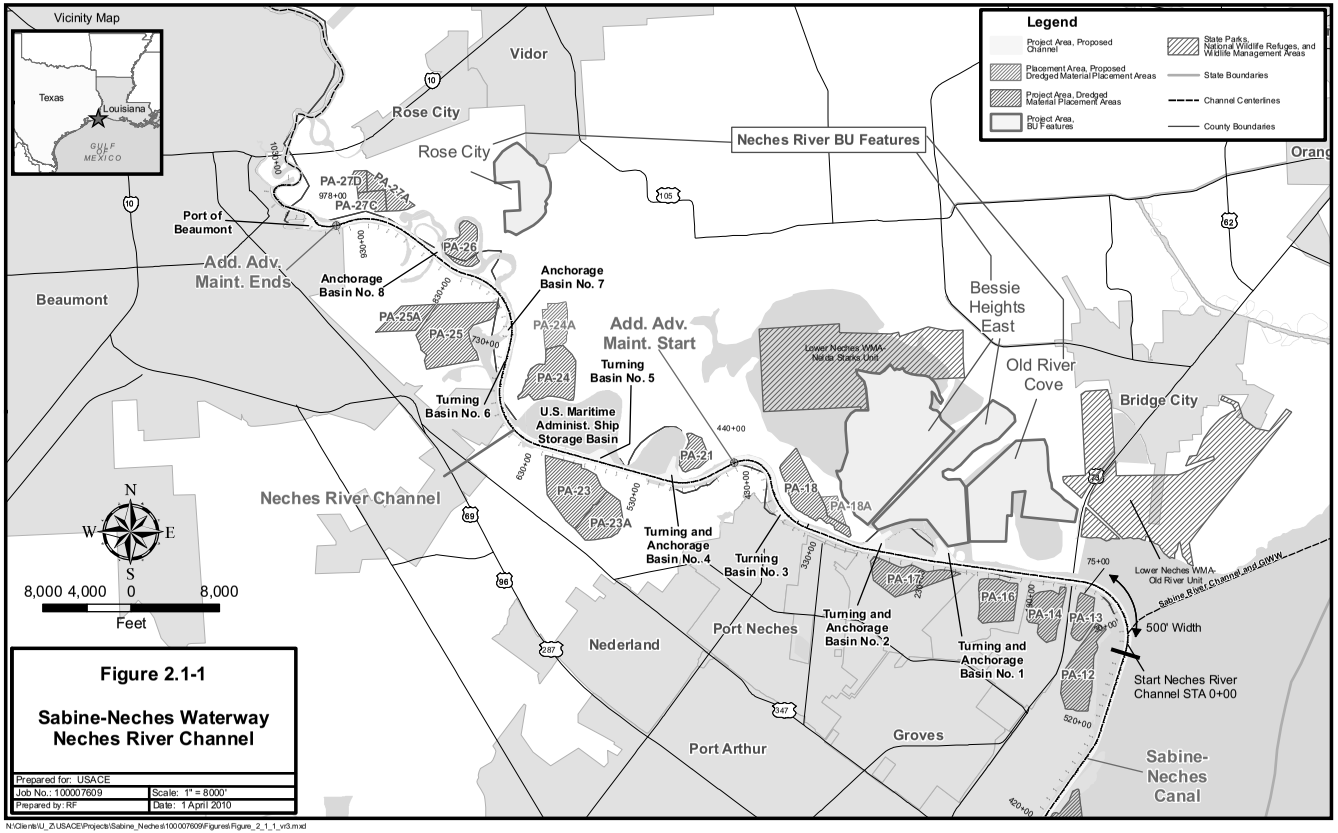


**Figure 2.1-1**

**Sabine-Neches Waterway Neches River Channel**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 8000' |
| Prepared by: RF | Date: 1 April 2010 |

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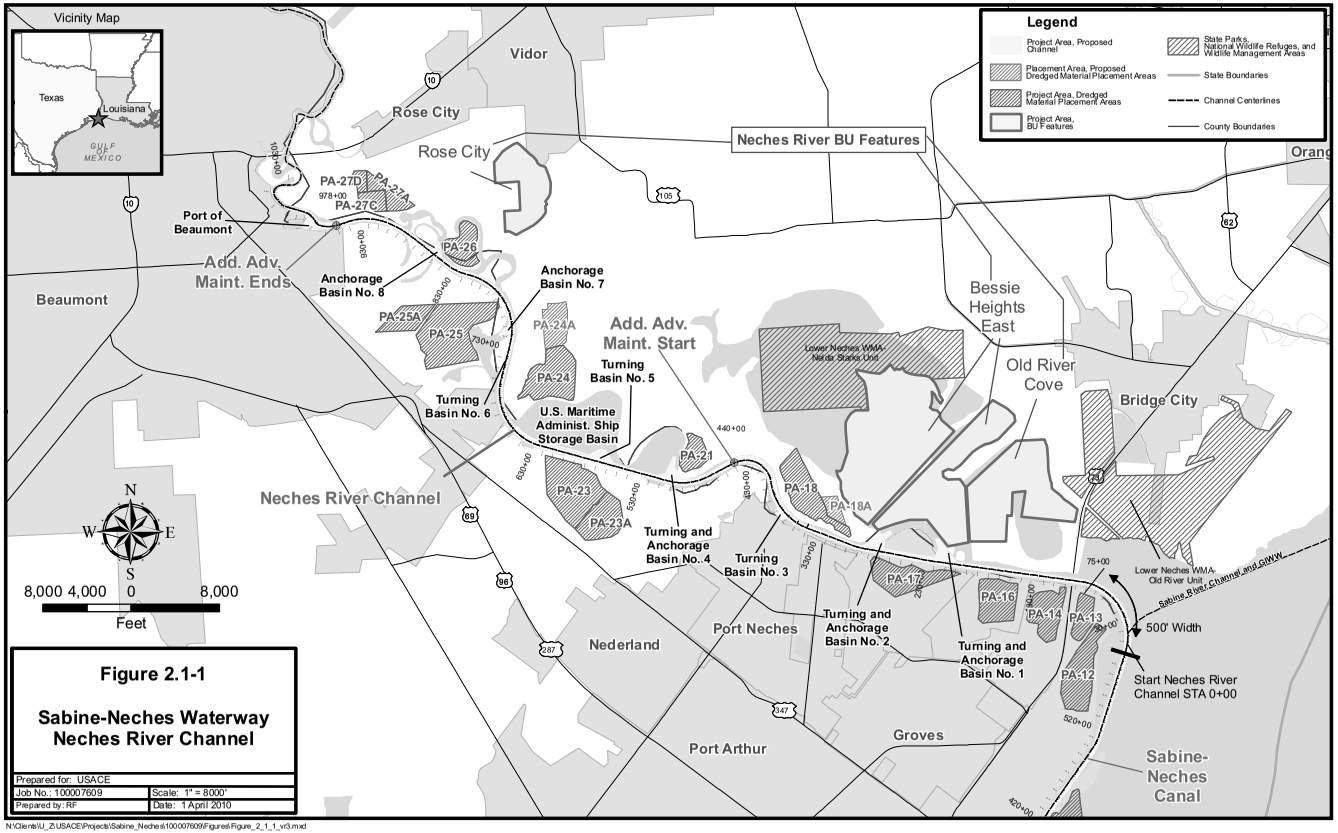


**Figure 2.1-1**

**Sabine-Neches Waterway Neches River Channel**

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| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 8000' |
| Prepared by: RF | Date: 1 April 2010 |

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only sailing restrictions. The need to lighter products and/or light load vessels increases overall vessel trips and shipping costs, and decreases the efficiency of the vessels using the waterway. The waterway is often congested because of frequent movements of lightered vessels carrying petroleum products from the Gulf to refineries on the Neches River Channel, and because of barge through-traffic using the GIWW. Vessels are now wider, placing limitations on the combined beam widths and drafts for vessel meetings on the waterway. Historically, casualty incidents on the SNWW channel are very low, due in large part to existing pilot rules that minimize the probability of incidents involving deep-draft vessels. Existing and proposed LNG facilities on the Sabine Pass Channel and Port Arthur Canal are subject to strict USCG regulations and to local pilot rules that prevent LNG vessels from meeting other vessel traffic. Increases in both inland barge and deep-draft vessel traffic along the waterway are expected to increase overall congestion and the likelihood of accidents. However, since the overall rate of casualty incidents is very low, the number of additional accidents in the future would also be low.

The No-Action Alternative would continue disposal activities for maintenance material from the 40-foot project in conformance with most, but not all, existing practices. In the FFR, the DMMP for the No-Action Alternative (the future without-project [FWOP] condition) is referred to as the Base Plan. The Base Plan forecasts disposal facility needs for all material that would be generated by maintenance dredging of the existing 40-foot project over a 50-year period of analysis. The 50-year analysis determined that additional capacity in upland PAs would be required, and it identified a least-cost beneficial use (BU) feature (the Gulf Shore BU Feature) that should be adopted as part of the Base Plan. The Gulf Shore BU Feature has also been included in the DMMP for the Preferred Alternative; it will be treated as a general navigation operation and maintenance (O&M) component.

No differences from existing offshore placement activities were identified for the Base Plan. The offshore channels (Sabine Bank Channel, Sabine Pass Outer Bar, and Sabine Pass Jetty Channel) would be maintained with a hopper dredge, and approximately 162 million cubic yards (mcy) of material would be placed in the four existing ODMDSs (sites 1–4). Bed sediments in the offshore channels vary from 4.3 percent sand and 95.7 percent silt plus clay in the Sabine Pass Outer Bar Channel to 24.3 percent sand and 75.7 percent silt plus clay in the Sabine Bank Channel (Parchure et al., 2005). These sites have sufficient capacity for the 50-year period of analysis as they are located in a dispersive environment where dredged material does not accumulate.

For the inshore Sabine Pass Channel, a cost analysis of placement alternatives in the FFR resulted in a change from traditional upland placement practices involving PA 5. Rather than placing all of the maintenance material from this channel into upland PA 5, the potential beneficial use of material from the channel section closest to the coast (Section 5) was evaluated to determine whether it could be used to nourish the Gulf shoreline on both sides of Sabine Pass (Gulf Shore BU Feature). Material from Section 6 of the Sabine Pass Channel would continue to be placed into PA 5 because the longer pumping distance to the coast makes shore nourishment cost prohibitive. The cost analysis determined that the Gulf Shore BU Feature is more cost effective than placing the material in the upland PA 5, and therefore it was adopted as part of the Base Plan.

Under the Base Plan, all of the inshore channels of the existing project (Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and the Neches River Channel) would continue to be maintained by hydraulic pipeline dredge. Material from non-Federal dredging of private mooring and dock facilities would also continue to be placed in upland PAs along with the material from the Federal project. Existing management practices that utilize 16 upland PAs located adjacent to the channel from Sabine Pass to the Beaumont Turning Basin would continue. To contain 229.4 mcy of material over the 50-year period of analysis, the heights of existing PAs would be raised on a regular, recurring schedule in accordance with existing SNWW management practices. One new PA in the middle reach of the Neches River Channel (an expansion cell at PA 24A) would be needed to provide sufficient capacity for the period of analysis. On average, bed sediments vary in the inland channels from 38.3 percent sand and 61.7 percent silt plus clay in the Neches River Channel to 16.2 percent sand and 83.8 percent silt plus clay in the Port Arthur Canal (Parchure et al., 2005). Beneficial use features are not included in the Base Plan for the inland channels because the lack of suitable material makes construction and maintenance of containment levees more expensive than placing the material in existing PAs. However, Section 204 projects would be considered on a project-by-project basis if non-Federal sponsors express an interest in paying the incremental cost for such projects.

## 2.2.2 Nonstructural Alternatives

### 2.2.2.1 Vessel Traffic Service

The existing VTS along the SNWW was evaluated as a nonstructural alternative. Although this service is managed by the USCG and thus is not within the jurisdiction of the USACE, it was evaluated because it appeared to be a potential alternative to structural plans. VTS was authorized by certain sections of the Port and Waterways Safety Act of 1972; the Oil Pollution Act of 1990 made participation mandatory in areas serviced by existing and future VTS (USCG, 2008a). The purpose of VTS is to provide active monitoring and navigational advice for vessels in particularly confined and busy waterways. VTS is designed to expedite ship movements, increase transportation system efficiency, improve all-weather operating capability, and enhance vessel safety and marine environmental protection (SETWAC, 2007; USCG, 2008b).

The Vessel Traffic Center in Port Arthur became operational in 2005 and monitors every ship, vessel, or boat that attempts to enter or leave the SNWW and the GIWW in the Port Arthur service area. Infrared cameras, along with radar, radio-telephone reports from vessel operators, and satellite surveillance sensors on towers along the SNWW allow VTS controllers to zoom-in on vessel activity at a moment's notice. The satellite-based Automatic Identification System (AIS), required by the Maritime Transportation Security Act of 2002, assists the VTS by determining exactly what a specific commercial vessel is carrying, along with its speed, dimensions, and destination. Most commercial vessels using the waterway were required to have AIS equipment installed by the end of 2004 (Jackson, 2004). These include power-driven vessels 66 feet in length or longer; power-driven vessels of 100 gross tons or more carrying one or more passengers for hire; towing vessels 26 feet or longer while navigating all dredges and floating plant likely to restrict or affect the navigation of other vessels; and all vessels required to

participate in the Vessel Movement Reporting System. However, not all vessels are required to carry AIS; in particular, pleasure crafts, fishing boats, and warships are exempt.

Currently, VTS Port Arthur is a voluntary system operated in accordance with existing VTS regulations. Until rules regarding VTS Port Arthur are published, vessels are exempt from all VTS and Vessel Movement Reporting System requirements, except the requirement for AIS continuous broadcasts. When VTS Port Arthur is included in the VTS regulation, participation will become mandatory. At that time, VTS Port Arthur will be authorized to designate temporary reporting points and procedures, impose vessel-operating requirements, or establish vessel traffic routing schemes. During conditions of vessel congestion, restricted visibility, adverse weather, or other hazardous circumstances, VTS may control or manage traffic by specifying times of entry, movement, or departure to, from, or within a VTS area.

While the VTS will help congestion and improve safety to some degree, the USCG's traffic management role is limited to specific circumstances when the SNWW is congested or experiencing hazardous conditions. The VTS assists vessel operators in making independent decisions regarding the safe navigation of their vessels, for which they retain complete responsibility. In this sense, VTS should be considered primarily a navigational aid, a tool for mariners to use along with numerous other tools to facilitate safe navigation (USCG, 2008b).

#### 2.2.2.2 Relaxation of Existing Pilot Rules

The SNWW is currently subject to transit rules that are needed for the pilots to safely guide large tankers through the narrow channel. These transit rules or restrictions are agreed upon by the shipping industry, supported by the USCG Captain of the Port Orders under the Ports and Waterways Safety Act of 1978, as amended, and administered by the Sabine Pilots Association (2007). An agreement enforcing these rules, dated January 12, 1981, will remain in force until the Sabine shipping industries, Sabine Pilots Association, and USCG agree to its revision or modification.

The existing 700-foot-wide offshore reach of the SNWW channel does not have vessel-meeting restrictions; however, in the narrower channel reaches, vessel-meeting restrictions are currently imposed. A general overview of the transit rules are:

- Daylight only sailing restrictions applied in specific reaches for vessels that exceed certain DWT, length, and breadth criteria.
- No meeting during nighttime sailing for vessels exceeding a given draft limitation.
- No meeting during either day or night, applied to vessels by DWT, length, breadth, and draft combinations.

Relaxation of the existing pilot rules for the waterway was considered as a nonstructural alternative early in the planning process. However, due to concerns about vessel handling and associated safety and that vessels utilizing the waterway are wider than those using the channel even 5 to 10 years ago, the Sabine Pilots Association would not consider relaxing the rules. The expectation for the with- and without-project future is that pilot rules will continue to limit the possibility of vessel meetings in the Sabine-

Neches Canal reach and that both vessel and shallow-draft tow movements will be scheduled through both VTS and communication between vessel pilots.

While vessel traffic is expected to increase under both the No-Action and future with-project (FWP) conditions, increases with a deeper channel are projected to be slightly lower because channel improvements will allow more deep-draft cargo to be carried with fewer vessel trips. Associated reductions in deep-draft vessel traffic would thereby serve to reduce the probability of casualties. However, since casualty occurrences in the SNWW are rare, the proposed improvements would not have a discernible effect on casualty rates. For LNG vessels, USCG safety rules will be the same with or without a deepened channel.

#### 2.2.2.3 Alternative Mode of Commodity Transport

Offshore oil terminals were evaluated as an alternative mode to landside port delivery of crude petroleum. Three offshore terminal alternatives were considered in the analysis, one existing and two proposed. The decision to use an offshore terminal instead of lightering or constructing a deeper channel is complicated but largely depends on the relative cost per ton, relative market volumes, and facility accessibility. While a quantitative analysis of a LOOP alternative is beyond the scope of USACE planning study, the overall infrastructure requirements were examined to the extent possible. Pipeline capacities and necessary expansions were identified, and the reasons for current and past choices were evaluated as were expectations about future interest.

The existing offshore terminal, the LOOP, is America's first and only deepwater port. LOOP is presently operating at capacity and has been since 2005. In addition to new customers brought on due to infrastructure damages associated with the 2005 hurricanes, recent increase in the LOOP is tied to utilization associated with domestic production in the U.S. Gulf. Present use of LOOP consists of Louisiana-based refineries and U.S. Gulf Coast state domestic offshore production interests. LOOP's existing base of customers use it as one of several options for delivering crude oil to their Gulf Coast refineries. Access to LOOP for the SNWW market would require substantial investment as SNWW crude oil import volume nearly equals LOOP's capacity. LOOP's design capacity of 1.4 to 1.8 million barrels per day is only marginally higher than SNWW 2003 to 2005 crude petroleum import volume, which ranged from 1.1 to 1.3 million barrels per day (USACE, 2007a). The investment necessary for LOOP to process SNWW's entire crude petroleum throughput would require a doubling of capacity.

While all of SNWW's crude oil could not currently transfer to LOOP, some tonnage could be diverted. The SNWW users continue to consider LOOP along with other alternatives; however, continued practices suggest that LOOP is not a cost-effective alternative to the existing SNWW practice of its land-based ports. The volume of potential diversions depends upon various ranges of LOOP expansion or construction of a new facility. The large fixed cost of expansion, and associated financing costs, necessitate participation by a consortium of companies. The SNWW industries have not found the option of investing in LOOP, and the necessary associated infrastructure expansions, to be a cost-effective alternative to existing practices of either direct shipment or offshore lightering. The lack of incentive has

remained since the 1970s. An additional variable pertinent to the current evaluation is that LOOP would appear to be a less attractive cost option when compared to lower shipping costs that the SNWW improvement project is expected to provide.

LOOP is located offshore of Grande Isle, Louisiana, in 110 feet of water. Grande Isle is 302 miles east of Port Arthur and Beaumont. LOOP was organized in 1972 as a Delaware corporation and converted to a limited liability company in 1996. Marathon Ashland Pipe Line LLC, Murphy Oil Corporation, and Shell Oil Company are LOOP's owners. LOOP is the only port in the U.S. capable of offloading deep-draft tankers known as Ultra Large Crude Carriers (ULCC) and Very Large Crude Carriers (VLCC). Along with offloading crude from VLCCs, LOOP also offloads smaller tankers. LOOP consists of three single-point mooring buoys used for the offloading of crude tankers and a marine terminal consisting of a two-level pumping platform and a three-level control platform.

A 48-inch-diameter pipeline connects the LOOP Marine Terminal located 23 miles offshore in the Gulf to the Clovelly, Louisiana, storage facilities. Clovelly is approximately 260 miles east of the SNWW Port Arthur and Beaumont facilities. Four pipelines connect the onshore storage facility to refineries in Louisiana and along the Gulf Coast. The Clovelly facility provides interim storage for crude oil before it is delivered via connecting pipelines to refineries on the Gulf Coast and in the Midwest. The oil is stored in eight underground caverns leached out of a naturally occurring salt dome. In 1996, one cavern was dedicated to the production streams coming in from the deepwater Gulf.

The domestic offshore crude oil system uses the same distribution system used by the foreign barrels. The caverns are capable of storing approximately 50 million barrels of crude oil (a barrel of oil is equal to 42 U.S. gallons). In addition, LOOP has an aboveground tank farm consisting of six 600,000-barrel tanks. LOOP operates the 53-mile, 48-inch LOCAP pipeline that connects LOOP to CAPLINE (Amoco Cushing-Chicago Pipeline Company) at St. James, Louisiana. CAPLINE is a 40-inch pipeline that transports crude oil to several Midwest refineries. St. James is 227 miles east of Port Arthur and Beaumont. LOOP is connected to over 50 percent of the U.S. refinery capacity and has offloaded over 7 billion barrels of foreign crude oil since its inception.

LOOP is designed to handle 1.4 million barrels per day, but depending on the sizes of ships being serviced, it can handle 1.8 million barrels per day. The variance relates to the pumping rates of the tankers using the facility. Larger tankers tend to have faster pumping rates, with some capable of pumping 80,000 barrels per hour. Smaller tankers may only be able to pump 35,000 barrels per hour. When fully operational, LOOP is generally the largest point of entry for crude oil imports into the U.S. About 13 percent of all waterborne foreign imports pass through LOOP each day. Again, LOOP's design capacity of 1.4 to 1.8 million barrels per day is only marginally higher than the SNWW 2003 to 2005 crude petroleum import volume, which ranged from 1.2 to 1.4 million barrels per day. Of the SNWW's approximate 1.3 million barrels per day import volume, terminals on the SNWW transport approximately 400,000 barrels per day of waterborne crude oil via pipelines to inland refineries including refineries in Texas, Louisiana, Oklahoma, Ohio, Arkansas, and Kentucky (Martin Associates, 2006). In total, the SNWW delivers approximately 12 to 16 percent of the crude oil supplied to domestic refineries east of

the Rockies. Refineries supplied via the SNWW provide transportation fuels and other products to consumers along the Gulf Coast, East Coast, and in the Midwest regions. The SNWW ports presently receive about 1 percent of their daily input through LOOP. Additional offshore and landside infrastructure would be necessary for an increase in volume to take place.

Although there are some competing markets, the SNWW and LOOP generally serve parallel markets, with LOOP consistently processing very large volumes and SNWW serving relatively smaller parcels. The sizes of the VLCCs using LOOP typically exceed 300,000 DWT, whereas the maximum-sized vessels using the SNWW are 175,000 DWT. The maximum design draft of these vessels is 55 feet or less. The minimum-sized crude oil tankers using the SNWW are in the 70,000 to 80,000 DWT range and have design drafts between 40 and 48 feet. LOOP's foreign petroleum imports are from the Middle East, whereas the SNWW's market consists of direct shipments from Mexico and Venezuela and lightened mother vessels and shuttles. It has been noted that the cost effectiveness of LOOP lessens for small vessel sizes. The SNWW has the ability to serve a more general market and range of users. In discussions with local port and oil industry personnel, it is noted that LOOP and similar proposals serve crude petroleum but do not serve a full range of petroleum and bulk cargoes that use the SNWW.

The most-immediate obstacle to increased use of LOOP or a new offshore facility is lack of major limitations for direct connection from LOOP to SNWW. A marginal increase in the SNWW's use of LOOP from its present 1 percent share would require LOOP pipeline connection modifications involving multiple pipelines and multiple companies. Such an investment may generate the necessity for higher throughput charges, which, in turn, may make access less cost effective than in the past. An industry analyst noted that, to a large extent, the companies demand that each segment, including pipeline transportation, stand on its own economically (Rabinow, 2004). The long-term availability of LOOP since the 1970s and low participation by the SNWW companies indicate that LOOP and new offshore terminal proposals have not provided the market utilization incentives for significant shares of the SNWW crude oil to shift towards these alternatives. The long-term trend is for domestic refining capacity to become more concentrated in regional centers and for imports of petroleum products to grow. This trend is evident with the SNWW with crude oil import tonnage exceeding that of any other U.S. port and being equal to LOOP. Imports of refined products and partially refined crude oil have grown significantly as have the use of draft-constrained vessels for transporting these cargoes.

In 2001, construction of a new terminal (called the Bulk Oil Offshore Transfer System, or BOOTS) offshore of Sabine Pass, Texas, was proposed. The relatively long distance from LOOP to the SNWW and the need for additional infrastructure suggest that a facility closer to the SNWW would be an attractive alternative to LOOP for SNWW channel improvements. However, the BOOTS facility has not yet been constructed, and the regulatory permit application is inactive. The USCG has had no update on the proposal and does not expect a submittal. At the present time, the potential user of the proposed project is the terminal proponent. They noted that their participation as sole supporter is not feasible financially. It was specifically noted that their feedstock needs were not sufficient to finance the expansions to LOOP.

The BOOTs project proponent was contacted, and it was found that a new location farther down the Texas coast near Freeport is presently being considered. Access by the SNWW refineries to the proposed Texas Offshore Ports System (TOPS) would have advantages over LOOP. There is an existing pipeline from Freeport to Texas City; however, its connection to Port Arthur would necessitate a new pipeline from Texas City to SNWW, a distance of approximately 75 miles. Industry indications are that the use of an offshore Freeport terminal would not serve as the exclusive supplier, just as LOOP is not the exclusive supplier for the Louisiana markets. TOPS would reduce the vessel traffic on the Neches River by reducing the number of shuttle vessels coming into the SNWW from the offshore lightering zone. However, a disagreement among the partners recently led to the withdrawal of two of the three companies from the partnership.

In a general discussion with industry, a representative noted that offshore oil terminal projects surface periodically, but the cost of these alternatives keeps them from moving beyond the initial planning stage. It is noted that the attractiveness of offshore alternatives over existing use of the SNWW is diminished by its ability to only serve one commodity (i.e., crude petroleum). It was added that the various crude oil blends and grades of oil introduce a range of additional concerns that add to throughput costs. The pipelines and associated infrastructure requirements vary between potential users, and mingling of products and grades of crude is complex and difficult to facilitate. The construction of an offshore terminal that can meet the needs of various users is a challenge with the costs to realize multiparty usage creating an impasse to these proposals moving beyond the initial planning stage. Recognition of the cost of multiple pipelines necessary to meet the needs of the large base of customers necessary to finance these project alternatives has resulted in a stalemate in the decision process.

Expansion of LOOP, construction of a new offshore facility such as BOOTS or TOPS, or an unloading terminal along the Sabine Pass or Port Arthur Canal reaches would reduce the vessel traffic on the Neches River. The reduction in ship traffic resulting from LOOP, BOOTs, or TOPS would reduce the economic viability of the SNWW deepening and widening project. However, past and present trends in infrastructure and fleet investments indicate that industry intends to continue using the Neches River Channel. An increase in the number of specially designed SNWW vessels was recently completed by one company, and another has invested in Neches River dock modifications for the larger “Aframax” and “Suezmaz” vessels. The focus of immediate private-sector petroleum vessel investments is concentrated on SNWW improvements rather than offshore or on the Sabine Pass Channel or Port Arthur Canal. Ongoing consultation with industry continues to show that commitments to offshore terminal investment have not materialized. During the 30 years since LOOP has become operational, several Texas Gulf Coast channel improvement projects have been completed and the benefits have been accrued. Offshore terminals would not accommodate products other than crude oil, and a significant proportion of benefits for the Neches River Channel project improvement are from refined petroleum products. The offshore terminal was found not to meet the efficiency objective for all waterway users as it addressed the needs of only one user and commodity (crude oil). For these reasons, this alternative was eliminated from further consideration.

### 2.2.3 Structural Alternatives

Six different channel depths (43, 45, 48, 50, 53, and 55 feet) were evaluated in combination with several different widening scenarios during preliminary and second alternatives screening. Widening the upper reaches of the SNWW to 500 feet through the Port of Beaumont was evaluated, as were selective widening alternatives of different widths for specific reaches. This analysis resulted in over 120 variations of alternative depths and widths. Costs were estimated for all of these variations and compared to benefits during this initial screening process. An incremental analysis of benefits for separable elements of the project was also conducted. Preliminary analysis indicated that approximately 65 percent of the project benefits were associated with the upstream Beaumont area and 35 percent with the Port Arthur area; therefore, continuing improvements up the Neches River to Beaumont was economically justified. The initial screening determined that depths of 45 feet and greater had higher net excess benefits than depths less than 45 feet. The initial analysis also showed slightly higher net excess benefits for the 52-foot and 55-foot depths than for depths between 45 and 50 feet. However, because the rate of change in net excess benefits for depths over 50 feet was relatively small, and due to the non-Federal sponsor's budget constraints, only depths between 45 and 50 feet were advanced for final screening. Ecological benefits and mitigation costs were not calculated for the 120 plus variations during the preliminary and second screening. However, the array of structural improvements was assessed for potential effects to the environment in a nonquantitative manner.

Deepening and widening combinations that were evaluated during preliminary screening are listed below.

- Maintain existing 40-foot depth with 500-foot width, and 3 existing turning basins, to Port of Beaumont;
- Deepen the entire waterway from the Gulf to the Port of Beaumont at depths of 43, 45, 48, 50, 53, and 55 feet with an extension of the Entrance Channel ranging from 5 to 25 miles in length and no widening;
- Deepen the entire waterway, considering the various depths (43, 45, 48, 50, 53, and 55) with an extension of the Entrance Channel ranging from 5 to 25 miles in length, and widen the Sabine-Neches Canal to Beaumont to match the 500-foot-wide channels in the lower reach;
- Deepening but not widening of the Taylor Bayou Channels and Basins at the various depths (43, 45, 48, 50, 53, and 55).

Two of the preliminary structural alternatives were found to be infeasible due to technical, economic, and environmental constraints, and were therefore not advanced into the second screening:

- Widening the entire existing channel from Sabine Pass to the Port of Beaumont, at widths varying from 500 to 700 feet, was found to be infeasible because a widening-only alternative would not provide the additional draft needed to increase navigation efficiency for the largest number of waterway users. In addition, this alternative would have had significant ancillary effects such as the destruction of large amounts of emergent land and wetlands, the disruption or displacement of

a large number of existing docks and berthing facilities, the relocation of bridge supports for existing highway bridges, and the creation of many new PAs.

- Selective widening only (widening only certain reaches of the channel) was eliminated because it would provide even fewer navigation benefits than the widening-only alternative discussed above

During the second alternatives evaluation, several widening combinations were evaluated. Each of the following was evaluated for deepening options of 43, 45, 48, 50, 53, and 55 feet with an extension of the Entrance Channel from 8 to 16.5 miles.

- Maintain existing 500- to 400-foot width of the inshore channels to Port of Beaumont at depths of 45, 48, and 50 feet;
- Reducing the deepened Sabine Bank Channel from 800 feet wide to 700 feet wide through the end of the extension channel;
- Selective widening (600- and 700-foot widths) from Sabine Pass Channel station 180+00 to Port Arthur Canal station 275+00 (long reach);
- Selective widening (600- and 700-foot widths) from Sabine Pass Channel Station 265+00 to Port Arthur Canal Station 85+00 (short reach);
- Selective widening (500-, 600-, and 700-foot widths) in the Sabine-Neches Canal;
- Selective widening (600- and 700-foot widths) in the Neches River Channel. Deepening and widening of the Taylor Bayou Channels and Basins;
- Constructing a 12-foot-deep by 150-foot-wide barge shelf from the Port Arthur Junction Area to the mouth of the Neches River; and
- Adding various combinations of up to eight turning basins and/or anchorage basins on the Neches River Channel.

Several of these alternatives were eliminated at the conclusion of the second screening. The alternative mode of commodity transport (LOOP and BOOTS) and the VTS alternatives would help with improving safety along the existing channel (by reducing vessel traffic or better managing the traffic). However, these alternatives do not address the navigational efficiency of the waterway and would not allow the vessels utilizing the channel to load more fully. The potential relaxation of the current transit rules by the pilots was evaluated but screened out as not implementable because the pilots do not support this course of action. Therefore, all of the nonstructural plans were eliminated from further consideration. The widening alternatives included widening of the Sabine Pass and Port Arthur Canal channel from 500 to 700 feet. Although the widening in combination with the deepening of the channel was economically justified, the widening alone did not provide a benefit to cost ratio equal to or greater than 1.0. Therefore, the widening alternative for this reach was not an incrementally justified feature and was eliminated from further evaluation. Depths less than 45 feet and greater than 50 feet were also eliminated from further

screening, because the economic analysis indicated that the NED depth was likely between 48 and 50 feet.

In summary, since structural alternatives (e.g., deepening the channel) were the only alternatives that would fully address the project objective of navigational efficiency, only the No-Action Alternative and some structural alternatives for improvements to the SNWW navigation system were carried forward for detailed analysis. Among all of the structural alternatives, only six depths (45, 46, 47, 48, 49, and 50 feet) were carried forward into detailed evaluation.

## 2.3 EVALUATION OF FINAL ALTERNATIVES

### 2.3.1 Alternatives Advanced for Final Screening

At the conclusion of the second screening, only the No-Action Alternative and six structural alternatives for improvements to the SNWW deep-draft navigation system were advanced into detailed screening. The barge shelf alternative was dropped from further consideration when implementation of the VTS improved communication between deep-draft vessels and barges, thereby providing a nonstructural solution for the barge shelf. The three nonstructural alternatives for deepening the deep-draft channel had been eliminated from further consideration, as described above. Structural alternatives evaluated during this final screening phase are listed below. Comparative channel dimensions and dredging quantities are provided in Table 2.3-1.

- Deepening the SNWW to Beaumont to 45, 46, 47, 48, 49, or 50 feet (Alternatives A through F, respectively, in Table 2.3-1) with an extension of the Entrance Channel ranging from 8 to 16.5 miles in length, a 700-foot-wide Sabine Bank and Extension Channel, and deepening and widening the Taylor Bayou Channels and Basins.

Adding various combinations of up to eight turning basins and/or anchorage basins to the 45-, 46-, 47-, 48-, 49-, and 50-foot Neches River Channel deepening alternatives (Alternative G).

### 2.3.2 Comparison of Alternatives and Selection of the Preferred Alternative

The selection of the Preferred Alternative (Alternative D) from the alternatives listed above was based upon a comparison of economic, engineering, environmental, and socioeconomic factors presented in Table 2.3-1. The economic analysis presented in Chapter V of the FFR identified the alternative described below as the plan that maximizes net excess benefits for deepening the SNWW. The Preferred Alternative is called the Selected Plan, and ultimately, the Recommended Plan, in the FFR. The Preferred Alternative, presented as the last alternative in subsection 2.3.1, is described in detail below:

Table 2.3-1
SNWW Alternatives Comparison Table
Screened Alternatives Analysis Matrix - Potential Impacts to Evaluation Criteria

| *Note Column Letter is for reference in this table ONLY* | **No-Action Alternative** | **Alternative A** | **Alternative B** | **Alternative C** | **Alternative D (Preferred Alternative)** | **Alternative E** | **Alternative F** | **Alternative G** |
|---|---|---|---|---|---|---|---|---|
| **ALTERNATIVES** | Maintain existing 40-foot-deep by 800-foot-wide by 22-mile-long Sabine Bank and Outer Bar Channels, transitioning to 500 feet wide in the Sabine Pass Jetty Channel, and 400-x-40-foot-deep channel to Beaumont | 45-Foot Channel to Beaumont with an 8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins. | 46-Foot Channel to Beaumont with a 9.7-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 47-Foot Channel to Beaumont with a 11.4-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 48-Foot Channel to Beaumont with a 13.2-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 49-Foot Channel to Beaumont with a 14.8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 50-Foot Channel to Beaumont with a 16.5-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | Up to eight Neches River Turning and Anchorage Basins |
| **PLAN COMPARISON** | | | | | | | | |
| **Construction Dredging Note: All totals in this section are approximate** | | | | | | | | |
| Inshore SNWW Navigation Channels and Basins | None | 35.1 mcy | 41.9 mcy | 48.8 mcy | 54.4 mcy | 61.3 mcy | 67.2 mcy | 8.2 mcy |
| Offshore SNWW Navigation Channel | None | 29.2 mcy | 33.8 mcy | 38.4 mcy | 43 mcy | 48.6 mcy | 54.1 mcy | NA |
| Total | NA | 64.3 mcy | 75.7 mcy | 87 mcy | 98 mcy | 109.9 mcy | 121.3 mcy | 8.2 mcy |
| **Maintenance Dredging (50-year plan) Note: All totals in this section are approximate** | | | | | | | | |
| Inshore SNWW Navigation Channels and Basins | 245 mcy | 249 mcy | 258.4 mcy | 267.6 mcy | 280.6 mcy | 289.9 mcy | 295 mcy | 8.4 mcy |
| Offshore SNWW Navigation Channel | 161 mcy | 332.8 mcy | 345.1 mcy | 357.2 mcy | 369.8 mcy | 382 mcy | 394.2 mcy | 0.0 mcy |
| Total | 407 mcy | 581.8 mcy | 603.5 mcy | 624.8 mcy | 650.4 mcy | 671.9 mcy | 689.2 mcy | 8.4 mcy |
| **Dredged Material Placement (50-year plan)** | | | | | | | | |
| Upland PAs | 16 existing PAs with periodic raising of containment levees. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | 16 existing PAs with higher containment levees; new cells at existing PAs (18A and 24A). | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative; marginal additional quantities already provided for in upland PAs. |
| Neches River Beneficial Use (BU) Feature | None. No suitable new work material available to construct containment levees. | New work and maintenance material quantities expected to be lower than Preferred Alternative, marginally reducing size of Neches River BU Feature. | New work and maintenance material quantities expected to be lower than Preferred Alternative, marginally reducing the size of the Neches River BU Feature. | New work and maintenance material quantities expected to be lower than Preferred Alternative, marginally reducing the size of the Neches River BU Feature. | New work material is used beneficially to construct this BU feature at Rose City, Bessie Heights, and Old River Cove. No material from the offshore channels would be used beneficially. | New work and construction material quantities expected to be higher than the Preferred Alternative. Increasing size of BU feature is unlikely since there are limited areas remaining near the channel that would be least-cost placement alternatives. | New work and construction material quantities expected to be higher than the Preferred Alternative. Increasing size of BU feature is unlikely since there are limited areas remaining near the channel that would be least-cost placement alternatives. | Material quantities from the turning/anchorage basins would be used beneficially, but quantities are so small that they would not significantly affect size of the size of the Neches River BU Feature. |
| Gulf Shore BU Feature | Nourishment of 3 miles of Texas and Louisiana Point shorelines, alternating every 3 years. Material from offshore channels is not being used beneficially. | Quantity of maintenance material will be less than that available with Preferred Alternative, but nourishment would still occur over 3 miles of shoreline at both Texas and Louisiana Points, alternating every 3 years for 50 years. | Quantity of maintenance material will be less than that available with Preferred Alternative, but nourishment would still occur over 3 miles of shoreline at both Texas and Louisiana points, alternating every 3 years for 50 years. | Quantity of maintenance material will be less than that available with Preferred Alternative, but nourishment would still occur over 3 miles of shoreline at both Texas and Louisiana points, alternating every 3 years for 50 years. | Same as No-Action Alternative | Quantity of maintenance material would be more than that available with the Preferred Alternative, but nourishment would still occur over 3 miles of shoreline at both Texas and Louisiana points, alternating every 3 years for 50 years. | Quantity of maintenance material would be more than that available with the Preferred Alternative, but nourishment would still occur over 3 miles of shoreline at both Texas and Louisiana Points, alternating every 3 years for 50 years. | Not applicable |
| ODMDS | 4 existing ODMDSs. No size increase is projected; sites are dispersive. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | 4 existing ODMDSs and designation of 4 new ODMDSs | Same as Preferred Alternative | Same as Preferred Alternative | Not applicable |
| **EVALUATION CRITERIA** | | | | | | | | |
| **Water Quality** | | | | | | | | |
| Water Column Effects | Turbidity during periodic maintenance dredging of existing Federal and non-Federal channels, basins, and berthing areas; best management practices employed during placement activities to ensure minimal effects on turbidity. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative | Turbidity during construction up to 1 mile downcurrent from cutter or drag head. Little, if any, difference in turbidity during periodic maintenance dredging of the navigation channels, basins, and berthing areas. Best management practices employed during placement activities ensure minimal turbidity and no release of contaminated materials. Neches River BU Feature would result in net benefit to water quality in study area, | About the same as Preferred Alternative | About the same as Preferred Alternative | Turbidity during construction up to 1 mile downcurrent from cutter or drag head. Little, if any, difference in turbidity during periodic maintenance dredging of navigation channels, basins, and berthing areas. Best management practices employed during placement activities ensure minimal turbidity and no release of contaminated materials. |
| **Sediment Quality** | | | | | | | | |
| Surficial Sediments | Alternative is not expected to change the quality of surficial sediments. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative | Data from physical, chemical, and bioaccumulation studies indicate that construction material from this Alternative is suitable for ocean placement and use in BU features. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative |

Table 2.3-1
SNWW Alternatives Comparison Table
Screened Alternatives Analysis Matrix - Potential Impacts to Evaluation Criteria

| *Note: Column Letter is for reference in this table ONLY* | No-Action Alternative | Alternative A | Alternative B | Alternative C | Alternative D (Preferred Alternative) | Alternative E | Alternative F | Alternative G |
|---|---|---|---|---|---|---|---|---|
| **ALTERNATIVES** | Maintain existing 40-foot-deep by 800-foot-wide by 22-mile-long Sabine Bank and Outer Bar Channels, transitioning to 500 feet wide in the Sabine Pass Jetty Channel, and 400-x-40-foot-deep channel to Beaumont | 45-Foot Channel to Beaumont with an 8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins. | 46-Foot Channel to Beaumont with a 9.7-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 47-Foot Channel to Beaumont with a 11.4-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 48-Foot Channel to Beaumont with a 13.2-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 49-Foot Channel to Beaumont with a 14.8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 50-Foot Channel to Beaumont with a 16.5-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | Up to eight Neches River Turning and Anchorage Basins |
| **Sediment Quality, cont'd** | | | | | | | | |
| Maintenance Material | Most material from inshore channel reaches is currently placed in upland confined PAs. Data from physical, chemical, and bioaccumulation studies indicate no cause for concern from effluent. Material from Section 5 would be used in the Gulf Shore BU Feature. Based upon past experience with SNWW testing, material is expected to be environmentally acceptable under all applicable regulations. | The quantity of maintenance material from inshore and offshore channel reaches would be less than the Preferred Alternative. The source of the material is the same as the No-Action Alternative. Material would be used beneficially at the Neches River and Gulf Shore BU features. Based upon past experience with the testing on the SNWW material, material is expected to be environmentally acceptable under all applicable regulations. | About the same as Alternative A | About the same as Preferred Alternative | The quantity of maintenance material from inshore channel reaches would increase 15% over the No-Action Alternative; in offshore reach the quantity would increase 130%. The source of the material is the same as the No-Action Alternative. Material would be used beneficially at the Neches River and Gulf Shore BU features. Based upon past experience with the testing on the SNWW material, material is expected to be environmentally acceptable under all applicable regulations. | About the same as Preferred Alternative | The quantity of maintenance material from inshore and offshore channel reaches would be higher than the Preferred Alternative. | Turning and anchorage basins in this alternative are located immediately adjacent to the navigation channel, in relict Neches River oxbows. The relict oxbow channels maintain circulation with the larger river and navigation channel. Slower relative velocities in the oxbows may result in higher shoaling rates. However, the turning/anchorage basins would not be expected to add significant maintenance dredging quantities due to their small size relative to the navigation channel. |
| **Hydrology** | | | | | | | | |
| Circulation, Exchange, Velocities | Increases in tidal exchange, velocities and water surface elevations would be expected with "most likely" RSLR of 1.1 feet. | Deeper navigation channel would allow greater tidal circulation and exchange with Gulf than No-Action Alternative. Average water elevations would be negligibly higher in most places, though lower than the Preferred Alternative. Velocity magnitudes would be slightly higher, but absolute magnitudes are small. | Same as Alternative A | Same as Preferred Alternative | Deeper navigation channel would allow greater tidal circulation and exchange with Gulf than No-Action Alternative. Average water elevations are negligibly higher, averaging less than 0.8 inch. Velocity magnitudes would be slightly higher, but absolute magnitudes are small. | Deeper navigation channel would allow greater tidal circulation and exchange with Gulf than No-Action Alternative. Average water elevations would be slightly higher in most places, and slightly higher than the Preferred Alternative. Velocity magnitudes would be slightly higher, but absolute magnitudes are small. | About the same as Alternative E | The turning/anchorage basin Alternative would have no effect on tidal circulation or exchange. |
| Freshwater Flows | Future freshwater inflows determined by precipitation, demand and supply strategies, and the Neches River and Sabine River Water Authorities in accordance with State and Federal operating permits. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative | Alternative will have no effect on freshwater inflows; however, by slight tidal exchange increases anticipated, conveying outflows to the Gulf marginally faster than under the No-Action Alternative. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative |
| Sediment Transport - Inshore Channels | The amount of sediment-laden run-off is likely to increase under the No-Action Alternative due to climate change. Low bottom velocities in some areas result in higher than average shoaling rates. These channel segments are portions of the Sabine Pass Channel near the mouth of Sabine Lake, the Port Arthur and Taylor Bayou Junction in the Sabine-Neches Canal, and a downstream section of the Sabine-Neches Canal. | This Alternative will have a larger volume below the existing river bed than the No-Action Alternative, resulting in higher shoaling rate than the No-Action Alternative. The channel prism would be smaller than alternatives B through F. | This Alternative will have a larger volume below the existing river bed than the No-Action Alternative, resulting in higher shoaling rate than the No-Action Alternative. The channel prism would be smaller than Alternatives C through F. | This Alternative will have a larger volume below the existing river bed than the No-Action Alternative, resulting in higher shoaling rate than the No-Action Alternative. The channel prism would be smaller than alternatives D through F. | This Alternative will have a larger volume below the existing river bed than the No-Action Alternative, resulting in higher shoaling rate than the No-Action Alternative and Alternatives A through C. | This Alternative will have a larger volume below the existing river bed than the No-Action Alternative, resulting in higher shoaling rate than the No-Action Alternative and Alternatives A through D. | This Alternative will have a larger volume below the existing river bed than the No-Action Alternative, resulting in higher shoaling rate than the No-Action Alternative and alternatives A through E. | Turning and anchorage basins in this Alternative are located immediately adjacent to the navigation channel, in relict Neches River oxbows. The relict oxbow channels maintain circulation with the larger river and navigation channel. Slower relative velocities in the oxbows may result in higher shoaling rates. |
| Coastal Shoreline Erosion | Coastal shoreline erosion would continue and accelerate on the Texas Gulf shoreline, beyond 0.5 mile from the West Jetty. The Louisiana Gulf shoreline is not eroding in the study area. The shoreline within 0.5 mile of each jetty is accreting. | There would be a slight reduction in the accretion rate near both jetties, but between 0.5 and 3.5 miles from both jetties, erosion would increase by 2-4 inches/year. | There would be a slight reduction in the accretion rate near both jetties, but between 0.5 and 3.5 miles from both jetties, erosion would increase by 2-4 inches/year. | There would be a slight reduction in the accretion rate near both jetties, but between 0.5 and 3.5 miles from both jetties, erosion would increase by 3-5 inches/year. | There would be a slight reduction in the accretion rate near both jetties, but between 0.5 and 3.5 miles from both jetties, erosion would increase by 3-5 inches/year. | There would be a slight reduction in the accretion rate near both jetties, but between 0.5 and 3.5 miles from both jetties, erosion would increase by 4-6 inches/year. | There would be a slight reduction in the accretion rate near both jetties, but between 0.5 and 3.5 miles from both jetties, erosion would increase by 4-6 inches/year. | Not applicable - inshore turning and anchorage basins would have no effect on offshore conditions. |
| Inland Shoreline Erosion | Continuation of significant channel shoreline erosion along the Sabine-Neches Canal and portions of the Port Arthur Canal. Acceleration of shoreline recession of east Sabine Lake. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative | Confined inland channel erosion rates reduced relative to the No-Action Alternative because of the larger channel and the fewer vessel trips predicted under this Alternative. East Sabine Lake shoreline recession same as the No-Action Alternative. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative |
| Salinity | Salinity intrusion from existing SNWW Ship Channel, GIWW and Calcasieu Ship Channel would continue to affect majority of study area. Salinity would increase between 0 and 2 parts per thousand (ppt) due to RSLR under median flows. | Salinity would increase from 0 to 1.3 ppt over No-Action Alternative under median flows. | Salinity would increase from 0 to 1.5 ppt over the No-Action Alternative under median flows. | Salinity would increase from 0 to 1.6 ppt over the No-Action Alternative under median flows. | Saltwater wedge penetration expected farther up the SNWW navigation channels than under the No-Action Alternative. Salinities would increase from 0 to 1.8 ppt over the No-Action Alternative under median flows. | Salinity would increase from 0 to 2.0 ppt over the No-Action Alternative under median flows. | Salinity would increase from 0 to 2.2 ppt over the No-Action Alternative under median flows. | The addition of turning and anchorage basins on the Neches River Channel would have no measurable effect on salinity because of their small size relative to the existing tidal prism. |

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| **ALTERNATIVES** | Maintain existing 40-foot-deep by 800-foot-wide by 22-mile-long Sabine Bank and Outer Bar Channels, transitioning to 500 feet wide in the Sabine Pass Jetty Channel, and 400 x 40-foot-deep channel to Beaumont | 45-Foot Channel to Beaumont with an 8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins. | 46-Foot Channel to Beaumont with a 9.7-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 47-Foot Channel to Beaumont with a 11.4-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 48-Foot Channel to Beaumont with a 13.2-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 49-Foot Channel to Beaumont with a 14.8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 50-Foot Channel to Beaumont with a 16.5-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | Up to eight Neches River Turning and Anchorage Basins |
| **Hydrology, cont'd** | | | | | | | | |
| Groundwater | Groundwater in the upper Chicot aquifer in the study area ranges from slightly to moderately saline, and increases in salinity as it nears the coast. Current activities that may affect groundwater (i.e., well extraction and existing dredging activities) are expected to continue. RSLR would adversely affect freshwater aquifers. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | Navigation channel deepening under this Alternative would not be expected to increase salinities in the aquifer beyond those already present under the No-Action Alternative. No impacts would be expected with the additional placement of dredged material into upland PAs under this alternative. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative |
| **Hazardous Materials** | | | | | | | | |
| | Evaluation and clean-up of nine priority sites of concern would continue under the No-Action Alternative | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | Four of the nine priority hazardous materials sites are located adjacent to the SNWW. These sites present minimal potential for risk to this alternative. PA 17 contains hazardous materials from landfill and dumping activities. The type and extent of these hazardous materials must be determined before the PA can be used. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative |
| **Air Quality** | | | | | | | | |
| Land-side Mobile Emissions | Land-side emissions in support of waste material placement will be maintained consistent with the level of existing maintenance dredging activities. | Air contaminant emissions from the combustion of fuel in equipment used for placement activities are estimated to be about 6% less than for the Preferred Alternative with a corresponding reduction in impact compared to the Preferred Alternative. | Air contaminant emissions from the combustion of fuel in equipment used for placement activities are estimated to be about 4% less than for the Preferred Alternative with a corresponding reduction in impact compared to the Preferred Alternative. | About the same as the Preferred Alternative | Air contaminant emissions from the combustion of fuel in equipment used for placement activities would result in minor short-term impacts on air quality in the immediate vicinity of the project area. | About the same as the Preferred Alternative | Air contaminant emissions from the combustion of fuel in equipment used for placement activities are estimated to be about 4% more than for the Preferred Alternative with a corresponding increase in impact compared to the Preferred Alternative. | Air contaminant emissions from the combustion of fuel in equipment used for placement activities are estimated to be small and would result in correspondingly minor short-term impacts on air quality in the immediate vicinity of the project area. |
| Ocean-Going Transit Emissions | Maintenance dredging activities will result in air emissions impact to project area. | Air contaminant emissions from the combustion of fuel in equipment used for placement activities are estimated to be about 59% less than for the Preferred Alternative with a corresponding reduction in impact compared to the Preferred Alternative. | Air contaminant emissions from the combustion of fuel in equipment used for placement activities are estimated to be about 41% less than for the Preferred Alternative with a corresponding reduction in impact compared to the Preferred Alternative. | About the same as the Preferred Alternative | Air contaminant emissions from the combustion of fuel in equipment used for dredging and placement activities would also result in short-term impacts on air quality in the immediate vicinity of the project area. | About the same as the Preferred Alternative | Air contaminant emissions from the combustion of fuel in equipment used for placement activities are estimated to be about 52% more than for the Preferred Alternative with a corresponding increase in impact compared to the Preferred Alternative. | Air contaminant emissions from the combustion of fuel in equipment used for dredging and placement activities are estimated to be small and would also result in correspondingly minor short-term impacts on air quality in the immediate vicinity of the project area. |
| Construction Emissions | Not applicable. | Air contaminant emissions from construction and dredging activities are expected to be about 18% less than for the Preferred Alternative with a corresponding reduction in short-term impacts on air quality in the immediate vicinity of the project area compared to the Preferred Alternative. | Air contaminant emissions from construction and dredging activities are expected to be about 12% less than for the Preferred Alternative with a corresponding reduction in short-term impacts on air quality in the immediate vicinity of the project area compared to the Preferred Alternative. | About the same as the Preferred Alternative | Pollutant emissions from construction and dredging activities will result in short-term impacts on air quality in the immediate vicinity of the project site. Construction of the proposed project would result in a 1 to 2% increase in emissions of nitrogen oxides ($NO_X$) above those resulting from existing emissions sources in the Beaumont-Port Arthur area. | About the same as the Preferred Alternative | Air contaminant emissions from construction and dredging activities are expected to be about 14% more than for the Preferred Alternative with a corresponding reduction in short-term impacts on air quality in the immediate vicinity of the project area compared to the Preferred Alternative. | Air contaminant emissions from construction and dredging activities are estimated to be much less than for the Preferred Alternative and will result in minor short-term impacts on air quality in the immediate vicinity of the project site. |
| General Conformity | Not required for No-Action Alternative. | A General Conformity Determination for $NO_X$ emissions would likely be required for evaluation of emissions from construction activities. | A General Conformity Determination for $NO_X$ emissions would likely be required for evaluation of emissions from construction activities. | A General Conformity Determination for $NO_X$ emissions would likely be required for evaluation of emissions from construction activities. | A General Conformity Determination for $NO_X$ emissions was submitted to TCEQ. TCEQ provided written concurrence that emissions are conformant with the Texas SIP for the Beaumont-Port Arthur region. | A General Conformity Determination for $NO_X$ emissions would likely be required for evaluation of emissions from construction activities. | A General Conformity Determination for $NO_X$ emissions would likely be required for evaluation of emissions from construction activities. | A General Conformity Determination would not be required for this construction. |

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|---|---|---|---|---|---|---|---|---|
| **ALTERNATIVES** | Maintain existing 40-foot-deep by 800-foot-wide by 22-mile-long Sabine Bank and Outer Bar Channels, transitioning to 500 feet wide in the Sabine Pass Jetty Channel, and 400-x-40-foot-deep channel to Beaumont | 45-Foot Channel to Beaumont with an 8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins. | 46-Foot Channel to Beaumont with a 9.7-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 47-Foot Channel to Beaumont with a 11.4-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 48-Foot Channel to Beaumont with a 13.2-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 49-Foot Channel to Beaumont with a 14.8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 50-Foot Channel to Beaumont with a 16.5-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | Up to eight Neches River Turning and Anchorage Basins |
| **Habitat Effects** | | | | | *Note: All CIP habitat impacts in Texas would be minimized and offset by the DMMP and no mitigation is required. All mitigation measures are located in Louisiana, compensating for salinity increase and loss to biological productivity.* | | | |
| Terrestrial and Emergent Vegetation (uplands and bottomland hardwoods) | No change to existing conditions for most uplands and bottomland hardwood areas. Most of the area is an upland ridge covered by primarily tallow woods; 86 acres are fresh marsh. Productivity impacts of this conversion are fully offset by productivity benefits of the Neches River BU Feature. | All other alternatives would use the same upland PAs as the Preferred Alternative. | All other alternatives would use the same upland PAs as the Preferred Alternative. | All other alternatives would use the same upland PAs as the Preferred Alternative. | No change to existing conditions for most uplands and bottomland hardwood areas. Two upland areas are being converted to new PA cells. In addition to PA 24A (see No-Action), another 71 acres of disturbed, low-quality scrub habitat would be converted to new PA 18A. Five currently inactive PAs (23A, 25A, 26, 27C, and 27D) would be returned to active use. All have been modified extensively by past placement activities and levees that isolate them and prevent contributions to the adjacent wetlands and riparian corridor. All contain degraded habitat with low habitat values, primarily roosting habitat for birds and some wildlife cover. | All other alternatives would use the same upland PAs as the Preferred Alternative. | All other alternatives would use the same upland PAs as the Preferred Alternative. | No incremental impacts to terrestrial and emergent vegetation from turning/anchorage basins. |
| Submerged Aquatic Vegetation (SAV) | Existing rate of emergent marsh loss would increase size of open-water areas at the expense of intertidal habitat, reduce marsh edge, and protected shallow-water habitat for SAV. Salinity-tolerant SAV species would expand coverage due to RSLR. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative | Construction dredging would not affect SAV. The Neches River BU Feature would result in net increase in shallow-water ponds and sinuous channels, which provide still, protected waters beneficial to SAV. SAV coverage would be expected to increase over the No-Action Alternative in BU and mitigation areas. | About the same as Preferred Alternative | About the same as Preferred Alternative | Turning and anchorage basins in this alternative are located immediately adjacent to the navigation channel, in relict Neches River oxbows. The relict oxbows maintain circulation with the larger river and navigation channel. Protected shallow-water areas at oxbow edge that may provide SAV habitat would be temporarily affected during construction. |
| Freshwater Aquatic Habitat (freshwater streams, fresh marsh and swamp) | Existing high rate of marsh loss would continue under No-Action Alternative due to combined effect of RSLR, and altered hydrology and salinity levels. Swamps subject to pulses of higher salinity during low-flow conditions. | Generally the same as the Preferred Alternative because there would be no change to upland PAs and no significant differences in salinity impacts. New work and maintenance material quantities are expected to be lower than the Preferred Alternative, marginally reducing the size of Neches River BU Feature. | About the same as Alternative A | About the same as the Preferred Alternative | Impacts would consist of the conversion of 86 acres of wetlands to an upland confined placement area and small reductions in biological productivity due to small increase in salinity over 35,600 acres of fresh marsh and 804 acres of swamps in Texas and Louisiana. The Naces River BU Feature would offset all productivity from small reductions in biological productivity due to a small increase in salinity. Compensatory mitigation would replace the lost biological productivity to fresh marsh and swamp in Louisiana. | Generally the same as the Preferred Alternative because there would be no change to upland PAs, and no significant differences in salinity impacts. New work and maintenance material quantities are expected to be higher than the Preferred Alternative but no change in the size of the Neches River BU Feature would be expected, | About the same as Alternative E | No freshwater habitat would be affected by turning/anchorage basin dredging or placement activities. |
| Estuarine Habitats (Sabine Pass, Sabine Lake, Neches and Sabine rivers and tributaries; Intermediate, Brackish, and Saline Marsh) | Existing high rate of marsh loss would continue under No-Action Alternative due to combined effect of RSLR, and altered hydrology and salinity levels. Water column turbidity and nutrient release associated with periodic, ongoing maintenance dredging would continue, although significant impacts are not anticipated. | Generally the same as the Preferred Alternative because there would be no significant difference in salinity impacts. New work and maintenance material quantities are expected to be lower than the Preferred Alternative, marginally reducing the size of Neches River BU Feature. | About the same as Alternative A | About the same as the Preferred Alternative | Small reductions in biological productivity due to small increase in salinity over large areas of estuarine marsh habitat (over 22,200 acres in Texas and 153,000 acres in Louisiana). Short-term impacts to benthic organisms are expected with channel dredging and the borrow trench and access channel for compensatory mitigation in the Willow Bayou marshes. Productivity impacts in Texas would be fully offset by benefits of Neches River and Gulf Shore BU features. Compensatory mitigation in Louisiana would fully compensate productivity losses to marshes and benthic resources. | Generally the same as the Preferred Alternative because there would be no significant difference in salinity impacts. New work and maintenance material quantities are expected to be higher than the Preferred Alternative but no change in the size of the Neches River BU Feature would be expected. | About the same as Alternative E | Small, one-time impact to benthic habitat with construction of new or expanded turning and anchorage basins. |

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| **Habitat Effects, con'd** | | | | | | | | |
| Marine Aquatic Habitat | Water column turbidity and nutrient release associated with periodic, ongoing maintenance dredging and placement would continue, although significant impacts would not be anticipated. | Shorter Entrance Channel Extension would result in fewer short-term impacts to benthic organisms than the Preferred Alternative. Reasonable and prudent measures to avoid impacts to sea turtles would be the same for all alternatives. | About the same as Alternative A | About the same as Preferred Alternative | Short-term impacts to benthic organisms are expected with creation of 4 new ODMDSs. Dredging impacts to bottom-feeding and pelagic organisms such as sea turtles may occur with hopper dredging, but reasonable and prudent measures to avoid impacts would be instituted with an avoidance plan. | Longer Entrance Channel Extension would result in greater short-term impacts to benthic organisms than the Preferred Alternative. Reasonable and prudent measures to avoid impacts to sea turtles would be the same for all alternatives. | About the same as Alternative E | Not Applicable |
| Terrestrial Wildlife Habitat | Ongoing maintenance dredging, including placement, would not result in additional impacts to terrestrial wildlife habitats (upland grasslands and coastal prairies, and upland, nonwetland riparian woodlands and forests). | All other alternatives would use the same upland PAs as the Preferred Alternative | All other alternatives would use the same upland PAs as the Preferred Alternative. | All other alternatives would use the same upland PAs as the Preferred Alternative. | No impact to Louisiana swamp and small productivity impact to 804 acres of Texas swamp. DMMP Neches River restoration would offset all impacts in Texas and results in excess of 843 Average Annual Habitat Units (AAHUs). Two upland areas are being converted to new PA cells. One 187-acre upland area would be converted to new PA cell 24A. Most of the area is an upland ridge covered primarily by tallow woods; however, 86 acres are fresh marsh. Another 71 acres of disturbed, low-quality scrub habitat would be converted to new PA cell 18A. Productivity impacts of this conversion are fully offset by productivity benefits of the Neches River BU Feature. | All other alternatives would use the same upland PAs as the Preferred Alternative. | All other alternatives would use the same upland PAs as the Preferred Alternative. | No incremental impacts to terrestrial wildlife habitat from turning/anchorage basins. |
| **Essential Fish Habitat (EFH)** | | | | | | | | |
| | Ongoing maintenance dredging, including placement, would not result in additional permanent impacts to EFH; temporary impacts due to sedimentation, turbidity, and nutrient release are temporary and episodic. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative | Turbidity would be temporary; localized impact during dredging and ODMDS material placement; benthos would be affected until natural recovery occurs.<br>The DMMP and mitigation measures propose 13,053 acres EFH emergent marsh (approximately 75%) and open shallow water (approximately 25%). | About the same as Preferred Alternative | About the same as Preferred Alternative | None |
| **Endangered and Threatened (E&T) Species** | | | | | | | | |
| E&T Vertebrates | Ongoing maintenance dredging, including placement, may result in sedimentation and alter hydrology; potential impacts to sea turtles are covered by the Gulf Regional Biological Opinion for USACE's maintenance dredging activities. | Same as the preferred alternative for piping plover and its critical habitat. Small reductions in potential impacts to sea turtles due to reduced dredging time as compared to the Preferred Alternative. | About the same as Alternative A | About the same as Alternative A | Proposed beach nourishment at Louisiana Point would occur along 3 miles of piping plover critical habitat; however, positive effects for the plover are anticipated (may affect, but not likely to adversely affect). A Biological Opinion from USFWS has concurred with this assessment. New work dredging (construction) is likely to adversely affect but not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, and green sea turtles. In a draft Biological Opinion, NMFS anticipates an incidental take of 4 sea turtles and has identified reasonable and prudent measures to be taken to minimize effects during construction. Potential impacts to sea turtles from maintenance dredging are covered by the Gulf Regional Biological Opinion for USACE's dredging activities. | About the same as Alternative A | About the same as Alternative A | None |
| E&T Invertebrates | None | None | None | None | None | None | None | None |
| E&T Plants | None | None | None | None | None | None | None | None |

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| **ALTERNATIVES** | Maintain existing 40-foot-deep by 800-foot-wide by 22-mile-long Sabine Bank and Outer Bar Channels, transitioning to 500 feet wide in the Sabine Pass Jetty Channel, and 400 x 40-foot-deep channel to Beaumont | 45-Foot Channel to Beaumont with an 8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins. | 46-Foot Channel to Beaumont with a 9.7-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 47-Foot Channel to Beaumont with a 11.4-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 48-Foot Channel to Beaumont with a 13.2-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 49-Foot Channel to Beaumont with a 14.8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 50-Foot Channel to Beaumont with a 16.5-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | Up to eight Neches River Turning and Anchorage Basins |
| **Cultural Resources** | | | | | | | | |
| Terrestrial Archeological Sites | Under the No-Action Alternative, archeological sites located in eroding marsh areas would increasingly be exposed to the erosive effects of wind and tidal action. Archeological sites along the SNWW navigation channel would continue to be exposed to the erosive forces of boat wakes; this would increase in the future as vessel trips rise to support projected imports under the current lightering requirements. | About the same as Preferred Alternative | About the same as Preferred Alternative | About the same as Preferred Alternative | Archeological site impacts in and around margins of DMMP BU features and Mitigation Measures would be avoided to the greatest extent possible. No unavoidable impacts have been identified. The restoration of eroding marsh areas will stabilize landforms, create stable marsh buffers, and prevent further erosion of sites. Future vessel trips and erosive boat wakes are expected to be reduced relative to the No-Action Alternative. | About the same as Preferred Alternative | About the same as Preferred Alternative | None |
| Historic Structures | No impacts to historic structures are expected to occur with the No-Action Alternative. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | The alternative will not affect the Sabine Pass Lighthouse, Rainbow Bridge, or any known historic structures. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative |
| Shipwrecks | Maintenance dredging would continue with the potential to affect unidentified shipwrecks along the margins of the SNWW. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | The Alternative would not affect the USS *Clifton* wreck site. Additional investigations would be conducted to determine if unknown shipwrecks eligible for the National Register of Historic Places would be adversely affected. If adverse effects to eligible shipwrecks are identified, they will be addressed in accordance with requirements of the Historic Properties Programmatic Agreement. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative |
| **Socioeconomics** | | | | | | | | |
| Land Use; Population; Community Values, Housing, Infrastructure and Services | Residential and industrial development would continue on its slow to moderate path. Community facilities, services, and housing would not increase due to low population trends. Land use plans and development would continue to follow neighboring cities' patterns. Some industrial sites along the ship channel are expanding, and some new facilities are being constructed. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | The Preferred Alternative would likely promote the development of some industrial sites along the ship channel, but population growth is not expected to change much from present. The Preferred Alternative would not divide, isolate, or separate residents from community facilities. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative |
| Recreation; Aesthetics | Recreational fishing and wildlife watching would remain as the major activity for recreation in the SNWW. Under the No-Action Alternative, 2,853 acres of marsh land, 871 acres of shallow-water habitat, and 6 miles of shoreline would not be restored. The marsh degradation process would proceed unchecked, eventually adversely affecting recreational fishing. The No-Action Alternative would not affect scenic and aesthetic values. | Similar to Preferred Alternative | Similar to Preferred Alternative | Similar to Preferred Alternative | Under the Preferred Alternative, 2,853 acres of marsh land, 871 acres of shallow water habitat, and 6 miles of shoreline would be restored, which would provide more fishing and wildlife watching for this area, thus enhancing the life for recreational use and improving some natural aesthetic values. | Similar to Preferred Alternative | Similar to Preferred Alternative | Same as Preferred Alternative |
| Environmental Justice (EJ) | The No-Action Alternative action would not impact minority or low-income persons. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | Populations includes 59.6% white persons, 26.7% black or African Americans, and 9.6% Hispanic or Latino persons. Therefore, the Preferred Alternative would not be located within a minority area. The median household income for the study area population is $28,884, which is above the Department of Health and Human Services 2006 poverty guideline of $20,000 for family of four; therefore, the Preferred Alternative would not be located in low-income area. No adverse or disproportionately high impacts on minority or low-income persons is anticipated from the Preferred Alternative. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative |

Table 2.3-1
SNWW Alternatives Comparison Table
Screened Alternatives Analysis Matrix - Potential Impacts to Evaluation Criteria

| *Note Column Letter & for reference in this table ONLY* | **No-Action Alternative** | **Alternative A** | **Alternative B** | **Alternative C** | **Alternative D (Preferred Alternative)** | **Alternative E** | **Alternative F** | **Alternative G** |
|---|---|---|---|---|---|---|---|---|
| **ALTERNATIVES** | Maintain existing 40-foot-deep by 800-foot-wide by 22-mile-long Sabine Bank and Outer Bar Channels, transitioning to 500 feet wide in the Sabine Pass Jetty Channel, and 400 x-40-foot-deep channel to Beaumont | 45-Foot Channel to Beaumont with an 8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins. | 46-Foot Channel to Beaumont with a 9.7-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 47-Foot Channel to Beaumont with a 11.4-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 48-Foot Channel to Beaumont with a 13.2-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 49-Foot Channel to Beaumont with a 14.8-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | 50-Foot Channel to Beaumont with a 16.5-mile by 700-foot-wide extension of the Entrance Channel, and deepening and widening of Taylor Bayou Channels and Basins | Up to eight Neches River Turning and Anchorage Basins |
| **Socioeconomics, cont'd** | | | | | | | | |
| Direct wages and salaries; Employment | In 2004, the ports created $877.7 million in direct wages and salaries; 83,692 jobs in Texas and Louisiana at private and public marine terminals along SNWW; 14,987 jobs directly related to activities along the SNWW; 13,628 induced jobs from local purchases from SNWW workers; 55,077 indirect jobs. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | The Preferred Alternative would likely promote the development of industrial sites along the ship channel and a steady historical trend towards increased reliance on these industries; the positive economic effects to the study area economy would be moderate at the least and substantial at best. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative |
| Local and Federal Tax Revenues | Local tax revenues: $426.5 million in 2004 generated by activity at marine terminals. Federal revenues: $853 million in 2004 generated by activity at marine terminals. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | The increase in the tax base as a result of the Preferred Alternative would be fairly slow and consistent with historical growth trends. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative |
| **Safety** | | | | | | | | |
| | The probability of accidents would increase under the No-Action Alternative as vessel trips rise to support projected imports under the current lightering requirements and as new LNG plants become operational. | Same as Preferred Alternative | Same as Preferred Alternative | Same as Preferred Alternative | Vessel traffic is expected to increase; however, these increases would be lower because of the deeper channel allowing more deep-draft cargo to be carried with fewer vessel trips. As a result, the probability of accidents would decrease relative to the No-Action Alternative. | Same as Preferred Alternative | Same as Preferred Alternative | The addition of turning/anchorage basins on the Neches River Channel under this Alternative provides areas adjacent to the navigation channel where deep-draft vessels can safely wait their turn to dock. More ships can safely use the waterway as compared to the No-Action Alternative. |
| **Commercial Navigation** | | | | | | | | |
| | Vessel trips would increase, adding to shipping delays, congestion, and cost. LNG vessels began using the lower waterway in 2008, adding to channel congestion and delays. Average annual benefits of the No-Action Alternative are $5,471. | Some deep-draft vessels would be able to enter the SNWW more fully loaded, reducing the overall number of vessel trips. Average annual benefits of this alternative are $84,917, and the benefit to cost ratio is 1.1. | Some deep-draft vessels would be able to enter the SNWW more fully loaded, reducing the overall number of vessel trips. Average annual benefits of this alternative are $97,117, and the benefit to cost ratio is 1.2. | Some deep-draft vessels would be able to enter the SNWW more fully loaded, reducing the overall number of vessel trips. Average annual benefits of this alternative are $105,540, and the benefit to cost ratio is 1.2. | Some deep-draft vessels would be able to enter the SNWW more fully loaded, reducing the overall number of vessel trips. Average annual benefits of this alternative are $116,334, and the benefit to cost ratio is 1.2 . | Some deep-draft vessels would be able to enter the SNWW more fully loaded, reducing the overall number of vessel trips. Average annual benefits of this alternative are $124,164, and the benefit to cost ratio is 1.2. | Some deep-draft vessels would be able to enter the SNWW more fully loaded, reducing the overall number of vessel trips. Average annual benefits of this alternative are $128,736, and the benefit to cost ratio is 1.2. | The addition of turning/anchorage basins on the Neches River Channel allows more ships to reduce vessel delays as compared to the No-Action Alternative. Average annual benefits are $1,312. |

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Deepening of the SNWW to Beaumont to 48 feet with a 13.2-mile-long by 700-foot-wide Sabine Bank and Extension Channel, existing 500- to 400-foot-wide jetty and inshore channels with the exception of deepening and widening of Taylor Bayou Channels and Basins, and the addition of Neches River Turning/Anchorage Basins 1, 4, and 8 (see figures 2.4-1a–g).

While the economic analysis determined that the 49-foot alternative is the NED plan, the 48-foot alternative is preferred by the non-Federal sponsor and will be recommended as the Locally Preferred Plan. Structural modifications of the Preferred Alternative meet the planning objective for increased navigational efficiency, and DMMP BU features and compensatory mitigation measures effectively avoid or mitigate all unavoidable environmental impacts.

Costs were estimated for all of the alternatives and used to determine the benefit-to-cost ratio in the economic analysis. Included in the costs were dredging, levee construction, relocations (including utility relocations), and O&M costs for the 50-year period of analysis. Ecological mitigation costs for the six depth alternatives were estimated using HS model salinity projections for the 40-, 45-, and 48-foot channel depths. Salinity was chosen as the best factor on which to base interpolations of mitigation costs because it is the primary driver in the ecological modeling that was used to determine the compensatory mitigation plan. The cost interpolation assumed that there would be a linear relationship between predicted salinities for each channel depth at the end of the period of analysis and the cost of mitigation.

Direct ecological effects associated with navigation channel improvements under all proposed alternatives and the placement of dredged material consist of:

- Impacts to benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats would be similar for all alternatives. Benthic organisms are expected to quickly rebound from the short-term impacts of channel dredging, the use of offshore PAs, and the Sabine Lake borrow trench/access channel associated with compensatory mitigation in Louisiana.
- Dredging impacts to bottom-feeding and pelagic organisms such as sea turtles may occur with hopper dredging of offshore channel reaches for all alternatives, but reasonable and prudent measures to avoid impacts would be instituted with an avoidance plan.
- Impacts to marsh would result from the enlargement of one PA under the No-Action Alternative and two PAs under all other alternatives. The new PAs would be small, and the incremental cost associated with one additional PA is too small to affect alternative selection. Most PAs would be enlarged by raising levee heights, which means that the footprint of PA impacts would be similar for all alternatives.
- Impacts to shorebirds and their habitat would result from the regular placement of maintenance material on the Gulf shoreline under all alternatives, including the No-Action Alternative. Birds would be temporarily displaced to nearby habitat during each placement episode. These impacts would be minor and temporary, and the number and footprint of each placement episode would be the same for each alternative.

Indirect effects provide the primary ecological impact of all structural alternatives. Although the SNWW channel is located primarily in Texas, large indirect impacts may occur in both Texas and Louisiana due

to small increases in salinity levels causing an increase in wetland loss rates and a decrease in biological productivity in aquatic habitats of the study area. HS modeling indicates that none of the depth alternatives would result in significant impacts to swamp and fresh marsh habitats in the upper reaches of the Sabine and Neches rivers. Salinity impacts of the six depth alternatives to the vast saline through intermediate marshes would be similar, with an average difference between the 45- and 50-foot alternatives of less than 0.5 parts per thousand (ppt).

### 2.3.3 Sensitivity of Project Alternatives to Relative Sea Level Rise

"*Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region*" (U.S. Climate Change Science Program [USCCSP], 2009) synthesizes the state of knowledge regarding possible effects of RSLR on coastal ecosystems and communities. Areas of the Nation's coast are experiencing submergence of low-lying lands, erosion of shores, and conversion of wetlands to open water as a result of RSLR. Studies suggest the rate of RSLR has increased recently and is likely to continue to increase in vulnerable areas. Forecasting impacts of RSLR on specific coastal areas is difficult because of the complexity of coastal ecosystems and ecological processes and uncertainty about regional variation in RSLR. According to USCCSP (2009:1), "Existing studies of sea-level rise vulnerability based on currently available elevation data do not provide the degree of confidence that is optimal for local decision making."

Circular No. 1165-2-211, Water Resources Policies and Authorities Incorporating Sea-level Change Considerations in Civil Works Programs (USACE, 2009a), requires the USACE to incorporate "the direct and indirect physical effects of projected future sea-level change in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects. . . ." In fulfillment of this requirement, the sensitivity of project alternatives to the full range of potential FWOP changes in sea level has been evaluated. There are a wide range of potential effects related to the full range of RSLR, but the sensitivity of project alternatives would be more limited. In particular, alternatives were evaluated to determine whether the purpose and function of navigation features could be undermined, whether environmental impacts might be exacerbated, and how economic benefits and costs might be affected by sea level change. Nonstructural alternatives were evaluated but eliminated in the second screening; they are therefore not addressed in this analysis.

In order to meet the requirements of Circular No. 1165-2-211, this section evaluates effects of the full range of possible RSLR rates, which were developed in accordance with a specific methodology prescribed in the guidance. RSLR rates that may be appropriate for the project area are discussed in detail in Section 3.3 of Appendix C to this FEIS. The range of RSLR was determined using both tide gage and basal peat data for the local subsidence component of RSLR. Tide gage data reflect the effects of recent historical subsidence. The average rate of RSLR measured at the Sabine Pass tide gage was 0.2 inch/year for the 48-year period between 1958 and 2006 (U.S. Department of Commerce [USDC]-National Oceanic and Atmospheric Administration [NOAA], 2006, 2009). However, there is significant scientific debate concerning the validity of tidal records with respect to the projection of future subsidence rates in the northwest Gulf coastal plain. The relative influence of historic anthropogenic activities in this area (e.g., oil and gas withdrawal) is difficult to quantify. If these activities contributed significantly to recent

observations of subsidence, then significant reductions in these activities may result in rapid deceleration of subsidence rates, returning them to long-term average rates best represented by the basal peat data. Deriving RSLR estimates using both basal peat and tide gage data, possible RSLR rates were estimated for the period from 2019 to 2069 to range from 0.3 to 2.8 feet. Possible low, intermediate, and high rates are as follows:

- 0.3 foot, Low (1.83 millimeters [mm]/year), based on basal peat subsidence rates
- 0.7 foot, Intermediate (4.27 mm/year), based on basal peat subsidence rates
- 1.1 feet, Intermediate (6.71 mm/year), based on tide gage subsidence rates (This value was used in the hydrodynamic-salinity modeling of the estuary for this project.)
- 1.5 feet, Intermediate (9.14 mm/year), based on tide gage subsidence rates
- 2.2 feet, High (13.44 mm/year), based on basal peat subsidence rates
- 2.8 feet, High (17.07 mm/year), based on tide gage subsidence rates

An intermediate rate of RSLR (1.1 feet by year 2069) was used as the "most likely" estimate of RSLR in the alternative analysis for this project, in accordance with the USACE planning guidance. The following discussion describes possible ways that high and low RSLR might affect the project alternatives and the recommended action. There are relatively little data and analysis currently available that would permit a detailed, quantitative analysis of the impacts of each of the possible RSLR scenarios on the project alternatives. Ways in which different RSLR rates might affect project design and impacts are presented in Table 2.3-2.

In general, the functioning of the navigation features associated with all alternatives (channel depths of 45 through 50 feet, turning/anchorage basins, PAs/ODMDSs, and the BU features) would not be significantly affected by the full range of potential sea level change. Construction dredging would occur within 10 years and would not be affected by future rates of RSLR. While shoaling rates toward the end of the period of analysis could increase due to an enlarged cross section and greater saltwater penetration, this small effect would probably be offset by increased overall water depths. PAs and BU features have been designed to accommodate sea level changes through the high RSLR range. PAs are located at sufficiently high elevations to withstand the potential rise, and appropriate erosion control measures are included. BU features are located well inland on the Neches River, and they have been designed with erosion control features that would survive the full range of RSLR. The addition of mineral soils and higher marsh elevations would provide stable landforms. Biomass accumulation and sediment from adjacent terrace margins should enable restored marsh vegetation to maintain itself even with the high RSLR rate.

The protection of human health and improvements in safety are not project objectives and therefore potential effects on calculated risk are not applicable. RSLR does not affect the functioning of the various depth alternatives or vessel safety. At the intermediate and high rates of RSLR, a significant increase in

Table 2.3-2
Relative Sea Level Rise Sensitivity of Project Alternatives

| Sensitivity of Design | | | | Sensitivity of Impacts | | |
|---|---|---|---|---|---|---|
| Navigation Channel Alternatives A-G | DMMP (PAs/ODMDSs) | DMMP (BU Features) | Mitigation Measures | Human Health/Safety | Environmental Impacts | Economic Costs/Benefits |
| **Low Rate (0.3 feet over 50 years)** | | | | | | |
| No significant effect for any depth alternative. Low range of future RSLR is lower than recent historical rate. | DMMP: no change to existing shoaling rate and maintenance dredging expected. All PAs designed for intermediate RSLR rate. | All BU features were designed to accommodate intermediate RSLR; low rate would have no effect. | All mitigation measures were designed to accommodate intermediate RSLR; low rate would have no effect. | RSLR does not affect the functioning of the various depth alternatives or vessel safety. Small increase in tidal surge penetration due to low RSLR rate would be expected; tidal surge protection is not a project objective. No increase in tidal surge impacts due to project. | Primary project impact is result of greater salinity intrusion. Salinity difference for low RSLR is within one standard deviation of the salinity difference between FWOP and FWP. | Benefits and costs of the deepened navigation channel would be the same as FWP forecast. |
| **Intermediate Rate (0.7 to 1.5 feet over 50 years)** | | | | | | |
| No significant effect for any depth alternative. Rising water depth offset by increased shoaling. Potential impacts to Sabine Pass Jetties addressed by separate O&M major rehabilitation project. | DMMP: no significant increase in maintenance dredging for depths greater than 48 ft. Possible rise of water surface elevation is within range used for engineering design of all PAs. No effect to ODMDSs. | Possible RSLR rise is within range used for engineering design of all BU features. | Possible RSLR rise is within range used for engineering design of all mitigation measures. | RSLR does not affect the functioning of the various depth alternatives or vessel safety. Intermediate increase in tidal surge penetration due to RSLR rate; tidal surge protection is not a project objective. No increase in tidal surge impacts due to project. | Salinity impacts were based upon RSLR of 1.1 feet. Salinity difference for range of intermediate RSLR rates is within one standard deviation of the salinity difference between FWOP and FWP. | Benefits and costs of the deepened navigation channel for the full intermediate range would be the same as FWP forecast. |
| **High Rate (2.8 feet over 50 years)** | | | | | | |
| No significant effect for any depth alternative. Possible small increase in maintenance dredging for all depth alternatives resulting from enlarged cross section and greater saltwater penetration. Potential impacts to Sabine Pass Jetties addressed by separate O&M major rehabilitation project. | DMMP: small increase in levee heights and/or armoring may be needed for some PAs. No significant effect to ODMDSs. | Addition of mineral soils and higher marsh elevations provides more-stable landforms. Biomass accumulation may enable restored marsh vegetation to remain stable relative to high RSLR rate. Erosion control features would survive the full range of RSLR. | Addition of mineral soils and higher marsh elevations provides more-stable landforms. High rate of RSLR could result in submergence and erosion of restored marsh. Monitoring and adaptive management plan have been developed to identify corrective actions that might be needed toward the end of the period of analysis. | RSLR does not affect the functioning of the various depth alternatives or vessel safety. High rate of RSLR would increase tidal surge penetration; tidal surge protection is not a project objective. No increase in tidal surge impacts due to project. | Potential salinity increase with high range of RSLR is still within one standard deviation of the salinity difference between FWOP and FWP. No significant increase in salinity impacts would be expected. | Benefits of the deepened navigation channel would be the same as FWP forecast. No facilities used by shipping industry would be rendered ineffective by the high range of RSLR. O&M costs could increase slightly toward the end of the period of analysis, but not enough to reduce benefit to cost ratio below parity. |

tidal surge penetration would be expected, but this would not affect project alternatives because tidal surge protection is not a project objective. Furthermore, HS modeling has determined that little or no increase in water surface elevation would be expected due to the deeper navigation channel.

The primary impact of RSLR on this project may be its potential impact on mitigation measures proposed for the Louisiana marshes along the east side of Sabine Lake. These mitigation measures are planned for marshes that could experience submergence and erosion at the high RSLR rate. In recent decades, marshes in the study area have been able to keep up with rates of 5.6 to 6.5 mm/year, suggesting that these marshes may be able to sustain themselves through rises in the intermediate range of RSLR (4.3 to 9.1 mm/year). The high rate of RSLR (17.1 mm/year) could threaten long-term survivability. Sustainability thresholds are determined by local physical, chemical, climatologic, and hydrologic conditions and cannot be extrapolated to other regions. However, as an example, studies in the mid-Atlantic region indicate that the tipping point for coastal ecosystems could range from an RSLR of as low as 2.0 mm/year to as high as 10 mm/year (USCCSP, 2009). There are relatively little data and analysis currently available that would permit a detailed, quantitative analysis of the impacts of the full range of potential RSLR on the SNWW ecosystem and project alternatives.

A monitoring and contingency/adaptive management plan has been developed to identify corrective actions that could be necessary decades after initial marsh construction (Appendix J). Corrective actions proposed in the contingency plan assume that the low to intermediate rates of RSLR will occur; the high rate is assumed to be unlikely. If monitoring determines that the extent of vegetation coverage does not meet ecological success criteria specified in the monitoring plan, manual planting would be employed to restore the requisite acres of emergent marsh. The ICT would determine whether marsh planting is needed and if so, to what extent and in which areas. Relocation of the mitigation areas to areas that would be protected from the potential effects of the full range of RSLR is not feasible. All intertidal marshes in the study area would be similarly affected by the sea level change because of the extremely low slope of the coastal plain. The option of purchasing credits in a mitigation bank was investigated; however, no mitigation banks exist for this area and resource type.

## 2.4 PREFERRED ALTERNATIVE

The description of the Preferred Alternative in this section is divided into two primary components, navigation channels improvements and associated elements, and dredged material placement features. Requirements for compensatory mitigation are covered in Chapter 5. General navigation features of the Preferred Alternative consist of navigation channels and basins, and bridge reinforcements. Other project elements required to complete project construction are Aids to Navigation; lands, easements, rights-of-way, and relocations (LERRs); and deep-draft utility relocations. The 50-year DMMP for both new work and O&M consists of ODMDSs, upland PAs, and the Neches River and Gulf Shore BU features. Detailed descriptions for project components are provided later in this chapter.

### 2.4.1 Navigation Channel Improvements

The description of proposed improvements begins at the farthest point offshore and moves inshore to the Beaumont Turning Basin. Project dimensions for the Preferred Alternative are provided in Table 2.4-1 and all channel sections and stationing are shown on figures 2.4-1a–g.

Table 2.4-1
Project Dimensions for Preferred Alternative

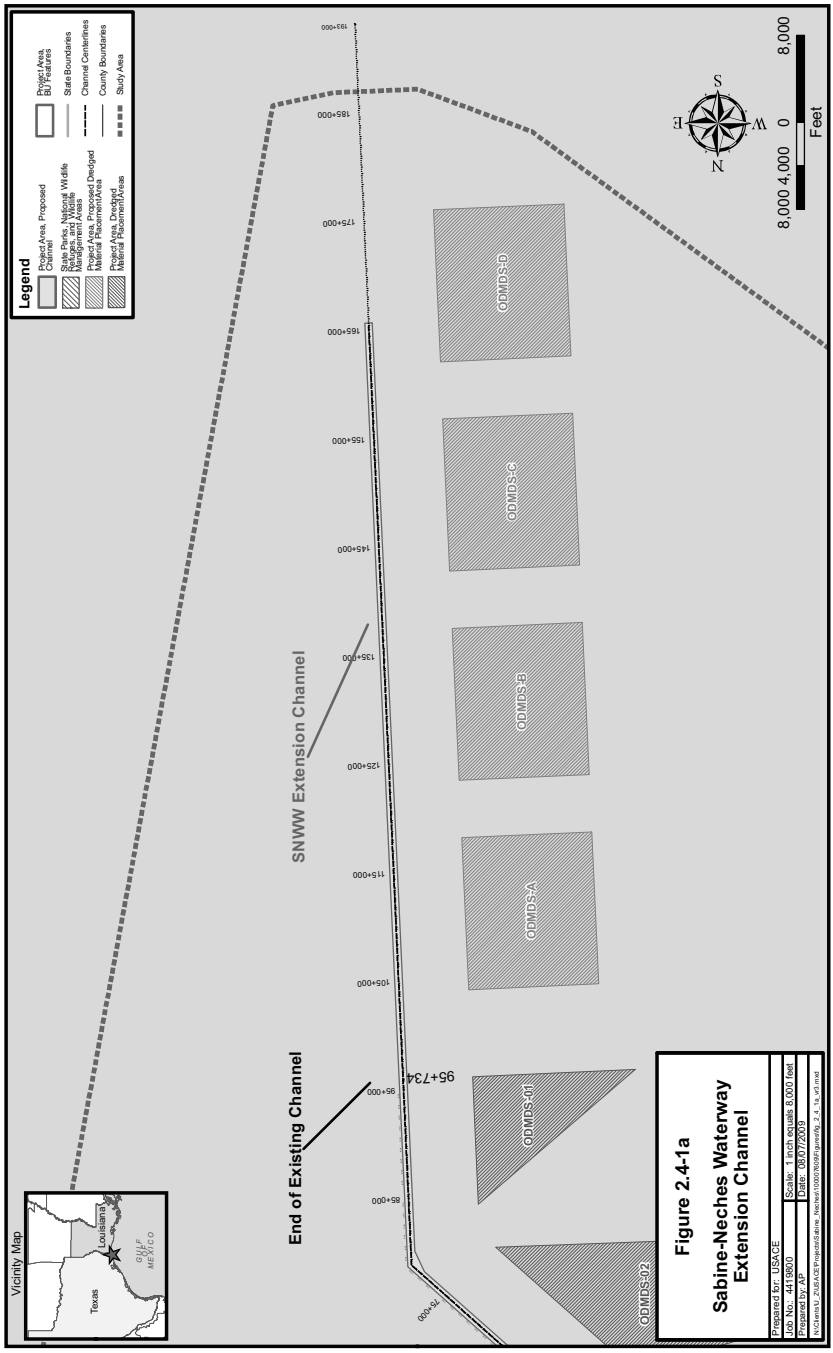
| Reach | Station | to | Station | Bottom Width (feet) | Project Depth (feet) | Side Slope* |
|---|---|---|---|---|---|---|
| Extension Channel | 165+443 | | 95+734 | 700 | 50 | 1V/2H |
| Sabine Bank Channel | 95+734 | | 25+800 | 700 | 50 | 1V/2H |
| Sabine Bank Channel | 25+800 | | 23+300 | 800–700 | 50 | 1V/2H |
| Sabine Bank Channel | 23+300 | | 18+000 | 800 | 50 | 1V/2H |
| Sabine Pass Outer Bar | 18+000 | | 0+000 | 800 | 50 | 1V/10H |
| Sabine Pass Jetty Channel | –214+88 | | 0+00 | 800–500 | 48 | 1V/2H |
| Sabine Pass Channel | 0+00 | | 296+25 | 1,355–500 | 48 | 1V/2H |
| Port Arthur Canal | 0+00 | | 325+84 | 1,660–500 | 48 | 1V/2H |
| Sabine-Neches Canal | 0+00 | | 592+94 | 1,050–400 | 48 | 1V/2H |
| Neches River Channel | 0+00 | | 980+00 | 400–1,413 | 48 | 1V/2H |
| **Taylor Bayou** | | | | | | |
| Entrance Channel | 0+00 | | 25+27 | 406–764 | 48 | 1V/2H |
| East Turning Basin | 0+00 | | 17+65 | 532–354 | 48 | 1V/2H |
| West Turning Basin | 25+27 | | 41+30 | 776 | 48 | 1V/2H |
| Connecting Channel | 41+30 | | 71+50 | 470–250 | 48 | 1V/2H |
| Taylor Bayou Turning Basin | 71+50 | | 106+25 | 1,000 | 48 | 1V/2H |

*Vertical to horizontal distance.

The authorized depth of the channel in the Preferred Alternative would increase from 40 to 48 feet along the entire existing channel, and the offshore entrance channel would extend 13.2 miles farther into the Gulf. The Sabine Pass Jetty Channel, Sabine Pass Channel, Port Arthur and Sabine-Neches canals, and the Neches River Channel would be deepened from 40 to 48 feet. The authorized depth of the existing offshore Entrance Channel (Sabine Pass Outer Bar Channel and Sabine Bank Channel) is currently 42 feet; the additional depth is needed to accommodate fluctuations in offshore surface water elevation. These channels and the proposed Sabine Bank Extension Channel would be deepened from 42 to 50 feet.

This would increase the SNWW from 64 miles to approximately 77 miles in length. No modifications to the existing Sabine Pass Jetties would be required as part of the CIP.

The Sabine Pass Jetty Channel and the majority of the inshore channels (Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel) would remain at their existing widths. With the exception of wider sections at anchorages or channel intersections, these channels transition from 500 feet wide between the jetties to 400 feet wide upstream of the Martin Luther King (MLK) Bridge on the Sabine-Neches Canal and Neches River Channel. The Taylor Bayou Channels and Basins would also be widened and deepened to 48 feet. Although the Sabine-Neches Canal and Neches River


Legend
Project Area, Proposed Channel
State Parks, National Wildlife Refuges and Wildlife Management Areas
Project Area, Proposed Dredged Material Placement Areas
Project Area, Dredged Material Placement Areas
Project Area, BU Features
State Boundaries
Channel Centerlines
County Boundaries
Study Area
Vicinity Map
Texas
Louisiana
GULF MEXICO
End of Existing Channel
SNWW Extension Channel
95+734
ODMDS-01
ODMDS-02
ODMDS-A
ODMDS-B
ODMDS-C
ODMDS-D
75+000
85+000
95+000
105+000
115+000
125+000
135+000
145+000
155+000
165+000
175+000
185+000
195+000
N
E
S
W
8,000 4,000 0 8,000
Feet
Figure 2.4-1a
Sabine-Neches Waterway
Extension Channel
Prepared for: USACE
Job No: 4419800
Scale: 1 inch equals 8,000 feet
Prepared by: AP
Date: 08/07/2009
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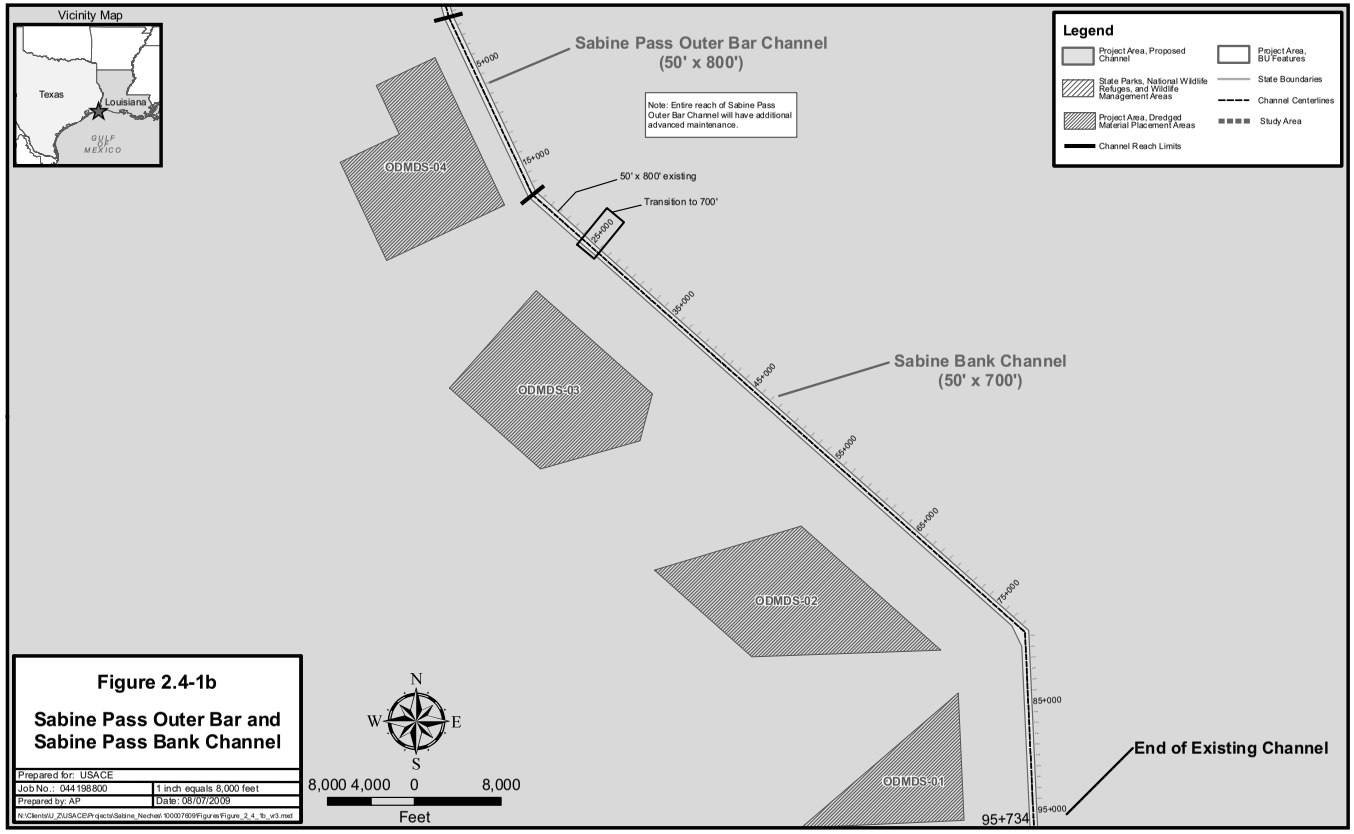
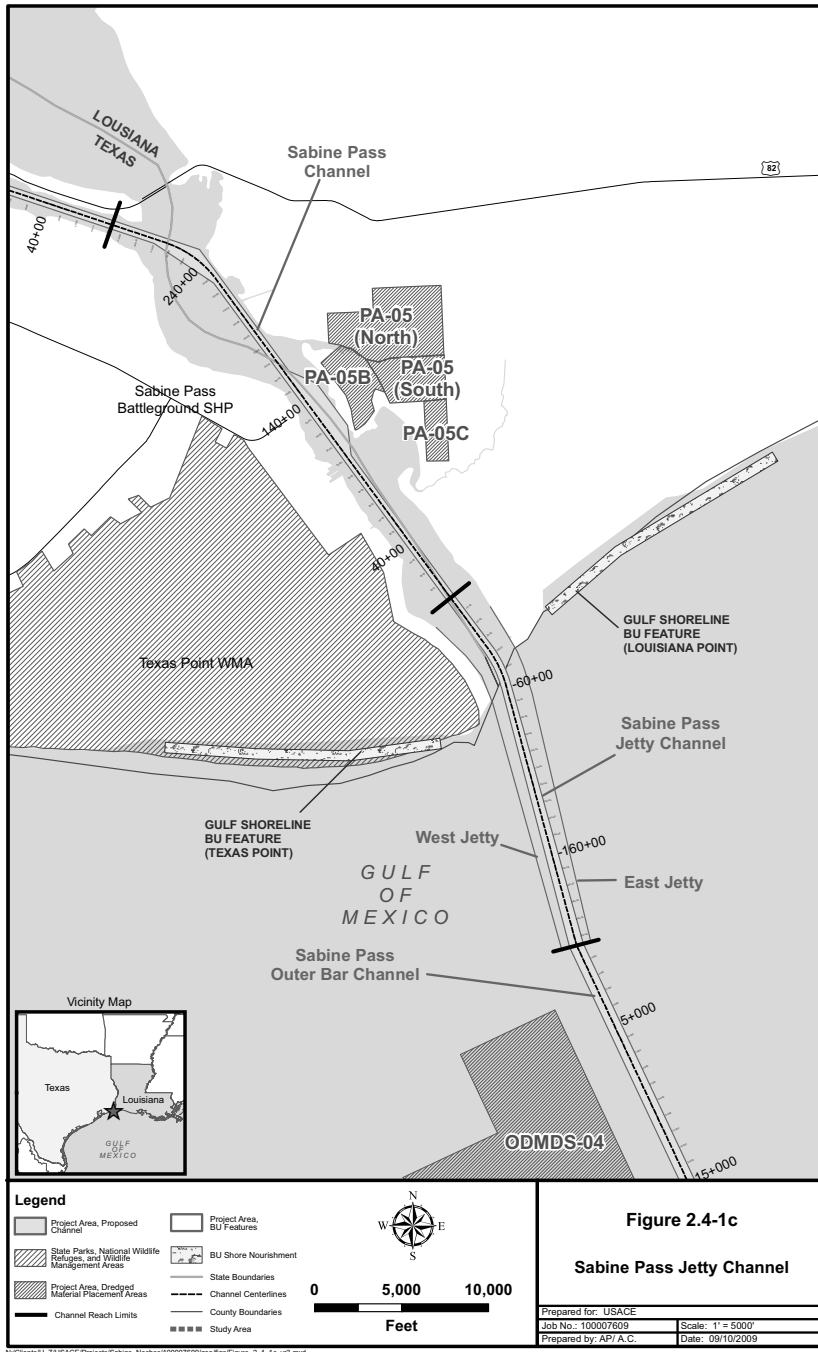
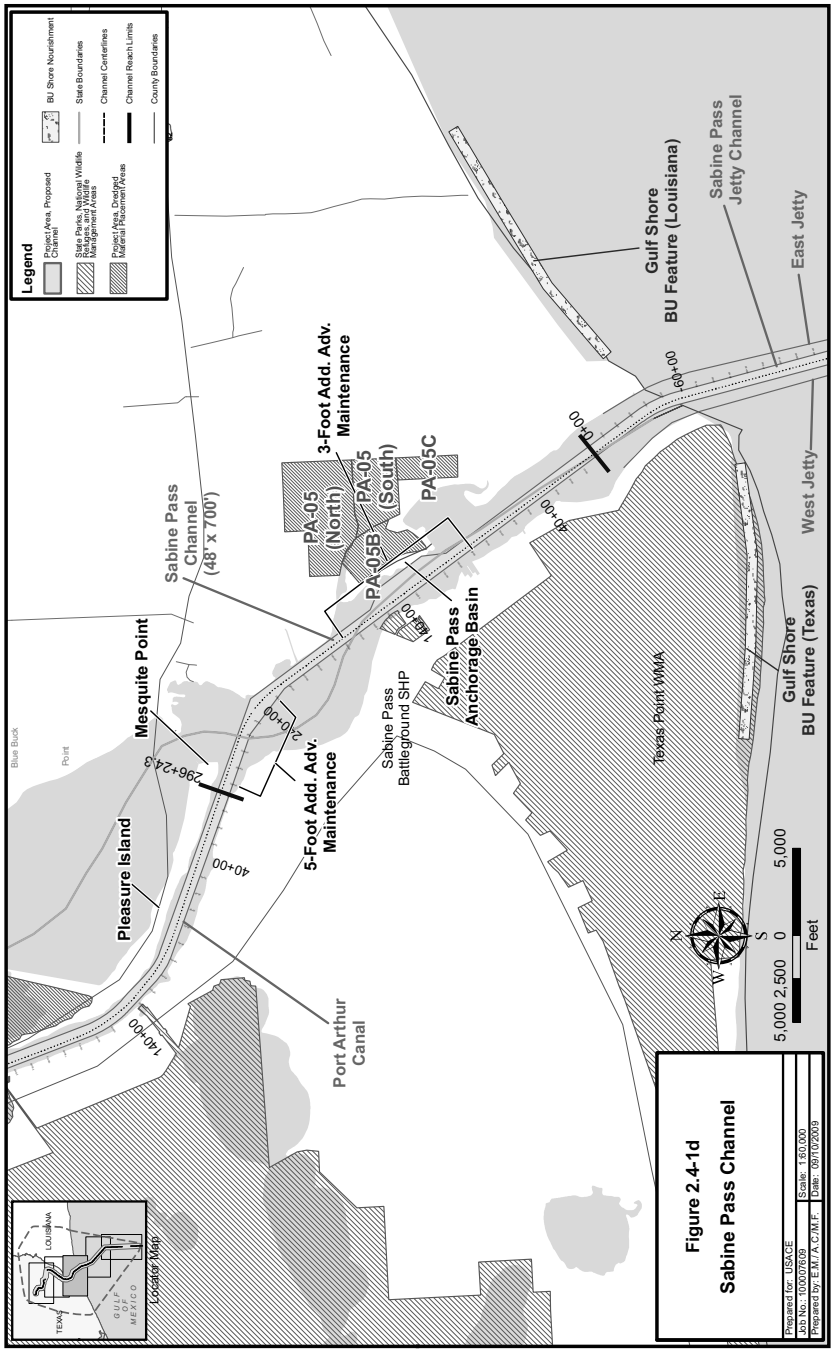
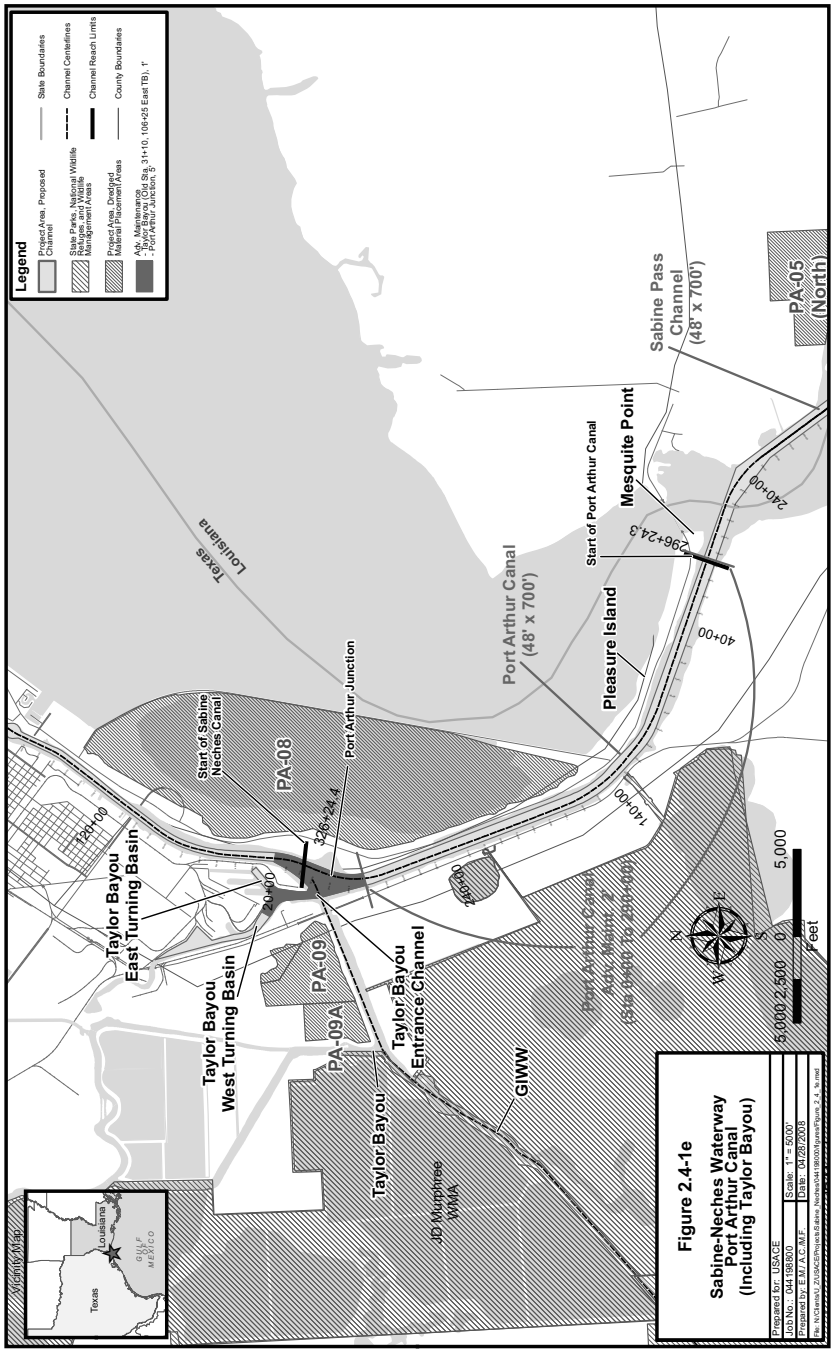

Vicinity Map
Texas
Louisiana
GULF OF MEXICO
Sabine Pass Outer Bar Channel
(50' x 800')
Note: Entire reach of Sabine Pass Outer Bar Channel will have additional advanced maintenance.
50' x 800' existing
Transition to 700'
Sabine Bank Channel
(50' x 700')
ODMDS-04
ODMDS-03
ODMDS-02
ODMDS-01
5+000
15+000
25+000
35+000
45+000
55+000
65+000
75+000
85+000
95+000
95+734
End of Existing Channel
Legend
Project Area, Proposed Channel
Project Area, BU Features
State Parks, National Wildlife Refuges, and Wildlife Management Areas
State Boundaries
Channel Centerlines
Project Area, Dredged Material Placement Areas
Study Area
Channel Reach Limits
N
W
E
S
8,000 4,000 0 8,000
Feet
Figure 2.4-1b
Sabine Pass Outer Bar and Sabine Pass Bank Channel
Prepared for: USACE
Job No.: 044198800
1 inch equals 8,000 feet
Prepared by: AP
Date: 08/07/2009
N:\Clients\U_Z\USACE\Projects\Sabine_Neches\100007809\Figures\Figure_2_4_1b_v3.mxd


LOUISIANA
TEXAS
Sabine Pass Channel
82
40+00
240+00
PA-05 (North)
PA-05B
PA-05 (South)
PA-05C
Sabine Pass Battleground SHP
140+00
40+00
Texas Point WMA
GULF SHORELINE BU FEATURE (LOUISIANA POINT)
60+00
Sabine Pass Jetty Channel
GULF SHORELINE BU FEATURE (TEXAS POINT)
West Jetty
160+00
East Jetty
GULF OF MEXICO
Sabine Pass Outer Bar Channel
5+000
ODMDS-04
15+000
Vicinity Map
Texas
Louisiana
GULF OF MEXICO
Legend
Project Area, Proposed Channel
State Parks, National Wildlife Refuges, and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
Channel Reach Limits
Project Area, BU Features
BU Shore Nourishment
State Boundaries
Channel Centerlines
County Boundaries
Study Area
N
W
E
S
0
5,000
10,000
Feet
Figure 2.4-1c
Sabine Pass Jetty Channel
Prepared for: USACE
Job No.: 100007609
Scale: 1" = 5000'
Prepared by: AP/ A.C.
Date: 09/10/2009
N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/Figure_2_4_1c_vr3.mxd


Legend
Project Area, Proposed Dredge
State Parks, National Wildlife Refuges and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
BU Shore Nourishment
State Boundaries
Channel Centerlines
Channel Reach Limits
County Boundaries
Locator Map
LOUISIANA
TEXAS
GULF OF MEXICO
Blue Buck
Point
Mesquite Point
Pleasure Island
Port Arthur Canal
Sabine Pass Channel (48' x 700')
5-Foot Add. Adv. Maintenance
3-Foot Add. Adv. Maintenance
PA-05 (North)
PA-05 (South)
PA-05B
PA-05C
Sabine Pass Anchorage Basin
Sabine Pass Battleground SHP
Texas Point WMA
Gulf Shore BU Feature (Louisiana)
Gulf Shore BU Feature (Texas)
Sabine Pass Jetty Channel
East Jetty
West Jetty
140+00
40+00
20+00
296+24.3
140+00
40+00
0+00
60+00
N
S
E
W
5,000 2,500 0 5,000
Feet
Figure 2.4-1d
Sabine Pass Channel
Prepared for: USACE
Job No.: 100007608
Prepared by: E.M./ A.C./M.F.
Scale: 1:60,000
Date: 09/10/2009
N:\Clients\U_Z\USACE\Projects\Sabine_Neches\100007608\gis\gis\Figure_2_4_1d_v2.mxd


Legend
Project Area, Proposed Channel
State Parks, National Wildlife Refuges, and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
Adv. Maintenance
- Taylor Bayou (Old Ship, 31+10, 106+25 East TB), 1'
- Port Arthur (Reach 3)
State Boundaries
Channel Centerlines
Channel Reach Limits
County Boundaries
Vicinity Map
Texas
Louisiana
GULF MEXICO
Texas
Louisiana
Taylor Bayou East Turning Basin
Taylor Bayou West Turning Basin
Start of Sabine Neches Canal
PA-08
Port Arthur Junction
326+24.4
PA-09
PA-09A
Taylor Bayou Entrance Channel
Taylor Bayou
JD Murphree WMA
GIWW
Port Arthur Canal (48' x 700')
Pleasure Island
Start of Port Arthur Canal
Mesquite Point
Sabine Pass Channel (48' x 700')
PA-05 (North)
Port Arthur Canal Adv. Maint. 2 (Sta 0+00 to 250+00)
5,000 2,500 0 5,000
Feet
Figure 2.4-1e
Sabine-Neches Waterway
Port Arthur Canal
(Including Taylor Bayou)
Prepared for: USACE
Job No.: 04198800
Scale: 1" = 5000'
Prepared by: E.M/ A.C./ M.F.
Date: 04/28/2008

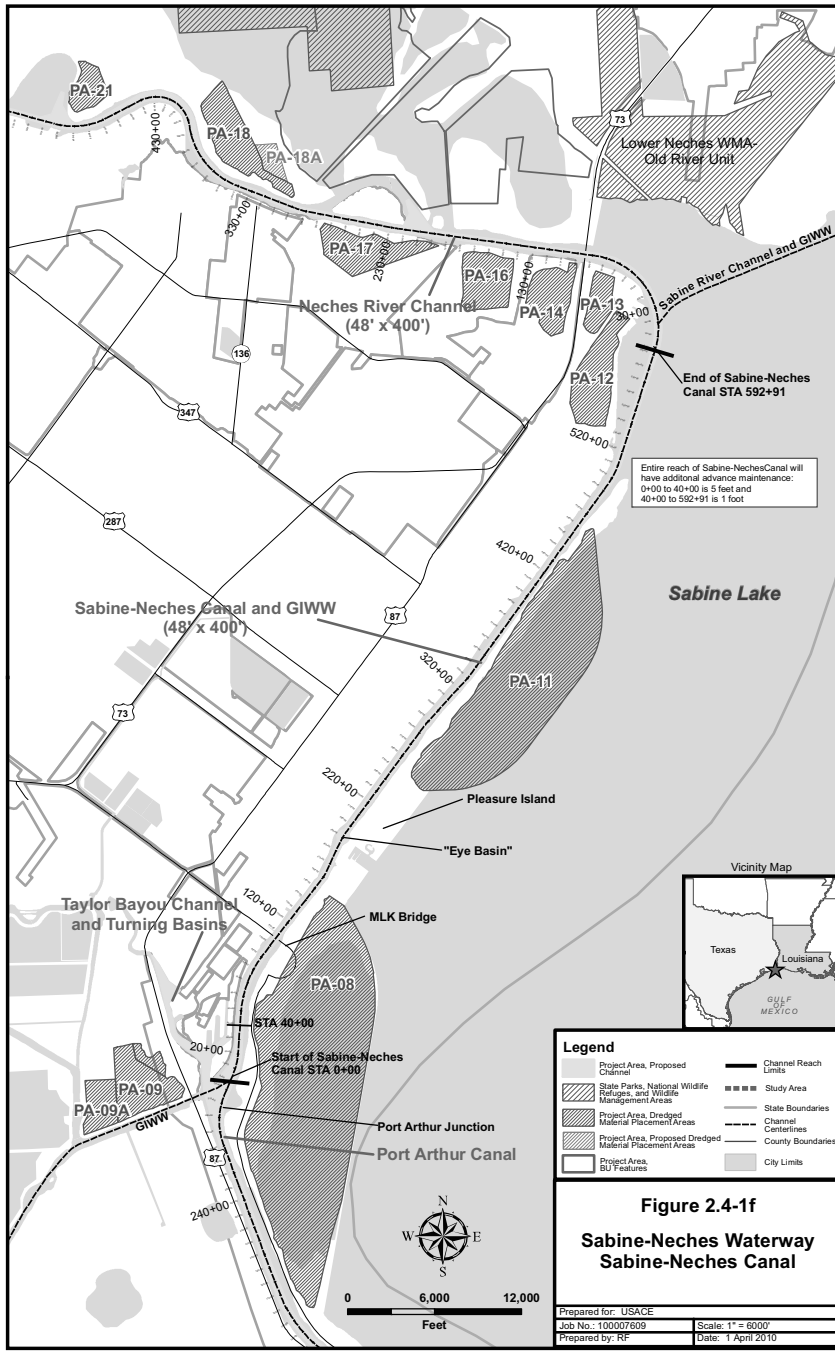



**Figure 2.4-1f**

**Sabine-Neches Waterway**
**Sabine-Neches Canal**

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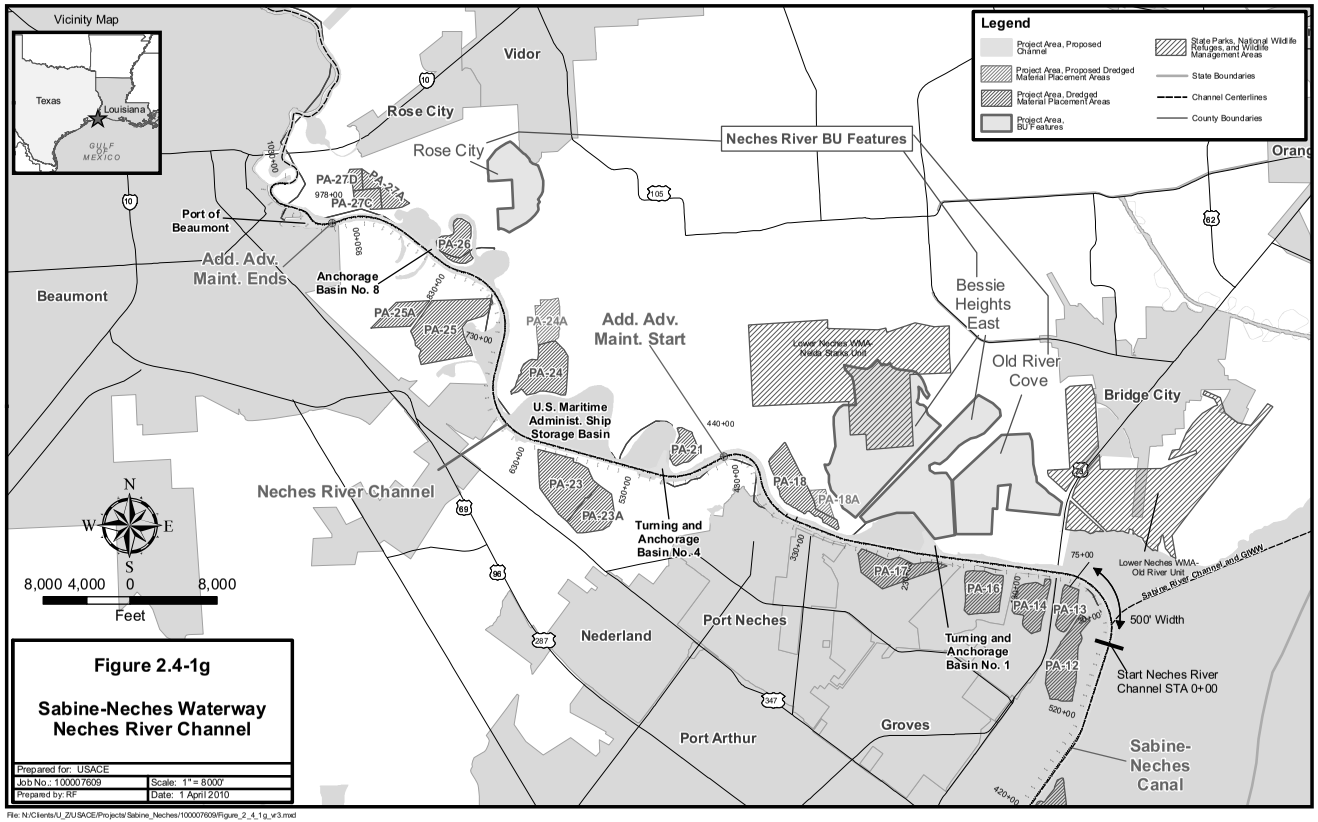


**Figure 2.4-1g**

**Sabine-Neches Waterway Neches River Channel**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 8000' |
| Prepared by: RF | Date: 1 April 2010 |

File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Figure_2_4_1g_v3.mxd

Channel would not be widened, navigation efficiency would be improved with short stretches of selective widening and bend easings in both reaches, and the addition or enlargement of one anchorage and two turning/anchorage basins on the Neches River Channel.

The Preferred Alternative would generate an estimated 98 mcy of new work and 650 mcy of maintenance material over the 50-year period of analysis (Table 2.4-2). The annual maintenance dredging quantities in the SNWW will increase from an average of 8.1 mcy for the current 40-foot project to 13.0 mcy for the proposed 48-foot project.

Table 2.4-2
New Work and 50-Year Maintenance Quantities for Preferred Alternative

| | Channel Reach | New Work Quantities (cy) | 50-Year Maintenance Quantities (cy) |
|---|---|---|---|
| Offshore | Sabine Bank Extension | 18,737,000 | 36,216,000 |
| | Sabine Bank Channel | 15,358,000 | 96,371,000 |
| | Sabine Pass Outer Bar Channel | 5,923,000 | 223,650,000 |
| | Sabine Pass Jetty Channel | 2,978,000 | 13,527,000 |
| Inshore | Sabine Pass Channel | 6,723,000 | 34,781,000 |
| | Port Arthur Canal* | 11,697,000 | 82,858,000 |
| | Sabine-Neches Canal | 11,944,000 | 73,245,000 |
| | Neches River Channel | 25,014,000 | 89,725,000 |
| | Total Quantities | 98 mcy | 650 mcy |

*Includes Taylor Bayou channels and basins.
cy = cubic yards

Dredging depths will actually be deeper than the authorized depth when allowances for overdepth and advanced maintenance are included. Allowable overdepth is an additional depth outside the required dredging template that is permitted to allow for inaccuracies in the dredging process. Allowable overdepth for the existing channel varies between 1 and 2 feet. The Preferred Alternative would maintain a constant 2 feet of allowable overdepth for all channel reaches. Advance maintenance is the practice of dredging deeper than the authorized channel dimensions to provide for the accumulation and storage of sediment. In critical and fast-shoaling areas, it is required to avoid frequent redredging and to ensure the reliability and least overall cost for operating and maintaining the project authorized dimensions. The existing SNWW project has a constant 2-foot advance maintenance depth, and the Preferred Alternative assumes a minimum 2-foot depth for all channel reaches. During the Final Alternatives evaluation phase, an analysis was performed to identify potential with-project changes in dredging frequencies, and to determine whether an increase in advance maintenance would be required. As a result, an increase in advance maintenance (ranging from 1 to 5 feet) was proposed for some portions of some channel reaches to allow the proposed dredging frequency to remain the same as the existing O&M dredging frequency. The full potential dredging depth is provided in the description for each reach below. The full potential depths of each channel reach (including allowable overdepth, advance maintenance, and additional

advance maintenance) were included in the HS modeling. Each channel reach is divided into different sections for dredging contracts. These sections are shown on the Engineering Plates in the FFR.

#### 2.4.1.1 Sabine Bank Extension Channel

This channel would lengthen the existing offshore entrance channel approximately 13.2 miles at a bottom width of 700 feet (Figure 2.4-1a). The additional length is required to reach a water depth in the Gulf equal to the proposed channel depth. The proposed offshore depth is 50 feet, but advance maintenance and allowable overdepth would add a total of 4 more feet, bringing the total dredged depth of the Extension Channel to 54 feet. It would be constructed by hopper dredge beginning at the end of the Sabine Bank Channel, and it would extend into the Gulf at the same bearing as the Sabine Bank Channel. An overview of the project details for the Sabine Bank Extension is listed in Table 2.4-3.

Table 2.4-3
Project Details of Sabine Bank Extension

| | |
|---|---|
| Length of Reach | 13.2 miles (new) |
| Project Depth | 50 feet |
| Bottom Width | 700 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| New Work Material | 18,737,000 cy |
| Placement Areas | ODMDSs A, B, C, and D |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 36,216,000 cy |
| Increase in Maintenance Material | 36,216,000 cy |
| Placement Areas | ODMDSs A, B, C, and D |
| Beneficial Use of Dredged Material | None |

#### 2.4.1.2 Sabine Bank Channel

This 14.7-mile-long channel would be deepened from 42 to 50 feet using a hopper dredge (Figure 2.4-1b). When advance maintenance and allowable overdepth are added to the proposed 50-foot depth, the Sabine Bank Channel would be dredged to 54 feet. The bottom width of the Sabine Bank Channel is currently 800 feet; it would remain 800 feet wide for the first mile past the end of the Outer Bar Channel, and then it would taper from 800 feet to 700 feet over the next 0.5 mile. The Sabine Bank Channel would continue the 700-foot bottom width for approximately 13.2 miles to its connection with the Extension Channel. Since the existing channel is 800 feet wide, new channel markers would be required to mark the tapered transition and the remainder of the narrowed Sabine Bank Channel. An overview of the project details for the Sabine Bank Channel reach is listed in Table 2.4-4.

Table 2.4-4
Project Details for Sabine Bank Channel Reach

| | |
|---|---|
| Length of Reach (sections 1, 2) | 14.7 miles (no change) |
| Project Depth | 50 feet |
| Bottom Width | 800 feet then narrow to 700 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| New Work Material | 15,358,000 cy |
| Placement Areas | ODMDSs 1 and 2 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 96,371,000 cy |
| Increase in Maintenance Material | 45,549,000 cy |
| Placement Areas | ODMDSs 1 and 2 |
| Beneficial Use of Dredged Material | None |

#### 2.4.1.3 Sabine Pass Outer Bar Channel

This 3.4-mile-long channel would be deepened from 42 to 50 feet using a hopper dredge (see Figure 2.4-1b). This portion of the channel has higher-velocity eddies moving around the end of the east jetty, which causes sediment to settle out as the currents cross the navigation channel, creating a higher shoaling rate. Due to the high shoaling rate, advance maintenance amounts would be increased to maintain current maintenance dredging cycles. When advance maintenance and allowable overdepth are added, the Outer Bar Channel could be dredged to 58 feet. The Outer Bar Channel would remain at its current 800-foot bottom width due to strong crosscurrents just beyond the end of the jetties. An overview of the project details for the Sabine Pass Outer Bar Channel reach is listed in Table 2.4-5.

Table 2.4-5
Project Details for Sabine Pass Outer Bar Channel Reach

| | |
|---|---|
| Length of Reach (Section 3) | 3.4 miles (no change) |
| Project Depth | 50 feet |
| Bottom Width | 800 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | 4 feet |
| New Work Material | 5,923,000 cy |
| Placement Areas | ODMDS 3 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 223,650,000 cy |
| Increase in Maintenance Material | 123,965,000 cy |
| Placement Areas | ODMDS 3 |
| Beneficial Use of Dredged Material | None |

#### 2.4.1.4 Sabine Pass Jetty Channel

This 4.1-mile-long channel would be deepened to 48 feet using a hopper dredge (Figure 2.4-1c). When advance maintenance and allowable overdepth are added, the Sabine Pass Jetty Channel could be dredged to 52 feet. The channel would gradually taper from the existing 800-foot width at the jetties' mouth to the existing 500-foot width. No impacts to the jetties would be associated with the proposed improvements. An overview of the project details for the Sabine Pass Jetty Channel reach is listed in Table 2.4-6.

Table 2.4-6
Project Details for Sabine Pass Jetty Channel Reach

| | |
|---|---|
| Length of Reach (Section 4) | 4.1 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | 800 to 500 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| New Work Material | 2,978,000 cy |
| Placement Areas | ODMDS 4 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 13,527,000 cy |
| Increase in Maintenance Material | 2,142,000 cy |
| Placement Areas | ODMDS 4 |
| Beneficial Use of Dredged Material | None |

#### 2.4.1.5 Sabine Pass Channel

This 5.6-mile-long channel begins just north of the jetties and extends upstream to Mesquite Point on Pleasure Island (Figure 2.4-1d). It would be deepened to 48 feet and constructed with a hydraulic pipeline dredge. Advance maintenance would vary in different sections of the Sabine Pass Channel to account for differences in shoaling rates. The maximum dredging depth for two reaches of this channel (Station 0+00 to Station 100+00, and Station 180+00 to Station 230+00) would be 52 feet. Due to additional advance maintenance required to maintain existing O&M dredging cycles, the reaches from Station 100+00 to Station 180+00 and Station 230+00 to the end of the Sabine Pass Channel at 296+25 would be dredged to a depth of 55 feet. The bottom width of the Sabine Pass Channel would remain 500 feet. The Sabine Pass Anchorage is located in this reach and its footprint would be reduced in size because it has never been fully utilized. The width would be decreased from 1,500 feet to 855 feet, and the length remains 8,200 feet. The angle of approach would remain the same. An overview of the project details for the Sabine Pass Channel reach is listed in Table 2.4-7.

#### 2.4.1.6 Port Arthur Canal (including Taylor Bayou Channels and Turning Basins)

This 6.2-mile-long canal begins near Mesquite Point and ends at the Port Arthur Junction Area with the Taylor Bayou channels (Figure 2.4-1e). The Junction Area serves as a turning basin and has an irregular shape where the Taylor Bayou channels and the GIWW merge with it. The Port Arthur Canal would be deepened to the proposed depth of 48 feet with a hydraulic pipeline dredge. Advance maintenance would

vary in different sections of the Port Arthur Canal to account for differences in shoaling rates. The reach from Station 00+00 to Station 290+00 would be dredged to a maximum depth of 53 feet. The remaining part (Port Arthur Junction) between Stations 290+00 and 325+84 would be dredged to a maximum depth of 57 feet. The bottom width of the Port Arthur Canal would remain 500 feet up to the Junction Area. An overview of the project details for the Port Arthur Canal reach (including Taylor Bayou) is listed in Table 2.4-8.

Table 2.4-7
Project Details for Sabine Pass Channel Reach

| | |
|---|---|
| Length of Reach (sections 5 and 6) | 5.6 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | 500 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | Station 100+00 to Station 180+00 is 3 feet<br>Station 230+00 to Station 295+61 is 3 feet |
| New Work Material | 6,723,000 cy |
| Placement Areas | PA 5 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 34,781,000 cy |
| Increase in Maintenance Material | 4,191,000 cy |
| Placement Areas | none |
| Beneficial Use of Dredged Material | Gulf Shore Beneficial Use Feature |

Table 2.4-8
Project Details for Port Arthur Canal Reach (including Taylor Bayou)

| | |
|---|---|
| Length of Reach (sections 7 and 8) | 6.2 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | Varies (widest is 500 feet) |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | (PA Canal) Station 0+00 to 290+00 is 1 foot<br>(PA Canal) Station 290+00 to 326+37 is 5 feet<br>(Taylor Bayou) Station 0+00 to 31+00 is 5 feet<br>(Taylor Bayou) Station 31+00 to 106+25 is 1 foot |
| New Work Material | 11,697,000 cy |
| Placement Areas | PAs 8 and 9 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 82,858,000 cy |
| Increase in Maintenance Material | 5,391,000 cy |
| Placement Areas | PA 8 and 9 |
| Beneficial Use of Dredged Material | None |

Located at the confluence of the Port Arthur Junction Area, the GIWW, and the mouth of the original Taylor Bayou, the Taylor Bayou Channels and Turning Basins consist of several sub-reaches: Entrance Channel, East Turning Basin, West Turning Basin, Connecting Channel, and the Taylor Bayou Turning Basin. Several significant changes are proposed for this area. When advance maintenance and allowable overdepth are added to the proposed 48-foot depth, all of the Taylor Bayou Channels and Basins could be dredged to 53 feet. The Taylor Bayou portion of the Junction Area, between Taylor Bayou Stations 0+00 and 41+20, would be dredged to 57 feet. The Taylor Bayou Entrance Channel and the West Turning Basin bottleneck curve would be widened, and a structural wall would protect local railroad tracks. Changes for each sub-reach are detailed below.

- **Taylor Bayou Entrance Channel.** The new bottom width widens on the west side of the channel. The channel would be widened to 444 feet at new Station 10+00. The new bottom width would taper back to the existing width by the end of the first curve at Station 28+38.
- **East Turning Basin.** The right side width would decrease 16 feet as the new depth extends down the existing side slope.
- **West Turning Basin.** The width of the existing bottleneck has been increased up to 120 feet on the west side, between new stations 33+00 and 55+00. The west bank of the basin would be protected by a structural wall, preventing impacts to the local railroad tracks present in this area.
- **Connecting Channel.** The West Turning Basin widening would taper back to the existing width in the Connecting Channel, between stations 55+00 and 67+00.
- **Taylor Bayou Turning Basin.** No changes would be made to the existing dimensions, but the basin would be deepened to the proposed 48-foot depth. Existing shore protection belonging to a local facility near Station 90+00 would be affected by penetration by the top-of-cut for the new depth.

#### 2.4.1.7 Sabine-Neches Canal

The 11.2-mile-long canal begins at the Port Arthur Junction Area and ends just south of the mouth of the Neches River (Figure 2.4-1f). The GIWW shares this canal with the deep-draft channel. It would be deepened to the proposed depth of 48 feet with a hydraulic pipeline dredge. When advance maintenance and allowable overdepth are added, stations 0+00 to 40+00 could be dredged to 57 feet, and the remainder of the canal through Station 592+91 could be dredged to 53 feet.

The bottom width of this canal would be selectively widened in three separate sections. The bottom width of the most-downstream curve (stations 0+00 to 20+00) would be widened to 500 feet on the east side of the channel, and then promptly tapered to the existing 400-foot width prior to the MLK Bridge (SH 82). The canal would be widened to 450 feet adjacent to the Port of Port Arthur, with gradual tapering upstream and downstream between stations 120+00 and 170+00. The third widening section would begin to taper at Station 565+00, gradually widening to 500 feet and remaining that width to the end at Station 592+91.

Bend easing is proposed for three areas in the Sabine-Neches Canal to improve ship maneuverability: stations 265+00 to 305+00, stations 350+00 to 395+00, and stations 500+00 to 520+00. The bend easing between stations 350+00 to 395+00 would eliminate a wiggle in the alignment and shift the footprint of the canal 10 feet east of the existing alignment up to Station 520+00.

Changes are also recommended for the canal bottom adjacent to the Port Arthur Dock and the "Eye Basin." The canal toes adjacent to the Port of Port Arthur would be moved approximately 10 feet to the east while keeping the same bottom width of 450 feet. The diameter of the turning point ("Eye Basin") at Station 190+00 would be decreased by 16 feet. An overview of the project details for the Sabine-Neches Canal reach is listed in Table 2.4-9.

Table 2.4-9
Project Details for Sabine-Neches Canal Reach

| | |
|---|---|
| Length of Reach (sections 9 and 10) | 11.2 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | varies 400 to 500 feet |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | Station 0+00 to 40+00 is 5 feet<br>Station 40+00 to 592+91 is 1 foot |
| New Work Material | 11,944,000 cy |
| Placement Areas | PA 11 |
| Beneficial Use of Dredged Material | None |
| Maintenance Material (50-year quantity) | 73,245,000 cy |
| Increase in Maintenance Material | 13,122,000 cy |
| Placement Areas | PAs 8 and 11 |
| Beneficial Use of Dredged Material | None |

#### 2.4.1.8 Neches River Channel

This 18.5-mile-long channel begins just south of the mouth of the Neches River (Figure 2.4-1g). It would be deepened to the proposed depth of 48 feet to Station 980+00 with a hydraulic pipeline dredge. Advance maintenance would vary in different sections of the Neches River Channel to account for differences in shoaling rates. Between stations 0+00 and 440+00, the maximum dredged depth would be 52 feet; between stations 440+00 and 978+00, it would be 54 feet. While the overall bottom width of 400 feet does not change for the majority of the channel length, the first curve at the mouth of Neches River (between stations 0+00 and 75+00) would be widened to 500 feet, and then tapered back to 400 feet prior to the SH 87 twin bridges. The channel also will be widened to 500 feet between turning basins No. 1 and No. 2. An overview of the project details for the Neches River Channel reach is listed in Table 2.4-10.

Three basins will be added or enlarged on the Neches River Channel. All would be dredged to the proposed depth of 48 feet, plus the advance maintenance and allowable overdepth associated with the specific channel reach in which they are located.

Table 2.4-10
Project Details for the Neches River Channel Reach

| | |
|---|---|
| Length of Reach (sections 11–18) | 18.5 miles (no change) |
| Project Depth | 48 feet |
| Bottom Width | 400 feet (majority of channel)<br>500 feet Station 0+00 to 75+00 |
| Advance Maintenance | 2 feet |
| Allowable Overdepth | 2 feet |
| Additional Advance Maintenance | Station 440+00 to 978+00 is 2 feet |
| New Work Material | 25,014,000 cy |
| Placement Areas | PAs 12, 13, 14, 16, 18, 21, 23, 24, 25, 26, 27 |
| Beneficial Use of Dredged Material | Neches River BU Feature |
| Maintenance Material (50-year quantity) | 89,725,000 cy |
| Increase in Maintenance Material | 23,277,000 cy |
| Placement Areas | PAs 12, 13, 14, 16, 17, 18, 21, 23, 24, 25, 26, 27 |
| Beneficial Use of Dredged Material | Neches River BU Feature (Rose City East and Bessie Heights East only) |
| Turning Basins/Anchorage Areas | 1 New; 2 Enlarged; 5 No change |

- Turning and Anchorage Basin No. 1 would be located in an old river oxbow at the east end of Texaco Island near Station 210+00. The Turning Basin would enlarge the existing basin from 1,000 to 1,350 feet in diameter. A new Anchorage Basin, 250 by 1,100 feet in size, would be added.
- Turning and Anchorage Basin No. 4 would enlarge an existing turning point at Station 510+00 from 1,000 to 1,350 feet in diameter. A new Anchorage Basin in the old river oxbow at Station 500+00 would be 250 by 1,100 feet in size.
- Turning Basin No. 6 is an existing basin at Station 700+00. It would retain the same dimensions and would not be deepened to the proposed depth of 48 feet. Maintenance dredging would continue at the existing depth.
- The new Anchorage Basin No. 8 would be located at Station 850+00. The 250-x-1,000-foot basin is located in an old river oxbow.
- The Beaumont Maneuvering Basin's overall dimensions would remain the same as the existing project. Located near Station 975+00, it would be deepened to the proposed 48-foot depth.

#### 2.4.1.9 Bridge Reinforcements and Fenders

Deepening and selective widening improvements to the SNWW navigation channels would affect existing fender systems of the Rainbow Bridge and Veterans Memorial Bridge over the Neches River Channel on SH 87 and the MLK Bridge over the Sabine-Neches Canal on SH 82. Bridge fender systems on both sides of the channel would require removal and replacement. None of the bridges would cause an unreasonable obstruction to navigation, and thus would not require modification or replacement pursuant to the Truman-Hobbs Act. However, existing MLK Bridge piers would be armored to protect them from erosion and maintain the proposed 400-foot channel width.

#### 2.4.1.10 Aids to Navigation

Many of the existing aids to navigation within the waterway would require removal and replacement. The upstream reach from the Beaumont Maneuvering Basin and the vicinity of SH 87 on the Neches River Channel would not require changes in the navigation aids. Ranges and buoys would not need to be replaced along the Port Arthur Canal, Sabine Pass Channel, and Sabine Pass Jetty Channel. However, aids along the remainder of the waterway would need to be relocated, and new aids will be required along the Extension Channel.

#### 2.4.1.11 Lands, Easements and Rights-of-Way

The non-Federal Sponsor is required to furnish the LERR for the proposed cost-shared project. The real estate requirements must support construction as well as operation and maintenance of the project after completion. A summary of the real estate requirements for each channel reach is provided in Table 2.4-11. Specific details of the real estate requirements can be found in the Real Estate Plan, Appendix 3 of the FFR.

Table 2.4-11
Real Estate Requirements for Placement Areas

| | Real Estate Requirement |
|---|---|
| **Channel Reach** | |
| Sabine Bank Extension | Navigational servitude |
| Sabine Bank Channel | Navigational servitude |
| Sabine Pass Outer Bar Channel | Navigational servitude |
| Sabine Pass Jetty Channel | Navigational servitude |
| Sabine Pass Channel | Acquire in Fee (PA 5) |
| Port Arthur Canal | Navigational servitude (PA 8)<br>Acquire in Fee (PA 9) |
| Sabine-Neches Canal | Navigational servitude (PAs 8, 11) |
| Neches River Channel | Owned by Sponsor (No-Action)<br>(PAs 12, 13, 14, 16, 18, 18A, 21, 23, 23A, 24, 24A, 25, 25A)<br>Acquire in Fee (PAs 17, 26, 27A, 27C, 27D)<br>Turning Basins – two will require the acquisition of land in perpetual channel improvement easement |
| **Louisiana Mitigation Areas** | |
| Willow and Black Bayou Areas | Navigational servitude |

#### 2.4.1.12 Relocations

The following assumptions were made to identify pipelines that could be affected by the recommended plan and to develop associated costs. The individual circumstances of each pipeline will be evaluated by USACE in consultation with non-Federal sponsor and the pipeline owner during the preconstruction, engineering, and design (PED) and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. Feasibility engineering guidelines indicate that pipelines with a minimum of 8 feet of cover for trenched lines or 5 feet of cover for directionally drilled

lines would not be adjusted. Pipelines that do not meet the minimum cover requirement would be required to be adjusted.

The adjusted pipelines must be located 20 feet below the authorized 48-foot depth. The 20 feet includes any advance maintenance and allowable overdepth. The relocation of active pipelines is assumed to be installed with directional drilling, and bundled where possible.

A total of 104 pipelines have been identified crossing the SNWW navigation channels. Of the 104 pipelines, 46 require adjustment to meet the minimum required vertical and horizontal clearances for the SNWW CIP.

Pursuant to Section 101(a) of the Water Resources Development Act (WRDA) of 1986, as amended, the Sponsor is responsible for performing, or assuring performance, of all relocations, including utility relocations, which are necessary for the CIP. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government.

The USACE, Galveston District has concluded preliminarily that 41 of the 46 lines located within the channel must be relocated and are classified as utility relocations for which the Sponsor must perform or assure performance. In accordance with Section 101(a)(4) of WRDA 86, one-half of the cost of each such relocation will be borne by the owner of the facility being relocated and one-half of the cost of each such relocation will be borne by the Sponsor. Such relocation costs will not include any cost for upgrading or improving such facilities, which is to be borne by the facility owner.

For more specific information regarding the utility relocations, and preliminary conclusions regarding the remaining 5 lines that must be removed but not replaced, see the FFR, Real Estate Plan, Appendix 4.

DMMP marsh restoration at Bessie Heights and mitigation marsh restoration measures east of Sabine Lake were assumed to require no relocations. However, since oil production is active in some of these areas, additional pipeline searches and coordination with pipeline owners would be required prior to construction to avoid impacts.

No relocations would be required for overhead power utilities, highway bridges, the Port Arthur Hurricane Flood Protection Levee, or its associated pump stations and closure structures.

### 2.4.2 Dredged Material Placement Areas

Dredged material produced by construction and operation of the Preferred Alternative over the 50-year period of analysis would be managed in accordance with the DMMP. More details can be found in the DMMP presented in Appendix D of this FEIS. The total new work construction quantity was presented in Table 2.4-2. Information on proposed maintenance quantities is important in evaluating potential project impacts. Table 2.4-12 provides a reach-by-reach comparison of maintenance quantities for the existing project (No-Action Alternative) and the Preferred Alternative. Disposal features proposed for the

Preferred Alternative consist of beneficial use features, upland PA features, and ODMDSs. The location of all disposal features is shown on Figures 2.4-1a–g.

Table 2.4-12
Existing and Proposed Maintenance Dredging Quantities

| Channel Reach | Existing 50-Year Maintenance Quantities (cy) | Proposed 50-Year Maintenance Quantities (cy) |
|---|---|---|
| Sabine Bank Extension | 0 | 36,216,000 |
| Sabine Bank Channel | 50,822,000 | 96,371,000 |
| Sabine Pass Outer Bar Channel | 99,685,000 | 223,650,000 |
| Sabine Pass Jetty Channel | 11,385,000 | 13,527,000 |
| Sabine Pass Channel | 30,590,000 | 34,781,000 |
| Port Arthur Canal | 88,249,000 | 82,858,000 |
| Sabine-Neches Canal | 60,123,000 | 73,245,000 |
| Neches River Channel | 66,448,000 | 89,725,000 |
| Total Quantities | 407 mcy | 650 mcy |

### 2.4.2.1 Quantities and Types of Dredged Material

Construction of the Preferred Alternative would require the development of significantly more PA capacity than currently exists for the SNWW project. The existing project uses 16 upland PAs and 4 ODMDSs. Construction of the Preferred Alternative would generate 98 mcy of new work material. Shoaling is projected to increase with the Preferred Alternative for several reasons (Parchure et al., 2005). The Entrance Channel would extend an additional 13.2 miles into the Gulf, and this would result in higher offshore dredging quantities. The deeper channel would have a greater cross-sectional area, making it function as a larger sediment trap; and higher salinities would increase flocculation and the deposition of suspended sediment.

Maintenance dredging is therefore projected to increase for the entire channel, from 407 to 650 mcy over the 50-year period of analysis. Expressed as average annual quantities, quantities will increase from 8.1 to 13.0 mcy per year (an increase of approximately 60 percent). Fifty-seven percent of the maintenance quantities for the Preferred Alternative would originate from the offshore channels, and 43 percent from the inshore channels. As would be expected with the offshore channel extension, maintenance dredging volumes for the offshore channel would increase more than the inshore reaches, with an increase from 162 to 370 mcy and 251 to 281 mcy, respectively. Additional capacity for the offshore reaches could be obtained by designating new ODMDSs, and the designation of four new ODMDSs is being sought (see Appendix B).

Finding areas suitable for the development of new upland PAs along the inshore reaches was difficult. The majority of land adjacent to the SNWW is either covered by residential and industrial development and existing PAs, or is coastal wetland. For this reason, considerable effort was directed toward evaluating alternatives for the placement of dredged material. Maintenance material would be used to the

greatest extent possible in the resulting DMMP. A discussion of the process used to evaluate these alternatives, and a description of alternatives considered, is provided in Section 2.5.

#### 2.4.2.2 DMMP Beneficial Use Features

All DMMP BU features proposed for inclusion in the DMMP of the Preferred Alternative are described in Table 2.4-13. Three former marsh areas on the Neches River (Rose City East, Bessie Heights East, and Old River Cove) would be combined into one large management feature called the Neches River BU Feature (see Figure 2.5-1). In the Gulf Shore BU Feature, maintenance material would be used to nourish Gulf shorelines at Texas and Louisiana Points (see Figure 2.5-2). The DMMP BU features are not being pursued as separable elements of an ecosystem restoration plan under Section 204 or 207 authorities. They are not ecosystem restoration measures, and as such, do not target a specific historical condition for the level of restoration. They are least-cost, environmentally acceptable placement features and are included as general navigation features (GNF) of the DMMP.

The Neches River BU Feature would take advantage of new work material provided by the channel-deepening project to build hydraulic containment levees within degraded, former marsh areas at Rose City East, Bessie Heights East, and Old River Cove. Each of these areas is referred to as a component of the overall Neches River BU Feature. Marsh would be created in each component using only new work, or a combination of new work and maintenance material. The Old River Cove component would be filled during initial construction with new work material alone. In the Bessie Heights East component, maintenance material would be placed incrementally in seven maintenance cycles over 28 years. At the Rose City East component, new work material would be used to construct containment levees and ridges, then the marsh would be completed with the placement of maintenance material during the first maintenance cycle following construction. For the Neches River BU Feature as a whole, 2,853 acres of emergent marsh would be restored in areas that are now open water; 871 acres of improved shallow-water habitat would be created by the formation of shallower ponds and interconnecting channels within the restored marshes; and 1,234 acres of existing fringing marsh would be nourished by winnowing fine-grained material from unconfined flows of dredged material effluent. The size of the Neches River BU Feature components and the magnitude of their ecological benefits are made possible by the large amounts of dredged material that would be generated by the proposed project, and extensive opportunities for beneficial use in the project area.

The Gulf Shore Nourishment Feature would use material from regular maintenance dredging of the eastern section of the Sabine Pass Channel to nourish eroding marsh, and possibly create new saline marsh, along a total of 6 miles of shoreline on both sides of Sabine Pass at Louisiana and Texas Points. Material would be hydraulically pumped along a 3-mile reach of shoreline, from 0.5 to 3.5 miles from each jetty. The unconfined placement of material during each 3-year dredging cycle would alternate between Texas and Louisiana, so that materials would be placed on each state's shoreline every 6 years, for a total of 16 placement events over the 50-year period of analysis. Historic dredging records indicate that the material from Sabine Pass would average 51 percent silt, 31 percent clay, and 18 percent sand. The material would be hydraulically pumped into the nearshore zone and some material would be

expected to flow over existing marsh while the remainder flows into the nearshore waters. This mix of materials does not contain typical beach-quality sand; however, resource agencies have ageed that returning the material to the littoral system would have a net beneficial effect, regardless of the material type.

Table 2.4-13
DMMP BU Features, SNWW Preferred Alternative

| Beneficial Use Features | No. | Description | Size of Influence Area |
|---|---|---|---|
| Rose City East (component of Neches River BU Measure) | TX 3-1 East | Restoring 345 acres fresh marsh, 72 acres of shallow water, and nourishing 151 acres of existing marsh in two construction events. New work material from Neches River Channel will be used to restore 225-acre marsh, construct hydraulic containment levees and higher elevation features. Maintenance material from the first maintenance cycle will be used to restore an additional 120 acres of marsh. | Influence area – 568 acres |
| Bessie Heights East (component of Neches River BU Measure) | TX 5-2 | Restores 679 acres of brackish and 1,190 acres of intermediate marsh, 660 acres of shallow-water habitat, and nourishes 651 acres of existing marsh. Marsh will be constructed with maintenance material from Neches River Channel for 28 years. New work material is used to build hydraulic containment levee. | Influence area – 3,180 acres |
| Old River Cove (component of Neches River BU Measure) | TX 6-1 | Restores 639 acres of brackish marsh, 139 acres of shallow-water habitat, and nourishes 432 acres of existing marsh with new work material from Neches River Channel. New work material used to construct hydraulic containment levee. | Influence area – 1,210 acres |
| Gulf Shore BU Feature (Texas and Louisiana Points) | TX 8-11 LA 5-2/ 6-2 | Nourish 3 miles of Gulf shoreline on both sides of Sabine Pass, from 0.5 to 3.5 miles from East and West Jetties, using maintenance material from Sabine Pass Channel. Unconfined placement of maintenance material along shoreline every 3 years for 50-year period of analysis (8 placement episodes). Assume 50:50 split of material between Texas and Louisiana accomplished by alternating placement in Texas and Louisiana. | Affected shoreline 6.0 miles total |

#### 2.4.2.3 Upland Placement Areas

Sixteen existing and two expanded upland PAs proposed for use with the Preferred Alternative are listed in Table 2.4-14. Existing upland PAs would be used to the greatest extent possible; however, the expansion of some existing PAs would also be required. The locations of each PA are shown on figures 2.4-1d–g, and the evaluation of PA impacts is presented in subsection 2.5.3.3.

### 2.4.3 Impact Analysis and Mitigation Needs Summary for the Preferred Alternative

A full summary of the impact analysis and compensatory mitigation needs for the Preferred Alternative is presented in Table 2.4-16 for each state. The calculation of impacts and benefits of the DMMP BU features and mitigation measures are described in Section 2.5 and throughout Section 4 of this FEIS.

Table 2.4-14
Upland Placement Areas, SNWW Preferred Alternative

| Placement Area | Additional Cell(s) | Size (acres) | Associated Waterway Section** |
|---|---|---|---|
| 5 | N&S, B and C | 957 | Sabine Pass Channel (sections 5 and 6) |
| 8 | | 3,570 | Port Arthur Canal (sections 7 and 8)<br>Sabine-Neches Canal (Section 9) |
| 9A | B | 481 | Port Arthur Canal (Section 8) |
| 11 | | 2,170 | Sabine-Neches Canal (Section 10) |
| 12 | | 355 | Neches River Channel (Section 11) |
| 13 | | 140 | Neches River Channel (Section 11) |
| 14 | | 255 | Neches River Channel (Section 12) |
| 16 | | 288 | Neches River Channel (Section 12) |
| 17 | | 316 | Not used for new work material |
| 18 | A* | 432 | Neches River Channel (Section 14) |
| 21 | | 135 | Neches River Channel (Section 15) |
| 23 | A | 773 | Neches River Channel (sections 15 and 16) |
| 24 | A* | 575 | Neches River Channel (Section 16) |
| 25 | A | 820 | Neches River Channel (sections 17 and 18) |
| 26 | | 192 | Neches River Channel (Section 18) |
| 27 | A, C, and D | 270 | Neches River Channel (Section 18) |

*New cells (PAs 18A and 24A), which enlarge existing PAs.
**Waterway sections are shown on FFR Engineering Plates C-01 through C-12.

Table 2.4-15
Preferred Alternative ODMDSs

| Placement Area | Size (acres) | Status | Associated Waterway Section |
|---|---|---|---|
| A | 3,405 | New | Extension Channel |
| B | 3,405 | New | Extension Channel |
| C | 3,405 | New | Extension Channel |
| D | 3,405 | New | Extension Channel |
| 1 | 2,020 | Active | Section 1 |
| 2 | 4,738 | Active | Section 2 |
| 3 | 3,939 | Active | Section 3 |
| 4 | 3,444 | Active | Section 4 |

### 2.4.4 Critical Assumptions

Critical planning and environmental assumptions were made in the evaluation of the benefits and impacts of the Recommended Plan. Table 2.4-17 provides a brief summary of the major assumptions, the scientific basis or rationale behind each assumption, and an indication of the consequences if the assumptions turn out not to be valid.

Table 2.4-16
Summary of the Impact Analysis and Compensatory Mitigation Needs for the Preferred Alternative

| | Texas | Louisiana | Project as Whole |
|---|---|---|---|
| **Impact Analysis (AAHUs*)** | | | |
| Negative Impacts (–) Before DMMP BU | –412 | –1,709 | –2,121 |
| Positive Impacts Resulting from DMMP BU | 1,068 | 210 | 1,278 |
| Net Gain or Loss (–) After DMMP BU | 656 | –1,499 | –843 |
| Offset of Impacts to Louisiana Federal Lands from Excess Texas BU Benefits | –340 | 340 | NA |
| Net Gain or Loss (–) After BU Benefits | 316 | –1,159 | –843 |
| **Compensatory Mitigation (AAHUs)** | | | |
| Total Compensation | 0 | 1,181 | 1,181 |
| **Net Gain After BU Benefits & Mitigation** | **316** | **22** | **338** |
| **Impact Analysis (Acres)** | | | |
| Size of Potential Impact Area | 58,649 | 197,530 | 256,179 |
| Area with No Impacts | 19,421 | 15,247 | 34,668 |
| Area of Direct Impacts | 86 | 0 | 86 |
| Area of Indirect Impacts | 39,228 | 182,283 | 221,511 |
| Net Acres of Land Loss (–) before DMMP BU | –247 | –691 | –938 |
| Total Shoreline Influenced by DMMP BU | 3 miles | 3 miles | 6 miles |
| Total Acres Affected by DMMP BU | 4,958 | 0 | 4,958 |
| Created Emergent Marsh | 2,853 | 0 | 2,853 |
| Improved Shallow Water | 871 | 0 | 871 |
| Nourished Existing Marsh | 1,234 | 0 | 1,234 |
| **Compensatory Mitigation (Acres)** | | | |
| Total Acres Affected by Mitigation | 0 | 8,095 | 8,095 |
| Created Emergent Marsh | 0 | 2,783 | 2,783 |
| Improved Shallow Water | 0 | 957 | 957 |
| Nourished Existing Marsh | 0 | 4,355 | 4,355 |
| **Total Acres Affected by DMMP BU and Mitigation** | **4,958** | **8,095** | **13,053** |
| Created Emergent Marsh | 2,853 | 2,783 | 5,636 |
| Improved Shallow Water | 871 | 957 | 1,828 |
| Nourished Existing Marsh | 1,234 | 4,355 | 5,589 |

*AAHU = Average annual Habitat Units

Table 2.4-17
Critical Assumptions

| Assumption | Rationale for the Assumption | Consequences if Assumption Becomes Invalid |
|---|---|---|
| **FWOP Condition** | | |
| Louisiana Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Projects in operation at Willow Bayou, Black Bayou, and Perry Ridge for remainder of project life. | Ecological effects of CWPPRA projects (reductions in land loss rates and/or salinity) based upon changes projected in environmental assessments. | If ecological benefit of CWPPRA project is less than expected, then FWOP salinity and land loss impacts would be slightly higher than expected; conversely, if ecological benefits are higher, FWOP impacts would be slightly lower than expected. |
| Most likely rate of RSLR estimated to be 1.1 feet in the study area by year 2069. Full potential range of RSLR estimated to be from 0.3 to 2.8 feet over period of analysis. | Eustatic sea-level rise based upon mid- to high mid-range projected by National Research Council (NRC) and Intergovernmental Panel on Climate Change (IPCC), respectively. Local subsidence component based upon long-term trends obtained from basal peat analysis. Full potential range calculated as required by Circular No. 1165-2-211. | Little consequence if RSLR is lower than expected. High rate of RSLR could result in small increase in maintenance dredging and PA levee heights for existing project; increase in hurricane tidal surge elevation; an increase in land loss due to submergence of intertidal marshes; and salinity increase. Functioning of navigation channel would not be affected; improvements at some dock facilities might be needed. |
| Future freshwater inflows assumed for HS modeling are slightly higher on Neches River than existing inflows; about the same as existing inflows on the Sabine River. | Future freshwater inflows were based upon demand projections and supply strategies approved by the 2007 Texas State Water Plan. | Little consequence if inflows are higher than projected. If inflows are lower than expected, FWOP ecological impacts would be higher than expected and more areas would be experiencing suboptimal salinities. |
| Changes in land loss rates are driven by the interaction of salinity and submergence, resulting in a reduction in plant productivity, leading to a decrease in plant growth, plant death, followed by peat collapse and wetland loss. Assumed linear relationship between change in salinity due to RSLR and change in FWOP land loss rate. | The salinity-vegetation productivity relationship is based upon algorithms developed for dominant wetland vegetation species in the study area. The algorithms were developed for the Louisiana Coastal Areas Ecosystem Restoration Study using data from a large number of professional studies. | If the relationship between salinity and land loss is different from that projected, FWOP land loss would be higher or lower than current estimates. |
| **FWP Condition (Preferred Alternative)** | | |
| RSLR – same as FWOP because deepening project causes only negligible increase in water surface elevation. | FWP water surface elevation change determined by ERDC HS modeling. | Little consequence if RSLR is lower than expected. No FWP effect on maintenance dredging, PA levee heights, or tidal surge penetration. At high rate, all areas suitable for marsh mitigation could be susceptible to submergence. DMMP BUs protected by containment structures. |
| Additional land loss would result primarily from the interaction of higher FWP salinities with FWOP RSLR. Assume direct linear relationship between salinity and land loss changes. | Associating land loss with salinity increases is based upon well-documented biological responses of inundated vegetation to salinity change. No data are currently available that relate specific salinity changes to specific land loss rate changes. | If the relationship between salinity and land loss is different from that projected, FWP impacts would be higher or lower than current estimates. |

Table 2.4-17, cont'd

| Assumption | Rationale for the Assumption | Consequences if Assumption Becomes Invalid |
|---|---|---|
| **Cost Estimates** | | |
| Cost estimate of the Preferred Alternative utilized appropriate probabilities of risk. | Cost risk analysis was performed using required forecasting and analysis tools. Cost contingencies developed by this analysis have been included in the total project cost estimate. | An increase in total project cost, exclusive of price level changes, of more than 20 percent of the total project cost stated in the authorizing legislation would require Congressional authorization. |
| It was assumed that up to 5 pipeline dredges would be available for use at one time for inshore channel dredging, and mitigation and BU marsh creation. Offshore dredging assumes use of only one hopper dredge at a time. | Assume offshore hopper dredge production averaging 7.9 mcy/yr; inshore pipeline dredge production of 7.2 mcy/year; and no more than 550 acres/year of mitigation or BU marsh creation by any one dredge. | If the assumed production rate is too high, or if the assumed number of dredges is not available, then construction would take longer and the total cost of construction would increase. |
| **Funding** | | |
| Sufficient funding streams would be available to construct the Preferred Alternative over the assumed construction periods and to provide long-term operation and maintenance. | USACE planning policy states that plans should be developed without funding constraints. Federal funding priorities are difficult to predict. | Total project cost could be higher because of longer construction schedule. Inadequate O&M funding could cause an increase in navigation costs or adversely affect monitoring of mitigation and BU features. |

## 2.5 EVALUATION OF ALTERNATIVES FOR THE MANAGEMENT OF DREDGED MATERIAL

### 2.5.1 Regional Sediment Management Objectives and Scope

The principles of RSM were applied in evaluating alternatives for the placement of dredged material from the proposed SNWW CIP. RSM is an approach for managing projects involving sand and other sediments derived from dredging and other activities in riverine, estuarine, and coastal systems (USACE, 2006b). Its major objective is the retention of sand or other sediments in natural aquatic systems, thereby supporting a more sustainable process and potentially reducing project costs (Martin, 2002). RSM incorporates many of the principles of watershed planning, but applies them in the context of dredging and other activities that influence sediment resources. It broadens the problem-solving perspective from a project-specific scale to a larger spatial and longer-term perspective. This requires the integration of a broad range of disciplines and collaborative partnerships among stakeholders. The USACE authorities and policies that support implementation of RSM are discussed in Technical Note No. 8 for the RSM Demonstration Program (USACE, 2003a).

The geographic focus of an RSM analysis is a sediment system, on a scale that is relevant to issues (e.g., dredged material management or processes like erosion or shoaling) that have been identified by stakeholders in the region. The RSM study area essentially coincides with the SNWW study area and contains riverine, estuarine, and coastal environments. It is large enough to facilitate understanding of sediment processes and behavior and the inherent interconnectedness of all parts of a sediment system. The RSM study area includes the existing 65-mile-long SNWW navigation channel that extends from

22 miles offshore in the Gulf, through a jettied entrance at Sabine Pass, up artificial canals on the west side of Sabine Lake, and finally up the Neches River Channel to the City of Beaumont. The SNWW area of analysis incorporates all of the existing and proposed navigation and placement features, and significant inflows and structures that affect the system. The littoral portion of the study area extends from Holly Beach, Louisiana, to Sea Rim State Park in Texas, roughly a distance of 40 miles. It extends into the Gulf along the existing Entrance Channel, proposed channel extension, and ODMDSs for a distance of roughly 40 miles; and it extends inland from the coastline approximately 40 miles to incorporate the tidally influenced reaches of the Sabine and Neches rivers watersheds and Sabine Lake.

The Texas Coastwide Erosion Response Plan has identified several parts of the study area as "critical erosion areas" because of impacts to habitats and traffic safety from ongoing erosion, and has called for an increase in the beneficial use of dredged material from the SNWW project to help address these issues. The plan was developed as part of the Texas Coastal Erosion Planning and Response Program (CEPRA) (GLO, 2004, 2005). The program has identified the Gulf shoreline between Texas Point and Sea Rim State Park as a critical erosion area. It attributes the erosion, in part, to a lack of sediment coming down the Sabine and Neches rivers, and the interruption of longshore sediment transport by the SNWW jetties. The CEPRA Plan recommends that long-term regional sediment management be utilized, along with highway realignment and beach dune restoration, to protect the important coastal evacuation route of SH 87 in Jefferson County. As described below, the Gulf Shore BU Feature will provide a long-term, RSM approach to restoring some sediment to the littoral zone in this area of high erosion. In Orange County, the CEPRA Plan calls for restoration of 9,400 acres of marsh in the Lower Neches River using dredged material to raise soil elevations in the former marsh areas that have become open water. These are the same marsh areas (i.e., Rose City, Bessie Heights, and Old River Cove) that have been combined into the Neches River BU Feature. The evaluation of these beneficial use features is described more fully later in this chapter.

## 2.5.2 Description of the SNWW Sediment System

### 2.5.2.1 Geomorphology

The modern coast of the northwest Gulf is the product of dramatic processes that occurred at the end of the Holocene sea level rise. The lowstand occurred approximately 20,000 to 18,000 years before present (B.P.) when the sea level was about 350 feet lower than today. Rapid sea level rise occurred until 7,000 to 6,000 years B.P., and then slowed to reach the modern stillstand about 3,000 years B.P. (Blum et al., 2002; Frazier, 1974; Nelson and Bray, 1970). The offshore shoal area of Sabine Bank is a relict shoreline that formed during this period. As the sea level rose, the Sabine and Neches rivers backfilled incised valleys that had developed during the lowstand. The Chenier Plain on both sides of Sabine Pass was created with sediment transported by the westernmost of the Mississippi River's major distributaries (Byrnes and McBride, 1995). The Mississippi River never flowed directly through this region, and thus much less erosion of the Pleistocene surface occurred (Penland and Ramsey, 1990). Rather than the hundreds of feet of silty sediment that overlays the Pleistocene surface in the Louisiana coastal plain to the east, the Pleistocene surface lies beneath about 49 feet of sediment in the Chenier Plain region. It is composed of a

series of parallel beach ridges that evolved as a series of prograding mudflats intermittently reworked into sandy or shelly ridges. Sabine Lake formed in the elongated drowned river valley of the Sabine River. The Sabine River and the Neches River empty into the northeast and northwest corners, respectively, of Sabine Lake.

The modern Gulf shoreline from Holly Beach to Sea Rim State Park is composed of mudflats, mud washover flats, clay marsh platforms, sandy washover flats, and some sandy beaches (Louisiana Department of Natural Resources [LDNR], 1997; PBS&J, 2006; USACE, 1971a). The low marshy areas on the east and west sides of Sabine Pass are known as Louisiana and Texas Points, respectively. Both shorelines within 10 miles of Sabine Pass are entirely undeveloped, and public access is limited. In Texas, a section of SH 87 has been abandoned since 1989 due to shoreline erosion. Most of the shoreline in the Texas portion of the study area is located within the Texas Point NWR. In Louisiana, SH 82 crosses Sabine Lake where the lake begins its constriction into Sabine Pass, and does not approach the coastline until it nears the small community of Johnson's Bayou. The property south of SH 82 is privately held, with the exception of the SNWW PA 5 on Sabine Pass. Recreation and wildlife preservation have been the major uses of the area; however, recently the new Sabine Pass LNG facility has been constructed on the waterway northwest of PA 5.

The only major inlet in the sediment system is Sabine Pass, the jettied entrance for the SNWW. These navigation structures extend seaward, blocking longshore sediment transport and carrying sediment out of the littoral zone. The Sabine Pass Jetties were built between 1883 and 1885 with east and west completion lengths of 25,000 feet (4.7 miles) and 22,000 feet (4.2 miles), respectively (Alperin, 1977). Longshore transport of sediments from the east is also affected by navigation jetties at Calcasieu Pass (USACE, 2004a). Construction on the east jetty at Calcasieu Pass began in 1893 and the west jetty in 1986 (USACE, 1961). Over the next 45 years, east and west Calcasieu jetties reached 10,500 feet (2 miles) and 8,200 feet (1.6 miles), respectively.

Offshore of Sabine Pass, the bottom slope averages 6 feet per mile until roughly 1 mile offshore, after which it steadily decreases to an average 1 foot per mile through roughly 10 miles offshore (White et al., 1987). Thus, for most of its extent the shelf is gently sloping and (with the exception of Sabine Bank) is relatively featureless. The Sabine Bank is the principal topographic feature with approximately 25 feet of relief. Sandy muds and clay muds predominate the surface inner shelf region; however, the surface of virtually the entire area is covered by a sheet of sand approximately 2 feet thick (Anderson and Wellner, 2002; PBS&J, 2004b). An extensive outcrop of Beaumont clay is located nearshore and within 2 feet of the sediment surface, beginning near Sea Rim State Park and extending westward (Nelson and Bray, 1970). The Beaumont clay is derived from coastal and deltaic plain silts and clays that were deposited on the continental shelf during the previous lowstand. The clay outcrops from a complex, eroding scarp face with relief of approximately 2 feet (Pacific International Engineering [PIE], 2003).

Sabine Bank is the only area that contains significant quantities of beach-quality sand (Morton et al., 1995). It is an elongated feature, located approximately 17 miles south of the mouth of Sabine Pass and oriented roughly parallel to the coast (Blum et al., 2002). The main body of the bank (Sabine West Bank)

is 20.5 miles long, and water depths over the bank range average 39 feet below mean low water. The existing SNWW Entrance Channel passes approximately 0.75 mile to the east of its eastern edge. A smaller body of Sabine Bank (Sabine Bank East), approximately 10.5 miles long, is located east-northeast of the SNWW channel. Existing ODMDSs 1 and 2 are located north and south of the eastern end of the Sabine West Bank, sufficiently distant that materials placed there do not flow onto them. All of the four existing and four proposed ODMDSs are evenly spaced on the west side of the existing and proposed extension channel. They were located on the west side of the channel so they will be downstream of the most prevalent circulation currents in the northwest Gulf.

#### 2.5.2.2 Wind, Tides, and Circulation

The hydrodynamic regime in the northwestern Gulf results from a complex interaction of tides, meteorological driving forces, freshwater inflows, and Coriolis acceleration. Both local conditions and the overall Gulf circulation pattern affect the area. In addition, major storms profoundly influence waves, tides, currents, and sediment movement.

The combination of a broad continental shelf and low waves in the Gulf allows local winds to play a more dominant role in shoreline dynamics in this area than on most other beaches around the U.S. (King, 2007). Local winds can directly modify longshore currents within the surf zone and in the nearshore environment. The average wind direction from a buoy off Sea Rim State Park is from the south-southeast (PIE, 2003). However, wind direction is more southerly in summer months and more southeasterly at other times of the year. Average speeds are fairly constant at 9 to 13 miles per hour throughout the year, reaching maximum in April and May.

Astronomical tides are generally small in the Gulf. They vary from diurnal to semidiurnal as a function of the moon's declination, with an average amplitude of approximately 1 foot (King, 2007). During average conditions, waves in the nearshore are depth-limited and controlled by water levels, the mild nearshore slope, and the possible presence of a soft mud bottom (PIE, 2003). The coast of the Chenier Plain between Sabine Pass and Calcasieu Pass is also microtidal, with tides ranging from 2.0 to 2.4 feet. Waves come from the south about 16 percent of the time and from the south-southeast 28 percent of the time (Byrnes and McBride, 1995).

A major feature that dominates circulation in the eastern Gulf is the Loop Current, a continuation of the Yucatan Current which enters the Gulf through the Yucatan straits. There are two important semipermanent currents that diverge from the Loop Current; the one in the northwestern Gulf circulates counterclockwise (Rouse et al., 2004). Inner-shelf currents in the Gulf off the Louisiana and upper Texas coast flow westward and move downcoast during the late fall, winter, and early spring. This flow is highly responsive to wind forcing and may briefly reverse direction and flow upcoast. This reversal typically occurs during late spring, so that for a month or more the mean current in this area may be eastward. During the summer, when winds are weaker, the coastal waters are highly stratified, and surface flows may not flow in the same direction as near-bottom currents.

Bottom currents have a strong effect on sediment movement on the shelf. A study of water velocities needed to cause rapid erosion on sediments similar to those in the study area found a critical erosion velocity of 0.47 knot, with little variation among sand, silt, or clay (Moherek, 1978). The bottom ocean currents near Sabine Pass should have sustained bottom velocities of at least twice the critical erosion velocity for several days each year. Within approximately 40 miles of the Gulf Coast in this area, bottom current will reach a maximum velocity of about 3.9 knots every 3 years and sustain velocities of 1 knot or greater for several days once a year (EPA, 1982). Pre- and postdredging surveys of the existing ODMDSs off Sabine Pass provide corroborating evidence of this sediment movement. Maintenance material from recurrent dredging placement episodes disperses after each placement and does not accumulate.

#### 2.5.2.3 Coastal Shoreline Erosion Impacts

The changes in sediment transport, while very small, can be expected to have some effect on the rates of shoreline erosion. Under the Preferred Alternative, there is a slight reduction in the erosion rate near the jetties. Near the jetties, the average rate of shoreline accretion was calculated to be as much as 60 feet/year. However, between 0.5 mile and 3 to 4 miles on either side of the jetties, the erosion would be increased by less than 0.5 foot/year for a 50-foot project and farther from the jetties than that, the shoreline change would decrease to zero. The effect of the 48-foot channel on the Gulf shoreline between 0.5 mile and 3.5 miles from each jetty was estimated to be 0.42 foot/year based upon the 45- and 50-foot project effects.

The Gulf Shore BU Feature should have a positive effect on reducing shoreline erosion. The presence of additional fine-grained sediments in the littoral system, which would be provided by the BU feature, should reduce the current erosion rate and minimize the small increase in shore erosion predicted with the project. In systems that have an abundant supply of fine-grained sediments, the presence of additional muddy sediment in the nearshore environment may attenuate waves and lessen wave-induced erosion (Hsiao and Shemdin, 1980; Tubman and Suhayda, 1976; Wells and Kemp, 1986). Furthermore, the predominantly fine-grained sediment provided by this BU feature should contribute to mudflat accretion by periodically moving onshore and becoming shore-attached. On the western Louisiana and eastern Texas coasts, sediments accumulate as mudflats and underwater mudshoals (or “fluid mud”) in the nearshore region. Nearshore, fluid mud can be trapped against the shoreline by prevailing south and southwesterly winds, and storms carry the trapped muddy ooze onto the chenier shoreline (Morgan et al., 1958; Wells and Kemp, 1982, 1986). Accretion of the shoreline can then occur by poorly understood processes (Huh et al., 1991; King, 2007; PIE, 2003).

Although the BU sediments would be largely fine grained, approximately 18 percent of maintenance material is expected to be sand. Sands that are deposited onshore would nourish and stabilize eroding marshes and sand deposited in the nearshore zone should stay in the nearshore environment, moving back and forth across the shoreface (Wamsley, 2008). Sand placed at Louisiana Point should remain on the shoreface where it was deposited; no significant amounts of sand are expected to enter the Jetty Channel. On erosive mud shorelines like those in the BU area, the sand percentage should increase, and it would form sandy lenses or a veneer over the mud shoreline substrate. As the sand lenses thicken, the sands help

protect the underlying mud from further erosion (Nairn, 1992). However, in smaller quantities, sand can also accelerate erosion of a mud beach. If the consolidated mud is not covered by a sand veneer, any sand that is mobilized by wave action would act as a scouring agent (King, 2007).

#### 2.5.2.4 Inland Shoreline Erosion Impacts

The primary area of concern for inland shoreline impacts is Pleasure Island along the confined channels of the Port Arthur and Sabine-Neches canals (Parchure et al., 2005). No increase in the existing erosion rate is predicted with the project for the eastern shore of Sabine Lake. The primary mechanism for shoreline erosion associated with the project is from passage of large vessels. Maynord (2005) investigated the mechanisms of ship-induced bank recession (shoreline erosion). The analysis employed a numerical model (HIVEL2D) to simulate the ship-induced velocity at the bank and employed information on the vessels in the existing and future fleets and information on the speeds that would be needed in both the No-Action and Preferred alternatives. The analysis focused on two sites on Pleasure Island; the north site is in the Sabine-Neches Canal, and the south site is in the Port Arthur Canal. The north site has no existing erosion protection, while the south site has riprap protection. Neither site will have a change in channel width. The analysis was calibrated to the existing rates of bank recession, and it used the model to account for differing numbers of vessel trips projected for the years 2030 and 2060 for both the No-Action and 50-foot alternatives. The Preferred Alternative is expected to have a lesser effect than the 50-foot alternative.

Maynord (2005) found that the rates of erosion are lower for the 50-foot alternative than for the No-Action Alternative at both the north and south sites for both 2030 and 2060 traffic levels. Overall, the effect of the Preferred Alternative should be to reduce the rate of erosion on inland channels relative to the No-Action Alternative because of fewer vessel trips that are predicted with the Preferred Alternative than in the No-Action Alternative.

#### 2.5.2.5 Longshore Transport

In general, the longshore movement of littoral sediments in the study area is from the east to the west (King, 2007; Morang, 2006; USACE, 2004a). In the recent past, the estimated net longshore sediment transport to the west ranged from 47,000 to 97,000 cy/year east of Sabine Pass (USACE, 1971a). West of Sabine Pass, the typical yearly net longshore sediment transport is to the southwest (Carothers and Innis, 1960; Mathewson, 1987; USACE, 1971b), with an occasional reversal of direction at Sea Rim State Beach (King, 2007; Mason, 1981). At Sea Rim State Park, the typical net transport to the southwest was about 70,600 cy/year; for the atypical reversal to the northeast, the net transport rate was 35,000 cy/year (Mason, 1981). Another study of coastal geomorphology and shoreline erosion in Jefferson County was conducted by PIE (2003) in conjunction with ongoing studies of erosion impacts to SH 87. PIE calculated longshore sediment transport using both Galveston Buoy and Wave Information Study data. In general, the gross sediment transport rate was found to be higher toward Galveston Island. Transport divergence was indicated near Sea Rim State Park, in the vicinity of two areas of high erosion along Texas Point.

Longshore transport and wave modeling have been performed, and a sediment budget has been prepared for the study area in conjunction with a shoreline erosion study of the Texas coast from Sabine Pass through Galveston Island (King, 2007; Morang, 2006). These studies have confirmed that the littoral system in the study area is dominated by fine-grained sediments. The shorelines along Texas and Louisiana Points are primarily composed of consolidated mud (King, 2007; USACE, 2004a). Farther to the west, the consolidated mud substrate is overlain by sand veneers and is only occasionally exposed. Aside from the prevalence of fine-grained sediments along Texas Point, there was no real trend in median grain sizes in the study area. In Louisiana, the shoreline is similar to those found in Texas for about 2 miles east of the jetty and then it transitions to a sandy beach that reaches toward Ocean View Beach. Sediment transport and deposition are distinctly different on mud shorelines than on sandy beaches (King, 2007). Once eroded, cohesive sediments (clays and silts) are generally carried in suspension until deposited in a less-energetic environment (e.g., deeper water outside the surf zone or in wave-sheltered areas such as quiet bays and estuaries), and so are lost to the littoral system.

On sand beaches, the mobilized sand generally stays within the active profile. This is the primary reason that most of the world's beaches are composed of sediments having diameters greater than 0.10 mm. The depth of closure, or the sedimentologically active zone, has recently been determined to be approximately 19.7 feet deep off the upper Texas coast (King, 2007). Sand deposited any deeper than this point is unable to move any closer to shore. On the Texas side of Sabine Pass, this is roughly 3 to 4 miles from shore; off Louisiana Point, this point is roughly 2 to 3 miles from shore.

In regions like the study area that have large supplies of fine-grained sediments, the nearshore seabed can be blanketed with thick, unconsolidated, gel-like, mud oozes called "fluid mud." There are numerous anecdotal reports of the presence of floating rafts of "fluid mud" on the Gulf's surface west of the Atchafalaya River mouth in Louisiana, and off Texas Point and Sea Rim State Park (Block, 1984; PIE, 2003). Nearshore, the fluid mud can be trapped against the shoreline by prevailing south and southwesterly winds, and storms carry the trapped muddy ooze onto the chenier shoreline (Morgan et al., 1958; Wells and Kemp, 1982, 1986). Accretion of the shoreline can then occur by poorly understood processes (Huh et al., 1991; King, 2007).

#### 2.5.2.6 Shoreline Descriptions

Jefferson County and Cameron Parish coastlines in the study area are mainland beaches fronting a chenier plain that formed from a Pleistocene promontory overlain by Holocene marginal deltaic sediments (King, 2007; USACE, 2004a). The upland area adjacent to the coast is a relatively flat, gently sloping terrain with marsh elevations of 1 to 2 feet mean sea level and ridge elevations of 5 to 6 feet mean sea level. Saline marsh vegetation covers the upland area behind the eroding shoreface. In the Texas Point NWR, a fillet of muddy substrate that was created by rapid deposition over approximately the last 100 years lies seaward of the chenier ridges. For the period between 1883 and 1970, the net accretion was documented at 2,225 feet (Morton, 1975). The fillet of recent deposits recedes rapidly and disappears approximately 0.5 mile from the West Jetty, where the Chenier Plain again fronts the Gulf until it ends about 18 miles from Sabine Pass (PIE, 2003).

The shoreline in the Texas Point NWR (between Sabine Pass and Sea Rim State Park) is a muddy shoreface composed of consolidated mud (King, 2007; PIE, 2003). A thin veneer of sand thrown up onto the marsh edge by storms covers some areas of the mud substrate. Farther west, the Sea Rim State Park area is a sediment transport convergence zone, and the beach typically has a substantial veneer of sand. In Louisiana, the coastline for approximately 10 miles east of the jetty contains tidal sand/mudflats, sand bars and sandy beaches with tidal flats (PBS&J, 2006). A narrow tidal sand/mud flat, ranging from 30 to 450 feet in width, extends for about 1.5 miles east of the jetty, and then transitions to a sandy beach. These beaches vary in width from 50 to 300 feet and end at an eroded, low mud bank shoreline. A sand bar is present in the nearshore zone that is the result of the beneficial placement of dredged material by Cheniere Energy in conjunction with construction of the Sabine Pass LNG facility. The 10-to-150-foot-wide bar begins about 0.5 mile from the jetty and extends for about 1 mile to the east. It lies roughly parallel to the shore, between 4,000 and 1,200 feet offshore.

#### 2.5.2.7 Historical Shoreline Change in the Study Area

The northwest Gulf Coast system is sand starved, and essentially no modern-day sand is being delivered to these beaches (Lee, 2003; Morang, 2006; Morton, 1977). The only coarse-grained sand reaching the Texas shores appears to originate from the erosion of underlying Pleistocene barrier-strand plain deposits, which contain lenses of fine-grained and poorly sorted sands in massive clay and silt deposits (Isphording et al., 1989). The lack of delivery of coarse-grained sand during the modern stillstand has contributed significantly to shoreline erosion in the area. The very limited coarse-grained load of the Sabine and Neches rivers is deposited in bay-head deltas in Sabine Lake rather than on the coast (Mason, 1981; Morang, 2006; USACE, 1971b). Therefore, the limited sand in the northwest Gulf coastal system either migrated up the shoreface with the Holocene sea rise or was eroded from relict Pleistocene deposits.

Chronic erosion is believed to be associated with the diversion of sand and other sediment resulting from channelization and regulation of the Mississippi and Atchafalaya rivers to the east, and the Sabine and Neches rivers in Texas. The Calcasieu and Mermentau rivers also do not supply coarse-grained sediments, and the Cameron jetties deflect the little material that does exist away from the Holly Beach area, so that it accumulates to the west at Long Beach, Louisiana's westernmost sandy beach (LDNR, 1997; USACE, 2004a). The Sabine Pass jetties also intercept sediment moving westward in the littoral drift, creating a wide, muddy, tidal flat next to the east jetty (PBS&J, 2006; USACE, 2004a). On the Texas side, a 0.5-mile-wide fillet of silt and mud, located immediately adjacent to the west jetty, intercepts sediments moving from the west during periodic reversals near Sea Rim State Park in the dominant longshore movement (PIE, 2003).

Shoreline change has been extensive in this region and continues to be an ongoing problem. In the area between Ocean View Beach and the Sabine jetties, the shoreline prograded seaward at an average rate of +12.9 feet/year between 1883 and 1994. Recently, however, accretion has slowed to +1.2 feet/year, and the behavior of this shoreline has become erratic, with change rates varying between –13.2 and +14.7 feet/year (USACE, 2004a). East of Ocean View Beach, the 10-mile-long coastline to Holly Beach fronts a series of chenier and beach ridges that provided a foundation for roadways and commercial

development before it was essentially destroyed by Hurricane Rita in 2001. Persistent erosion in this area, on the order of –4.3 feet/year between 1985 and 1998, was recorded here prior to the hurricane (USACE, 2004a). Hurricane Rita's storm surge at Louisiana Point was 10.6 feet as recorded by U.S. Geological Survey (USGS) sensors (Farris et al., 2007). The surge deposited 3.3 feet of new sediment on the Hackberry Beach chenier ridge and inundated thousands of acres of coastal marsh. Bar welding to the lower shoreface was also evident (Guidroz et al., 2006). Immediately after the storm, hundreds of acres of marshay cordgrass marsh in Cameron Parish appeared to have been severely impacted by extensive flooding of high-salinity waters. When the water finally subsided, the vegetation in many areas appeared dead, and the marsh had areas that were 30 to 50 percent devegetated. Over time, porewater salinity levels should decline as rainwater flushes salinity from the system (Farris et al., 2007). On the Texas side of Sabine Pass, a 0.5-mile stretch of shoreline adjacent to the west jetty is aggrading at a rapid rate, but beyond this narrow zone to the west, is an active erosion zone extending approximately 15 miles to the vicinity of Sea Rim State Park (Morang, 2006). This eroding stretch of the Jefferson County coastline is experiencing the largest erosion rate on the upper Texas coast, up to 40 to 50 feet/year (King, 2007). It has been identified as a "critical erosion area" by the Texas Coastwide Erosion Response Plan because of threats to traffic safety and wildlife habitat. Shoreline erosion has destroyed a portion of SH 87, an important hurricane evacuation route, and is eroding coastal wetland habitat at Texas Point and McFaddin NWRs (GLO, 2004, 2005).

#### 2.5.2.8 Sabine Pass Sediment Budget

New littoral transport rates have recently been calculated for the Sabine Pass littoral zone. The Sabine Pass sediment budget (Morang, 2006) applied shoreline change statistics that were computed from changes in sediment volume for littoral cells, using cross-shore profiles that were projected with an ERDC modeling study (King, 2007). The sediment budget focused on characterizing sediment movement in the coastal segments of the navigation channel and nearby Texas shoreline. Accurate estimates of the percentage of total transport that is suspended sediment load from the inshore area were not available. Six of the 23 cells defined for this study are relevant to this discussion—three cells (the Sabine Pass Channel, the Sabine Jetty Channel, the Sabine Outer Bar Channel) were used to analyze sediment movement in the navigation channels through Sabine Pass and past the jetties; three other cells (the Sabine Fillet, Texas Point NWR, and Sea Rim State Beach) were used to calculate sediment movement along the littoral zone westward of Sabine Pass. A summary of the sediment budget results is presented in Table 2.5-1.

#### 2.5.2.9 Existing Project Shoaling and Sediment Transport Conditions

The following summary of shoaling and sediment transport conditions for the existing SNWW includes all segments of the existing SNWW navigation system. The analysis of channel sections covered by the sediment budget (see Table 2.5-1) is derived primarily from Morang (2006); dredging cycle lengths, velocity data, average percentages of sediment sizes, and dredging quantities for channel reaches not covered by the sediment budget were obtained from the SNWW Sediment Study (Parchure et al., 2005); other supporting analyses are identified as the data are presented. The discussion begins with the upstream end of the SNWW (the Neches River Channel) and moves downstream through the confined Sabine-

Neches and Port Arthur canals, the Sabine Pass Channel, and then offshore into the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, and the Sabine Bank Channel. Finally, the interaction of the channel and adjacent shoreline sections is described.

Table 2.5-1
Sediment Budget for Sabine Pass (adapted from Morang, 2006)*

| Cell | Sources and Quantity (1,000 cy per year) | Sinks and Quantity (1,000 cy per year) | PA/ODMDS and Quantity (1,000 cy per year) |
|---|---|---|---|
| Sabine Pass Channel | 866.7 (approximately 20% sand) from Port Arthur Canal and Sabine Lake | 274.2 mud and sand into Jetty Channel | 592.5 into PA 5 |
| Sabine Pass Jetty Channel | 274.2 (mud and minor sand) from Sabine Pass Channel | Unknown quantity of fine-grained material carried in suspension offshore | 289.1 to ODMDS 4 (dispersed by shelf circulation, storm and tidal currents) |
| | 14.9 (mud) offshore | | |
| Sabine Outer Bar Channel | Unknown amount from Sabine Jetty Channel (possible mud input) | | 1722.6 to ODMDS 3 (dispersed by shelf circulation, storm and tidal currents) |
| | 1,722.6 from undetermined source (littoral sediments and/or ODMDS) | | |
| Sabine Fillet | 25.1 longshore transport from Texas Point NWR (west) | 14.9 longshore transport (mud & minor sand) to Jetty Channel | |
| | | 10.2 shoreline growth at Sabine mud fillet | |
| Texas Point NWR | 434.2 from beach erosion (+90% mud) | 152.0 overwash losses | |
| | | 173.7 mud lost offshore | |
| | | 25.1 longshore transport of mud to east | |
| | | 83.5 longshore transport to west (sand & shell) | |
| Sea Rim State Beach | 83.5 longshore transport from Texas Point NWR (east) | 117.7 beach growth at Sea Rim State Beach | |
| | 34.3 longshore transport from McFadden NWR (west) | | |

*Sediment Budget quantities are based on 25 years of data from Galveston District's Dredging Database. SNWW CIP without-project shoaling quantities are based on data from 1967 to 2001. A cross check and conversion verified that the quantities are similar.

#### *2.5.2.9.1 Neches River Channel*

Dredging cycles on the Neches River Channel vary from 3 to 4 years along the eastern half of the channel near Sabine Lake to 6 years along the western segment near Beaumont. Approximately 3.1 mcy/cycle are dredged from eastern channel sections 11, 12, 13, 14, and 15 and placed into PAs 12, 13, 14, 16, 18, 21, 23, and 23A. Approximately 3.3 mcy/cycle are dredged from western channel sections 16, 17, and 18 and placed in PAs 24, 25, 25A, 26, 27A, 27C, and 27D near Beaumont. Peak ebb and flood velocities are low (0.8 foot/second and 0.3 foot/second, respectively). Bed sediments average 62 percent silt and clay and 38 percent sand.

#### *2.5.2.9.2 Sabine-Neches and Port Arthur Canals*

These canals traverse the confined channel segment between the City of Port Arthur and Pleasure Island. Sabine-Neches Canal sections 9 and 10 are dredged every 4 years. Approximately 3.7 mcy/cycle are placed in PAs 8 and 11. Bed sediments average 78 percent silt and clay and 22 percent sand. Port Arthur Canal Section 7 is dredged every 3 years and approximately 1.8 mcy/cycle are placed in PA 8. Section 8 and the Taylor Bayou Channels and Basins are dredged every 2 years; approximately 2.3 mcy/cycle are placed in PAs 8, 9, and 9A. Peak ebb and flood velocities are 2.6 and 2.2 feet/second, respectively. Bed sediments average 84 percent silt and clay and 16 percent sand. The junction of the Port Arthur Canal, Taylor Bayou Channel, and the Sabine Pass Channel is an existing dredging hot spot, often requiring dredging more frequently than the 2-year cycle. This is due, at least in part, to a rapid decrease in velocity as the flows move into the much wider junction. In addition, existing erosion along the channel side of Pleasure Island may be returning sediment to the system (Parchure et al., 2005).

#### *2.5.2.9.3 The Sabine Pass Channel*

Channel sections 5 and 6 are dredged every 3 years and approximately 1.9 mcy/cycle are placed in PA 5. Bed sediments average 70 percent silt and clay and 30 percent sand. There are no obvious sand sources because the banks of the channel are low mudflats. Little sand reaches the open coast from the Sabine and Neches rivers because Sabine Lake is an efficient sediment trap and most of its coarse material is deposited in the lake or trapped in the lower alluvial reaches of the rivers. Since the dredged material is removed from the system, some mechanism must be replenishing the sand. It may be delivered to this channel by unusually high runoff from Sabine Lake or the Port Arthur Canal. Although ebb and flood velocities are roughly equal through this section, lower velocities are present where Sabine Lake discharges into the channel; shoaling rates are higher than average around this discharge point. Peak ebb and flood velocities in the remainder of the channel are 4.0 and 3.2 feet/second, respectively. Negligible amounts of material come from the littoral system, entering the channel and moving upstream. Conversely, plumes of fine-grained material can be seen moving through the pass into the Gulf in satellite images. This material disperses over the continental shelf and does not contribute to the littoral budget.

#### *2.5.2.9.4 The Sabine Pass Jetty Channel*

Section 4 is self-scouring and needs far less frequent maintenance dredging than the other coastal reaches. Ebb velocities are high, peaking at about 3.5 feet/second, and flood velocity reaches 3.0 feet/second. Despite this jetting action, on the average about 1.1 mcy/cycle of dredged material are placed in ODMDS 4 in a 5-year dredging cycle. Sediment delivered by the Sabine Pass Channel is predominantly silt and some sand, and about 5 percent of the total transport comes from the littoral system. A small boat cut in the east jetty may allow material carried by the longshore current moving west from Louisiana to enter the channel (PBS&J, 2004b). Bed samples average 89 percent clay and silt and 11 percent sand. Before- and after-dredging bathymetry surveys have demonstrated that the material placed offshore in the ODMDS does not accumulate; it disperses quickly after placement in the offshore environment.

#### *2.5.2.9.5 The Sabine Pass Outer Bar Channel*

Section 3 is the first 3.4 miles of navigation channel outside of the jetties. Ebb velocities fall rapidly as the channel discharges over the Outer Bar. Peak ebb velocities fall from about 3.5 feet/second within the jetties to 2.7 feet/second just beyond the jetties, to 1.3 feet/second near the intersection with the Sabine Bank Channel. Peak flood velocities of 3.0 feet/second within the jetties fall to 2.4 feet/second just beyond the jetties, and to 0.4 foot/second at the end of the channel reach. It appears that little material moves from the Sabine Pass Jetty Channel into the Sabine Outer Bar channel, based upon the balance of material entering versus what is removed by dredging. Yet, the shoaling rate in this section is very high. Approximately 1.9 mcy/cycle are removed yearly and placed in ODMDS 4. Bed samples average 96 percent silt and clay and 4 percent sand. The source of the sediment is undetermined. Existing and proposed ODMDSs are located west of the channel because the mean current flow in this area is westward most of the year. However, this flow reverses and moves eastward for a month or longer during the late spring (Rouse et al., 2004). During periods of reversal, sediment may drift back into the channel from ODMDS 4. However, typical flow patterns move ebb flows to the south/south-southwest just beyond the jetties, and flood flows generally come from the east (Parchure et al., 2005). Furthermore, anecdotal accounts from the Sabine Pilots Association report a strong east to west current crossing just outside the jetties in the vicinity of ODMDS 4 (Webb, 2003).

#### *2.5.2.9.6 The Sabine Bank Channel*

Sections 1 and 2 (totaling 6.6 miles long) extend the navigation channel into the open Gulf. They are dredged every 4 years, and approximately 4.2 mcy/cycle are placed in ODMDSs 1 and 2. Bed sediments average 76 percent silt and clay and 24 percent sand. Ebb and flood velocities are nearly equal (ranging between 0.25 and 0.70 foot/second), but the velocity pattern is erratic. Rapid shoaling is not a problem in this reach, and no other management concerns are known.

#### *2.5.2.9.7 Adjacent Gulf Shorelines*

At Louisiana Point, the littoral current has supplied sufficient sediment in the recent past to cause shoreline progradation between Ocean View Beach and the Sabine jetties (USACE, 2004a), and create a

wide tidal mudflat against the jetty (PBS&J, 2006). Some fine-grained sediment from this westward littoral current may be entering the Sabine Pass Jetty Channel through a small boat cut in the east jetty (PBS&J, 2004b).

All but the easternmost wedge of Texas Point (the Sabine Fillet) is undergoing severe beach erosion, with shoreline retreat of up to 1,150 feet between 1974 and 2000. Shoreface sediment losses are approximately 434,200 cy/year (see Table 2.5-1). Longshore transport to the west carries 20 percent to Sea Rim State Beach (PIE, 2003), 35 percent is lost to overwash, and 40 percent is carried offshore. Approximately 6 percent moves eastward, carried by periodic reversals in the dominant longshore current (King, 2007; PIE, 2003). The west jetty intercepts about 40 percent of the total eastward transport, creating a ½-mile-wide fillet of silt and mud against the jetty; the remainder is carried into the Sabine Pass Jetty Channel.

In contrast to Texas Point, Sea Rim State Beach is located in a convergence zone and receives 117,700 cy/year (see Table 2.5-1) of littoral material from both the east and west. About 70 percent is carried by longshore transport from the east at Texas Point, and 30 percent comes from McFaddin NWR to the west. The accreting beach is composed of sand (0.10 to 0.14 mm in size) and shell fragments, underlain by mud.

### 2.5.3 Analysis of Sediment-related Problems and Opportunities

This section describes RSM problems and opportunities that were identified by the SNWW study and presents the results of a preliminary screening that was designed to identify potential beneficial uses for the dredged material that would be generated with the Preferred Alternative.

The principles of RSM were applied to ensure that the dredged material arising from the SNWW CIP would be viewed as a valuable resource, integral to economic viability and environmental sustainability of the region. In developing the DMMP for the project, this study searched for opportunities to achieve savings by defining sediment-related problems, coordinating projects, and identifying opportunities for beneficial use (Martin, 2002). The large quantities of dredged material that would be generated by the Preferred Alternative created an ideal opportunity for the exploration of the beneficial use of dredged material. A series of public workshops and extensive ICT consultation evaluated a wide array of opportunities to use dredged material beneficially (GEC, 2002; Turner Collie & Braden, 2003).

A variety of private stakeholders, State and Federal resource agencies, and USACE engineering and scientific experts identified the following existing and FWOP sediment-related problems in the region:

- Lack of sand in the littoral system
- Interruption to the littoral system caused by SNWW jetties
- Extensive shoreline erosion at Texas Point
- Erratic accretion and erosion at Louisiana Point
- Rapid shoaling in the Sabine Pass Outer Bar Channel
- Rapid shoaling in the Port Arthur Junction

- Erosion of west side of Pleasure Island
- Erosion of Sabine Lake eastern shore
- Lack of sediment recharge to, and continuing loss of, sediment from emergent marshes

The following FWP impacts that could potentially be addressed with the beneficial use of dredged material or other project elements were also identified:

- Project impacts associated with the creation of new ODMDSs for the Extension Channel
- Project impacts associated with the creation of new upland PAs to accommodate new work material and increased quantities of maintenance material over the period of analysis
- Project impacts associated with a small increase in Gulf Coast shore erosion within 3.5 miles of each jetty
- Project impacts to cypress-tupelo swamps and intertidal marshes from reductions in biological productivity due to project-induced salinity increases and marsh loss
- Additional advance maintenance due to a higher than average increase in shoaling in the Sabine Pass Outer Bar Channel, one section of the Sabine Pass Channel, the Port Arthur Junction, and portions of the Neches River Channel

#### 2.5.3.1 Preliminary Screening – Features Eliminated From Consideration

Opportunities to use dredged material beneficially to address these sediment-related concerns were suggested by public workshop participants and the ICT and/or developed by the USACE technical studies. These suggestions resulted in the evaluation of a wide array of BU features, which could reduce or avoid salinity impacts, restore or replace degraded wetlands, create new terrestrial or marine habitat, and return sediment to the littoral zone. Table 2.5-2 lists all features that were considered and eliminated during preliminary screening and the reason for dropping them from further consideration. The incremental cost estimates presented in the table were developed during preliminary screening; they are based upon 2005 cost levels and use $2.05/gallon for marine diesel. Incremental costs are the additional costs that would be needed to use the material beneficially, over and above the normal costs of dredging and placement in designated PAs or ODMDSs. It is likely that the actual costs would be much higher than estimated here.

The feasibility of using new work and/or maintenance material was considered for all features. In the analysis for the inshore reaches, PA containment levee construction was the first priority for the use of new work material, followed by beneficial use opportunities. In the offshore reaches, opportunities for beneficial use of new work material were evaluated and eliminated before material was committed to existing and proposed ODMDSs. For maintenance material in both inshore and offshore reaches, priority was given to beneficial use if it could be demonstrated to be the least-cost alternative.

Table 2.5-2
Dredged Material Beneficial Use Features Eliminated from Consideration

| Feature Description | Reason for Elimination |
|---|---|
| **Hydrologic Restoration** | |
| Marsh islands isolating Sabine-Neches Canal from Sabine Lake | Increased salinities in Black Bayou and up the Sabine River |
| Marshes constricting flow at mouth of Sabine Lake (north and south of SH 82 swing bridge) | Ineffective at reducing salinities<br>Increases velocities through mouth of Sabine Lake |
| Marshes constricting flow along the side of the Port Arthur Canal | Ineffective at reducing salinities<br>High cost relative to amount of marsh acres created |
| Construction of channel islands blocking flow from bayous emptying Neches River marshes at Rose City and Bessie Heights | Potential to cause backwater flooding<br>Obstructed channel access for private landowners<br>Navigation safety concerns |
| Filling canal at Texas Bayou using new work material from Sabine Pass Channel | Ineffective at reducing salinities because access still provided by Texas Bayou |
| **Emergent Marsh Restoration** | |
| Marsh restoration using new work material from Neches River Channel to restore marsh in Rose City West | Area is being developed as a mitigation bank; no longer available for restoration |
| Marsh restoration using new work material from Neches River Channel to restore marsh in Bessie Heights West | Would be feasible but cost exceeds Traditional Placement Plan<br>Preliminary estimate of incremental cost – $581K<br>Sponsor has not been identified |
| Marsh restoration using new work material along the east shore of PAs 8 and 11 at Pleasure Island | Unacceptable location; interferes with levee maintenance |
| Marsh restoration at Old River Cove, east of power plant inflow channel, using new work material from the Neches River Channel | Would be feasible but cost exceeds Traditional Placement Plan<br>Preliminary estimate of incremental cost – $472K<br>Sponsor has not been identified |
| Marsh restoration north of Keith Lake using maintenance material from Port Arthur Canal | Would be feasible but cost exceeds Base Plan<br>Preliminary estimate of incremental cost – $300K<br>Sponsor has not been identified |
| Marsh restoration in Texas Point NWR using new work material from Sabine Pass Channel to restore marsh behind subsided jetty section. | Would be feasible but cost exceeds Traditional Placement Plan<br>Preliminary estimate of incremental cost – $445K<br>Sponsor has not been identified |
| **Wildlife Habitat Creation** | |
| Bird island constructed in Sabine Lake using new work material from Sabine-Neches Canal | Would be feasible but cost exceeds Traditional Placement Plan<br>Preliminary estimate of incremental cost – $1.9 million<br>Sponsor has not been identified |
| **Returning Sediment to Littoral Zone** | |
| Texas or Louisiana Point shore nourishment using new work material from Section 5 of the Sabine Pass Channel | Would be feasible but cost exceeds Traditional Placement Plan<br>Preliminary estimate of incremental cost – $6.6 million<br>Sponsor has not been identified |
| Texas or Louisiana Point shore nourishment using new work material from sections 5 and 6 of the Sabine Pass Channel | Would be feasible but cost exceeds Traditional Placement Plan<br>Preliminary estimate of incremental cost – $19.5 million<br>Sponsor has not been identified |
| Stockpiling new work material from Extension channel for future beneficial use | Not feasible because material would disperse rapidly and not be available for use at a later date |
| Transporting sediment from new work dredging of the Extension Channel to the Texas or Louisiana littoral zone | Would be feasible but cost exceeds Traditional Placement Plan<br>Preliminary estimate of incremental cost – $86.3 million<br>Sponsor has not been identified |
| **Marine Habitat Restoration** | |
| Construction of topographic high in littoral zone with new work material | Topographic elevation would be temporary<br>Incremental costs ($268 million) make it economically infeasible |

Given the large amount of dredged material that would be generated with the proposed project, considerable effort was expended to identify areas that could benefit from its beneficial use. All degraded marsh areas near the SNWW were investigated to determine whether least-cost beneficial use features could be developed. No interior marsh areas in need of nourishment or restoration were identified adjacent to Sabine Pass in Louisiana. Areas in Louisiana that could benefit from beneficial use of dredged material are all located in the marshes east of Sabine Lake. However, these were found to be too distant from the navigation channel to permit cost-effective use of dredged material from the SNWW navigation channels. Numerous degraded marshes in Texas with potential for beneficial use were identified adjacent to the navigation channel. They are located in the Texas Point NWR adjacent to the Sabine Pass Channel, in the J.D. Murphree WMA adjacent to the Sabine-Neches Canal, and in areas of the Neches River WMA and private lands adjacent to the Neches River Channel. The Gulf shoreline at Texas and Louisiana Points is close enough to the navigation channel to allow cost-effective beneficial use of dredged material. The shoreline on the Texas side of Sabine Pass was also identified as a high priority area for beneficial use because of high ongoing erosion in this area.

Several hydrologic restoration features that were intended to prevent higher FWP salinities in portions of the study area were eliminated early in the screening process. They were modeled using the HS model and found to be either ineffective at reducing salinities or to have significant unintended impacts. For example, marsh islands constructed with new work material were proposed as a means of isolating the salinity wedge in the Sabine-Neches Canal from Sabine Lake. Modeling determined that the islands did block the flow into the lake, but forced a salinity wedge to travel up the Sabine River Channel, potentially affecting cypress-tupelo swamps in that watershed. Other proposed BU features that were unsuccessful in reducing salinities are described in Table 2.5-2.

A large number of conceptual designs for emergent marsh restoration throughout the study area were initially identified as possible compensatory mitigation measures. Because of their proximity to the navigation channel, several marsh restoration features in Texas were also evaluated to determine whether they would be less costly than traditional placement. Only the Neches River and Gulf Shore BU features were determined to be less costly than using upland PAs for new work (Traditional Placement Plan) or maintenance material (Base Plan). These features and the cost analysis are presented in detail later in this chapter. Marsh restoration features considered but eliminated included marsh restoration in Texas Point NWR using new work material from the Port Arthur Canal or the Sabine Pass Channel, and at Bessie Heights West using new work material from the Neches River Channel. Another feature used new work material for marsh restoration in the part of Old River Cove marsh that lies east of the intake canal. All were found to be feasible but more costly that traditional upland placement. The preliminary incremental costs for these features were relatively low, ranging from $300,000 to $581,000, but no sponsor has been identified to share the incremental cost.

The creation of new wildlife habitat using new work material from the Sabine-Neches Canal was also explored. This feature would provide needed nesting habitat for colonial waterbird species such as cormorant, pelican, heron, egret, spoonbill, gull, tern, and skimmer. These birds regularly nest in large numbers along the Texas and Louisiana coasts, frequently on bay islands, both natural and manmade.

Despite the presence of excellent waterbird habitat in the Sabine NWR, no colonies have been documented in Louisiana within the study area. The lack of isolated, predator-free islands is believed to be a primary cause for this lack of nesting habitat. It was proposed that an island be constructed in the middle of Sabine Lake with new work material from the Sabine-Neches Canal. This feature was eliminated when the cost was found to be approximately $2 million higher than the use of traditional upland PAs, and no sponsor was identified to share the incremental cost.

Several features were evaluated that would return sediment normally placed in upland PAs or ODMDSs to the littoral zone. Conceptual plans were developed for shore nourishment at Texas and Louisiana Points using new work material from Section 5 or sections 5 and 6 of the Sabine Pass Channel. The features were found to be feasible but cost $6.6 and $19.5 million, respectively, more than upland placement in PA 5. Stockpiling dredged material in ODMDS 4 for later use was also investigated. Like all other SNWW ODMDSs, material placed at this site disperses quickly after placement. Although it is closest to shore, the dispersed material in ODMDS 4 is not likely to migrate into the littoral zone because it is located beyond the depth of closure. It is expected that any material stockpiled within ODMDS 4 would be unavailable for use within 3 months of placement. Since stockpiling assumes that the beneficial use need will not be immediate or short term, it was concluded that this feature is not a viable alternative. Transporting and discharging coarser-grained sediments from the new work dredging of the Extension Channel (stations 117+000 to 146+000) into the littoral zone offshore of Texas or Louisiana Point was also evaluated. A hopper dredge with pump-out capability could be used to dredge the channel, move as close as possible to shore, and pump the material via a connecting pipeline to a discharge point within the 14-foot-depth contour. Discharging the material at or inshore of the depth of closure should guarantee the reintroduction of sediments within the littoral zone, where natural processes will beneficially distribute the sediments. It is estimated that the incremental cost of this action would be about $86.3 million. While feasible, this BU feature is much more costly than placement in the proposed ODMDSs B and C. No sponsor has been identified to share the incremental cost of the feasible BU features discussed above.

The creation of new marine habitat in the form of a “topographic high” offshore of Louisiana Point was also investigated. This feature would involve the beneficial use of new work material from the deepened Sabine Bank and Extension channels to create a new refuge or feeding locale for fish and shrimp. The material would be dredged as usual with a hopper dredge and then transported far enough upcurrent to prevent redeposition in the navigation channel. The material would be dropped in mounds forming a series of rows over a large area, roughly 2.0 by 2.5 miles. The actual ecological benefits of such a feature off the Texas coast have not been demonstrated. A similar feature was constructed outside of Galveston Bay, but no monitoring was conducted to determine whether any benefits accrued. In addition, the feature would be temporary because the dispersive processes acting on the ODMDSs would also be present here. It was eliminated from further consideration when it was estimated that the incremental cost of the temporary habitat would be approximately $268 million.

#### 2.5.3.2 Detailed Evaluation of Disposal Features

After the preliminary screening, BU features that appeared to be least-cost alternatives for the beneficial use of dredged material in reducing with-project salinities, restoring marsh, or providing shoreline nourishment were advanced for detailed evaluation. Water and sediment sampling and bioaccumulation studies have established that dredged material from all SNWW navigation channels is suitable for beneficial use (PBS&J, 1999, 2002, 2004a). The ecological benefits of the following beneficial use features were evaluated and quantified using the WVA model, and these benefits were used to minimize project impacts as described below. A description of the WVA model is provided in Chapter 4. In addition, numerous existing upland PAs were evaluated for use with the Preferred Alternative. All BU alternatives to ODMDSs were eliminated during the preliminary screening. Existing and proposed ODMDS sites were therefore evaluated for the placement of all material from the offshore channel reaches.

##### *2.5.3.2.1 Neches River BU Feature*

Three former marsh areas on the Neches River have been combined into one large management feature, called the Neches River BU Feature (Figure 2.5-1), to provide flexibility in the use of new work and maintenance material from the several construction reaches of the Neches River Channel. The primary objective of this combination feature would be to beneficially utilize dredged material to restore emergent marsh in an area that has suffered dramatic, widespread loss of marsh. The BU feature would utilize new work and maintenance material that would otherwise be removed from the sediment system and stored in upland, confined placement areas.

The Neches River BU Feature would offset all indirect salinity impacts to Texas wetland habitats on the Neches and Sabine rivers (Hydrologic Units [HUs] TX 3 through TX 8, and TX 10 through TX 13) by restoring 2,853 acres of emergent marsh, improving 871 acres of shallow water by creating shallower ponds and interconnecting channels, and nourishing 1,234 acres of existing fringing marsh by winnowing fine-grained material from unconfined flows of dredged material effluent (Table 2.5-3). The BU feature thus provides benefits to a total of 4,958 acres of degraded marsh on the lower Neches River, or 53 percent of the restoration target set by the CEPRA 2004 plan update for the lower Neches River (GLO, 2004). The BU feature also offsets the direct impact of converting 86 acres of freshwater wetlands to a confined placement area (PA 24A). The size of the Neches River BU Feature components and the magnitude of their ecological benefits are made possible by the large amounts of dredged material that will be generated by the proposed project and extensive opportunities for beneficial use in the project area.

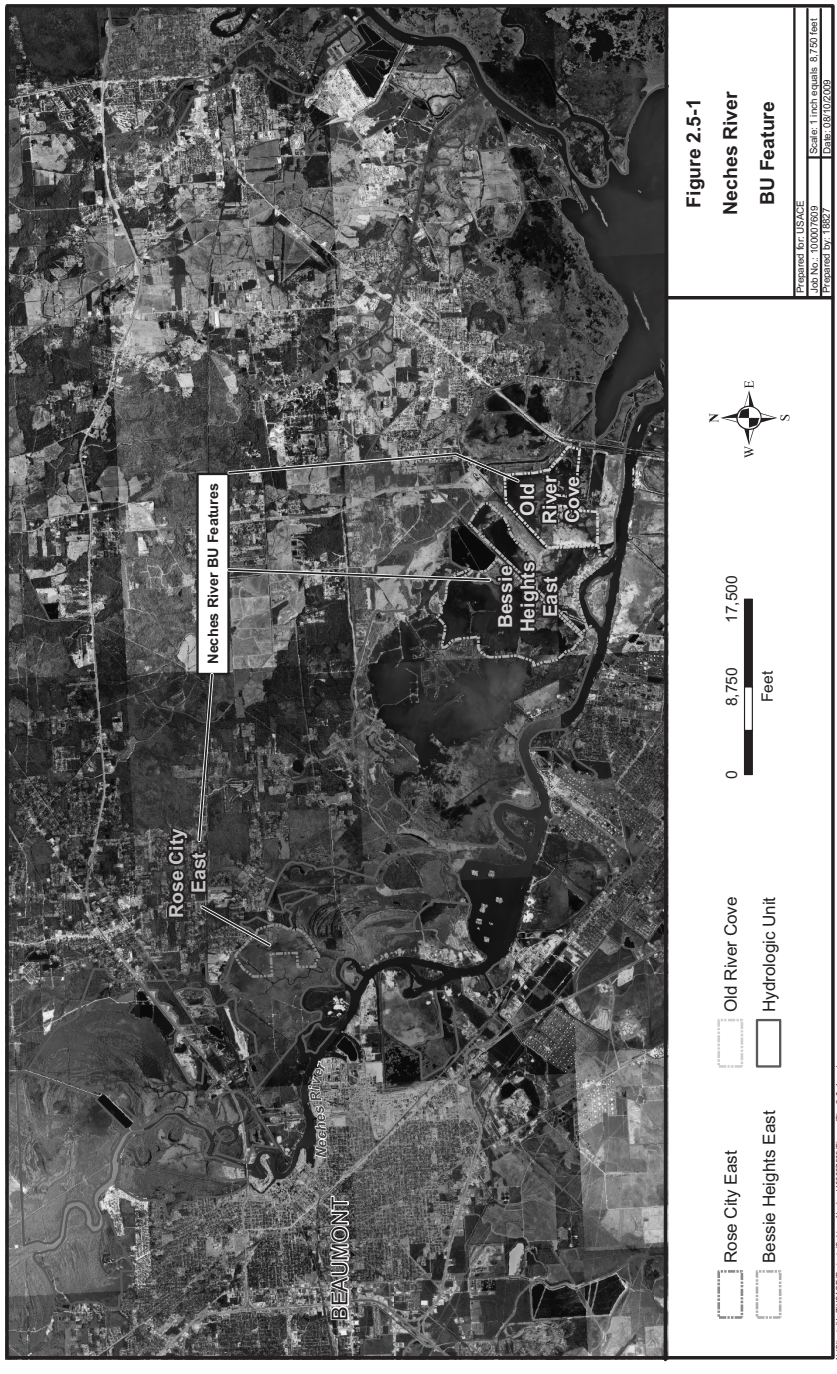


**Figure 2.5-1**
**Neches River**
**BU Feature**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1 inch equals 8,750 feet |
| Prepared by: 18827 | Date: 08/10/2009 |

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Table 2.5-3
Acreage Restored by Each Component of Neches River BU Feature

| Components of the Neches River BU Feature | Restored Emergent Marsh | Improved Shallow-Water Habitat | Nourished Existing Marsh | Total Influence Area |
|---|---|---|---|---|
| Rose City East | 345 | 72 | 151 | 568 |
| Bessie Heights East | 1,869 | 660 | 651 | 3,180 |
| Old River Cove West | 639 | 139 | 432 | 1,210 |
| Total | 2,853 | 871 | 1,234 | 4,958 |

#### *2.5.3.2.2 Gulf Shore BU Feature*

The use of dredged material was also evaluated for Gulf shoreline nourishment at Texas and Louisiana Points (Figure 2.5-2). Over the 50-year period of analysis, maintenance material would be hydraulically pumped from Section 5 of the adjacent Sabine Pass Channel onto a total of 6 miles of shoreline on both sides of Sabine Pass. Some material is expected to flow over existing marsh while the remainder will flow into nearshore waters. Material placement during each 3-year Sabine Pass Channel dredging cycle would alternate between Texas and Louisiana, so that material would be placed on each state's shoreline every 6 years. This recurring action would nourish eroding marsh, minimize projected FWP shoreline impacts, and potentially create new marsh. As this BU feature is located within the Texas Point NWR, USACE has requested that the USFWS prepare a compatibility determination for the proposed activity. See correspondence dated January 23, 2007, in Appendix A1 of the FEIS.

Texas Point is undergoing severe beach erosion, with shoreline retreat of up to 1,150 feet between 1974 and 2000 (King, 2007; Morang, 2006). This is the highest rate of shoreline loss on the upper Texas coast and a CEPRA "critical erosion area" (GLO, 2005). In Louisiana, persistent erosion along the shoreline between Ocean View and Holly Beach, on the order of –4.3 feet/year between 1985 and 1998, was recorded here prior to Hurricane Rita (USACE, 1971a, 2004a). Nearer to Louisiana Point, significant accretion over the last 100 years has slowed to +1.2 feet/year, and the behavior of this shoreline has become erratic, with some areas eroding and some aggrading (USACE, 2004a).

Historic dredging records indicate that the maintenance material from Sabine Pass will average 51 percent silt, 31 percent clay, and 18 percent fine sand (USACE dredging data base). This mix of materials does not contain typical beach-quality sand, but the material types and composition are similar to what is present on the shorelines today. Narrow beach fronts of silt or clay lie seaward of eroding overwash marsh terraces (PBS&J, 2006). Given the unusual characteristics of this sand-starved system, returning the material to the littoral system is likely to have a net beneficial effect, regardless of material type. The longshore transport in this system contains primarily fine-grained sediments, but these sediments have been shown to accumulate in the near shore zone and result in shoreline accretion by, as yet, poorly understood processes (King, 2007; Morang, 2006).

Shoreline Nourishment

Hydrologic Unit

2 1 0 2
Miles

N W E S

**Figure 2.5-2**

**Gulf Shore BU Feature**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 044198800 | Scale: 1:93,500 |
| Prepared by: A. Christiansen | Date: 04/28/2008 |

File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/044198800/figures/Fig2_5_3_v2.mxd

The Gulf Shore BU Feature will provide a regular source of predominantly fine-grained sediment that should contribute to mudflat accretion and periodically move onshore to become shore-attached through a process described by PIE (2003). On the western Louisiana and east Texas coasts, sediments accumulate as mudflats and underwater mudshoals (or "fluid mud") in the nearshore region. Nearshore, fluid mud can be trapped against the shoreline by prevailing south and southwesterly winds, and storms carry the trapped muddy ooze onto the chenier shoreline. The northwest Gulf is a microtidal, storm-dominated environment. In a typical year there are about 20 to 30 frontal passages generating waves, surges, and wind-driven currents, with most frequent waves from the southeast about 3 to 4.5 feet in height (PIE, 2003).

Mudflat accretion on the western Louisiana coast appears to correlate with periods of high sediment influx from the Atchafalaya River and the passage of large storm systems. Up to 1,000 feet of accretion along a 4.5-mile segment of shoreline in western Louisiana occurred over a few days during the passage of Hurricane Aubrey (Morgan et al., 1958). Another study reports that accretion in western Louisiana occurs most frequently during storms and that it can be very rapid (Wells and Kemp, 1986). Huh et al. (1991) report that surge deposits of gel-like mud become stranded on the upper shoreface during storms. These deposits can dry and crack, forming mud cobbles that help to armor the shoreline. Fluid mud and mudflat accretion at the shoreline has also been observed on the Jefferson County shoreline. At Sea Rim State Beach in June 2002 (PIE, 2003), shoreline features were observed that resembled the storm surge deposits of fluid mud and mud cobbles reported above.

The presence of additional fine-grained sediments in the littoral system that will be provided by the BU feature should reduce the current erosion rate and minimize the small increase in shore erosion predicted with the project (Gravens and King, 2003). In systems that have an abundant supply of fine-grained sediments, the nearshore seabed can be blanketed with fluid mud. The presence of additional muddy sediment in the nearshore environment may attenuate waves and lessen wave-induced erosion (Hsiao and Shemdin, 1980; Tubman and Suhayda, 1976; Wells and Kemp, 1986). There are also anecdotal reports of Gulf areas off Louisiana and Texas Points being safe havens for vessels during storms due to the near-total attenuation of waves (Block, 1984; King, 2007; Wells and Kemp, 1986).

The BU dredged material is expected to be composed largely of unconsolidated muds. These fine-grained sediments are expected to initially be highly mobile and some portion of the material will be rapidly lost from the vicinity of the shoreline. As demonstrated by another BU project at Texas Point (USACE, 2000), a significant percentage will also flow onshore and nourish existing marsh along the eroding beachfront. Because of the prevailing wave climate, the mobile material within the surf zone should generally migrate to the west at both Texas and Louisiana Points (Wamsley, 2008). Transport processes identified by the Sabine Pass sediment budget (Morang, 2006) indicate that the material would move toward the eroding shoreline at Texas Point. There, the additional fine-grained sediments could lower erosion rates through the mudflat accretion and wave attenuation processes described above. A small quantity of material may migrate to the east and contribute to the Sabine fillet at the west jetty (King, 2007; Morang, 2006).

In Louisiana, the sand bar formed by BU sediments from the Cheniere LNG project may shelter the shoreline from wave energy sufficiently to allow fine-grained sediments to form a mudflat behind the sandbar (Nairn and Willis, 2002). While a significant percentage will be rapidly carried offshore, some is likely to move downcoast with the littoral current, enlarging the sand and mudflat already present at the east jetty. Potential impacts of elevated levels of total suspended solids (TSS) are expected to be similar to those that resulted from the Cheniere LNG BU project (PBS&J, 2004b). A temporary increase in suspended silt/clay was expected during the first 8 to 9 months following placement. After the termination of placement activities, TSS was expected to decrease for about 18 months when concentrations reached background levels. Modeling conducted for the Cheniere project indicated that it will take 9 years before the silt and clay component of Cheniere BU material become totally suspended and are removed from the littoral zone. Since the Gulf Shore BU Feature proposes a placement episode every 6 years, all the fine-grained sediments would not have been removed before new material is added. This should result in the retention of some portion of the fine-grained sediment, and thus facilitate mudflat accretion through the processes described above. During and after each placement episode, most of the resuspended silt and clay are expected to enter the Sabine Pass Jetty Channel through the shallow boat cut, but deposition in the channel is not expected. It should remain in suspension and be transported back into the Gulf.

Although the BU sediments will be largely fine grained, approximately 18 percent of maintenance material is expected to be sand. Sands that are deposited on shore will nourish and stabilize eroding marshes; sand deposited in the nearshore zone should stay in the nearshore environment, moving back and forth across the shoreface (Wamsley, 2008). Sand placed at Louisiana Point should remain on the shoreface where it was deposited; no significant amounts of sand are expected to enter the Jetty Channel. On erosive mud shorelines like those in the BU area, the sand percentage should increase and it will form sandy lenses or a veneer over the mud shoreline substrate. As the sand lenses thicken, the sands help protect the underlying mud from further erosion (Nairn, 1992). However, in smaller quantities, sand can also accelerate erosion of a mud beach. If the consolidated mud is not covered by a sand veneer, any sand that is mobilized by wave action will act as a scouring agent (King, 2007).

It is acknowledged that the behavior of the BU sediments within this complex littoral system cannot be predicted with certainty over the period of analysis, especially given the potential for strong storms to affect the coastal environment. However, there is sufficient knowledge of general processes and baseline conditions to support evaluation of potential impacts and benefits. Furthermore, the engineering feasibility and potential environmental benefits have been demonstrated by successful recent BU projects at Texas and Louisiana Points (PBS&J, 2004b; USACE, 2000). All of this information was used to establish explicit assumptions about the expected behavior of the BU material in the quantification of project impacts and benefits using the WVA model, as described in Appendix C of the FEIS. The WVA model analysis assumed that 60 percent of the pumped quantity will remain in the existing marsh and on the shallow nearshore slope in front of the existing shorefront immediately after material placement. Since the material is unconsolidated and prone to erosion, only 50 percent of that material was assumed to remain by the end of each 6-year cycle. It was further assumed that the regular addition of material every 6 years would slow the resuspension of fine sediments and result in the accumulation of some new marsh

by the end of the period of analysis. No attempt was made to account for the effect of large storm systems. No long-term impacts to vegetation or benthic sediments were assumed to result from nourishment episodes. NWR personnel reported that the marsh vegetation at Texas Point rebounded quickly and with renewed vigour after being covered with up to 1 foot of material by the Texas Point BU project (Walther, 2005). Potential impacts to Critical Habitat for the wintering piping plover are expected to be beneficial in the long term, with short-term displacement during disposal activities. Benthic invertebrate fauna residing in the intertidal and tidal impact zones will be smothered, but studies have shown the impact to be similar to that resulting from natural events such as storms and hurricanes (Saloman and Naughton, 1977; Simon and Dauer, 1977). Following the burial, the resident species should recover quickly because of their short life cycle, high reproductive potential and the rapid recruitment of larvae and motile macrofauna from nearby unaffected areas (Nelson and Pullen, 1988).

#### 2.5.3.3 Upland Placement Features

##### *2.5.3.3.1 Existing Active PAs*

Existing PAs were evaluated to determine whether they possessed sufficient capacity for new work and maintenance material over the 50-year period of analysis. All of the upland PAs were reviewed by the ICT for potential impacts to environmental resources, and no further environmental review was recommended for existing PAs that were in active use. Existing and proposed upland PAs are shown on figures 2.4-1d–g.

##### *2.5.3.3.2 Existing Inactive PAs*

Field visits were made to existing PAs that had been inactive in recent years (PAs 23A, 26, 27C, and 27D). Inactive PAs were visited to determine whether habitat and connectivity had developed since their last use such that they were contributing to the function of adjacent wetlands. No field visits or further review of new PA 18A and inactive PA 25A were recommended by the HW as they were known to contain low-quality, upland habitat. Observations made during the field visits are summarized below.

Existing PA 23A (269 acres) is a leveed upland area east of PA 23, covered by a secondary growth of tallow and black willow forest. Existing PA 26 (192 acres) is a leveed oxbow of the Neches River south of Rose City; it is covered primarily with cattail, phragmites, and palmetto in low spots and yaupon (*Ilex vomitoria*), privet, pine, and tallow on slightly higher elevations. Existing PA 27C (87 acres) is located on the upland west of Rose City, southwest of 27A and south of 27D. It is covered by a secondary upland forest of mixed loblolly pine (*Pinus taeda*), water oak (*Quercus nigra*), and sweetgum (*Liquidamber styraciflua*); most of the larger trees have been wind-thrown by recent storm events. Existing PA 27D (35 acres) is a leveed upland area adjacent to 27A. Its water table is kept artificially high by runoff from an adjacent industrial facility. This artificial water table supports dense California bulrush, fringed on the eastern side by a narrow corridor of second-growth cypress, sweetgum, and tallow. Both 27C and 27D are situated on the north side of the Neches River opposite the Beaumont Turning Basin. All of these areas have been modified extensively by past placement activities and associated levee systems that have artificially altered the hydrology. Surrounding levees hold water and isolate the areas from adjacent

waterbodies, preventing them from contributing to the function of the adjacent wetlands and riparian corridor. All contain degraded habitat with low habitat values, primarily roosting habitat for birds and some wildlife cover. Renewed use of these areas would not constitute a significant adverse change to the existing environmental condition.

#### *2.5.3.3.3 Areas Considered for PA Expansion*

The quantities of dredged material projected for the Preferred Alternative necessitated additional PA capacity. Areas adjacent to existing PAs 14, 16, and 24 were evaluated to determine their suitability as PAs. The proposed expansion areas were designated as PAs 14A, 16A, 18A, and 24A. The HW evaluated these areas with aerial photographs and field inspections; descriptions and evaluations provided below were based upon those observations.

PA 14A (82 acres) is located south of existing PA 14, on the south side of the Neches River near its mouth. It is a relatively undisturbed wet meadow of marshhay cordgrass (*Spartina patens*) containing numerous small ponds. The area floods during seasonally high tides and heavy storms, providing intermittent hydrologic connectivity to the riparian corridor. It provides habitat for numerous native wildlife species and is covered by a valuable intermediate wetland. It was determined that use of this area would be a significant adverse change to existing conditions. The USACE reevaluated needs along the lower Neches River and dropped it from further consideration for use as a PA.

PA 16A (202 acres) is located west of existing PA 16 on the south side of the Neches River near its mouth. It is covered by intermediate marsh and crisscrossed by shallow streams and small ponds. It has never been leveed and receives tidal circulation through a natural bayou connecting to the Neches River and the Star Lake Canal, which forms its western boundary. Dominant wetland plants are marshhay cordgrass, several varieties of bulrush, cattail, and widgeon-grass (*Ruppia maritima*). The vegetation community and hydrologic connectivity to adjacent wetlands in the riparian corridor make this a high-quality native marsh providing important habitat for native fish and wildlife. The USACE determined that use of this area would be a significant adverse change to existing conditions. The EPA includes the 16A area in a preliminary area of concern for the Star Lake Canal Superfund Site (EPA, 2006). An EPA feasibility study to determine the nature and extent of contamination is under way. The area has been dropped from further consideration for use as a PA.

PA 18A (71 acres) is located north of existing PA 18. It is a disturbed upland area containing low-quality scrub habitat. Based upon HW review of an aerial photograph of the proposed expansion area and knowledge of the area, the area was determined to be suitable for use as a PA.

PA 24A (187 acres) is located north of the Maritime Administration's Reserve Fleet area. The area contains a central upland ridge with surrounding wetland components. The northern portion of the area is hydrologically connected to the Neches River, but hydrologic connections to the southern half of the site are restricted by prior levee and road construction. Wetlands in the area contain small open-water pockets but are primarily densely vegetated with California bulrush (*Scirpus californicus*), common reed (*Phragmites australis*), and marshhay cordgrass. Observed aquatic vegetation in shallow-water ditches

includes common salvinia (*Salvinia minima*), water smartweed (*Polygonum hydropiperoides*), and white pond lily (*Nyphaea odorata*). Ninety-five percent of the overstory on the upland ridge is a secondary growth of invasive Chinese tallow (*Sapium sebiferum*) with occasional bald cypress (*Taxodium distichum*), red maple (*Acer rubra*), sweetgum, and American holly (*I. opaca*) composing about 5 percent of the overstory. The upland ridge is not hydrologically connected to adjacent riparian habitat and has very little mast forage. Wildlife value is limited to roosting habitat for birds and some wildlife cover. Wetlands in the northern portion and in swales surrounding the upland ridge are a higher quality fresh marsh habitat; the majority of the marshhay cordgrass wetland is located in the northern section. In order to minimize impacts to wetlands, the USACE redrew the proposed boundary of the PA to exclude 144 acres of the marshhay cordgrass in the northern section, reducing the proposed PA from 331 acres to 187 acres.

The proposed project's need for PA capacity in this reach of the SNWW requires that 86 acres of the lower quality wetlands in the southern portion of the area be converted to an upland PA. Impacts to the upland ridge would not constitute a significant adverse change to the existing environmental condition because of the low quality of that habitat. The conversion of 86 acres of freshwater wetlands to a confined PA is included in the predicted impacts of the Preferred Alternative. The WVA model quantified the loss of marsh function and acres due to this conversion as a loss of 32 AAHUs. The impact is fully offset by benefits of the DMMP Neches River BU Feature.

#### 2.5.3.4 ODMDS Features

Four ODMDSs (Nos. 1–4, see Figure 2.4-1b) are currently in use for the existing SNWW project. Alternatives for the placement of new work material and the increase in maintenance material resulting from the construction of a deeper and longer offshore channel have been evaluated in an ODMDS Site Designation FEIS, which is included as Appendix B to this FEIS. Appendix B evaluates alternatives for the selection of new ODMDSs, including the use of the existing ODMDSs for the proposed CIP and beneficial use sites.

The existing ODMDSs were evaluated to determine whether they could accommodate all new work and maintenance material from the Preferred Alternative. Although it was determined that they were large enough to hold all the material, the 13.2-mile length of the channel extension would make the cost of hauling all new work and maintenance material to existing ODMDSs prohibitively expensive. Designation of four new ODMDSs (Nos. A–D, see Figure 2.4-1a) will be necessary. The best locations for the new sites were determined using the "zone of siting feasibility" screening technique, which delineates economically feasible sites that are sufficiently removed from ecologically sensitive or incompatible use areas to eliminate or minimize adverse impacts.

The ODMDSs FEIS found no significant environmental impacts related to the use of existing and proposed ODMDS sites for the SNWW Preferred Alternative. Analysis of northwestern Gulf circulation patterns confirmed that the existing and proposed ODMDSs were properly located on the west side of the navigation channel. Before- and after-dredging bathymetry surveys have demonstrated that the material

placed offshore in the ODMDS does not accumulate; it disperses quickly after placement in the offshore environment.

The USACE and EPA have cooperated in the preparation of an FEIS for the proposed ODMDSs; this document is Appendix B of the FEIS. Public comment on the proposed ODMDSs was requested concurrently with comments on the SNWW CIP. If the FFR and FEIS are approved by the USACE and the Recommended Plan is authorized by the U.S. Congress, the EPA will publish a rule-making in the *Federal Register* that establishes SNWW ODMDSs A, B, C, and D for use in conjunction with construction and operation of the 48-foot project.

## 2.5.4 Incremental Environmental Impacts and Benefits of the DMMP

Incremental DMMP impacts of the proposed 48-foot project are discussed in detail in Section 4 of the FEIS, but are summarized here. The incremental impact consists of marsh lost with construction of one new upland placement cell (PA 24A), low-quality scrub habitat lost with the construction of another upland placement area (PA 18), and four new ODMDSs (A–D). No impacts are anticipated with improvements to existing upland PAs that are needed to provide additional capacity for the 50-year period of analysis, since improvements are limited to increasing containment levee heights. The DMMP BU features have net ecological benefits that are described below.

### 2.5.4.1 Methods and Objectives

The DMMP BU features described above provide ecological benefits, which offset project impacts. The benefits were used to reduce or minimize project impacts before remaining, unavoidable impacts were quantified, and compensating mitigation was developed. The WVA model was used to quantify impacts to all affected habitat types in the study area and establish the appropriate amount of offsetting DMMP benefits by habitat type. An HS model was used to evaluate and quantify salinity impacts and benefits of the BU plan. The WVA model is summarized in Section 5 and described in detail in Appendix C of the FEIS. The HS model is also summarized in Section 5, but it is described in detail in Brown and Stokes (2009). Evaluation of beneficial use alternatives was conducted within the ICT and technical workgroups in meetings conducted from 2001 to 2006. The BU plan was revised by the USACE in 2009 to reflect changes necessitated by project reformulation and revised HS modeling.

The DMMP benefits contribute to multiagency regional plans (the Texas Parks and Wildlife Department [TPWD] regional management plan for J.D. Murphree, Sea Rim State Park, Texas Point NWR, and McFaddin NWR, see Keith Lake: the Texas Coastwide Erosion Response Plan [GLO, 2004, 2005]; the Louisiana Comprehensive Management Plan [Louisiana Coastal Protection and Restoration Authority (LCPRA), 2007; USACE, 2008a]; the Louisiana Coast 2050 Plan [Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority (LCWCR/WCRA), 1998], and the North American Waterfowl Management Plan [NAWMP Plan Committee, 2004]), by restoring and preserving scarce and vulnerable wetlands and wildlife habitat, nourishing eroding Gulf shorelines, restoring sediment to the littoral zone, and using dredged material

beneficially to the greatest extent possible. The DMMP also complies with the Coastal Zone Management Plans (CZMP) for each state by sharing dredged material from the Sabine Pass Channel to accomplish regular shoreline nourishment. The Gulf Shore BU Feature shares this resource equally between the states because it is dredged from a channel that straddles the state boundary.

#### 2.5.4.2 Offsetting and Minimizing Ecological Impacts

BU features included in the DMMP provide benefits that offset and minimize all indirect and direct impacts (–412 AAHUs) of the Preferred Alternative in Texas (Table 2.5-4) and partially offset impacts in Louisiana (Table 2.5-5). In Texas, construction of the Neches River BU Feature and the Texas portion of the Gulf Shore BU Feature will produce benefits totaling 1,068 AAHUs. Therefore, there will be a net gain of 656 AAHUs, which more than offsets all negative impacts that occur in Texas. Impacts that are offset include the direct loss of 32 AAHUs for the conversion of fresh marsh to upland PA 24A. The majority of the offset Texas impacts are in the Neches River watershed, but approximately 16 percent are losses to cypress-tupelo swamp (–22 AAHUs) and fresh and intermediate marsh (–45 AAHUs) in the Sabine River watershed. In Louisiana, the Gulf Shore BU Feature provides benefits totaling 210 AAHUs. Given total Louisiana impacts of 1,709 AAHUs, there is a net loss of 1,499 AAHUs remaining in Louisiana after offsetting benefits of the Louisiana portion of the Gulf Shore BU Feature are applied.

It is important to note that the impacts presented here do not include all impacts of the Preferred Alternative in Texas as FWP impacts in Texas's Salt Bayou (TX 9) hydro-unit are not included. Jefferson County, Texas, and USACE, with support from the TPWD, GLO, and Texas Water Development Board (TWDB) have been studying ways to reduce the amount of saltwater intrusion, decrease high-energy inflows, and minimize impacts to larval fish access in an ongoing Section 1135 Continuing Authorities Program (CAP) study for the Salt Bayou hydrologic unit. When the Keith Lake Section 1135 CAP study was begun in 2003, it seemed likely that the CAP study and construction would be completed before the SNWW CIP could be authorized and constructed. The Keith Lake Section 1135 study was therefore considered separable from the SNWW CIP, and for planning purposes, it was assumed that a water control structure at Fish Pass would be part of the future without-project condition for the SNWW CIP.

Incremental impacts of the SNWW CIP will be calculated for the Salt Bayou unit of the SNWW study area when WVA modeling is completed for the Keith Lake Section 1135 study. It is possible that the excess DMMP benefits (316 AAHUs) of the SNWW CIP will cover all incremental project impacts. However, if it is determined that additional mitigation is needed, then USACE and the non-Federal sponsor of the SNWW CIP will initiate consultation with resource agencies, identify and incrementally justify additional compensatory mitigation for the Salt Bayou unit, and prepare a supplemental environmental impact statement.

Table 2.5-4
Texas – FWP Impacts and Benefits by Habitat Type

| | | Offset Impacts by Acres and Habitat Type (acres) | | | Total Impacts/Benefits by Habitat Type (AAHUs) | | |
|---|---|---|---|---|---|---|---|
| HU # | Hydrologic Unit (HU) Name | No Effect | Impacts Offset by BU Plan | Acres Impacted | Total Loss | Offsetting Benefits of BU Plan | Net FWP Benefit |
| **Bottomland Hardwood** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 412 | | | | | |
| TX 2 | Neches-Lake Bayou | 1,040 | | | | | |
| TX 3 | Rose City | 1,775 | | | | | |
| TX 5 | Bessie Heights | 293 | | | | | |
| TX 6 | Old River Cove | 197 | | | | | |
| | ***Subtotal - Neches River*** | **3,717** | **0** | **0** | **0** | **0** | **0** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | 388 | | | | | |
| TX 11 | Adams Bayou | 640 | | | | | |
| LA/TX 1 | Sabine Island | 524 | | | | | |
| | ***Subtotal - Sabine River*** | **1,552** | **0** | **0** | **0** | **0** | **0** |
| | **Total Bottomland Hardwood** | **5,269** | **0** | **0** | **0** | **0** | **0** |
| **Cypress/Tupelo Swamp** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 2,760 | | | | | |
| TX 2 | Neches-Lake Bayou | 2,277 | | | | | |
| TX 3 | Rose City | 464 | | | | | |
| | ***Subtotal - Neches River*** | **5,501** | | | **0** | **0** | **0** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | 110 | | | | | |
| TX 11 | Adams Bayou | | | 115 | –4 | | –4 |
| TX 12 | Blue Elbow South | | | 689 | –18 | | –18 |
| LA/TX 1 | Sabine Island | 1,194 | | | | | |
| LA/TX 2 | Blue Elbow | 2,737 | | | | | |
| | ***Subtotal - Sabine River*** | **4,041** | **0** | **804** | **–22** | **0** | **–22** |
| | **Total Cypress/Tupelo Swamp** | **9,542** | **0** | **804** | **–22** | **0** | **–22** |
| **Fresh Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 436 | | | | | |
| TX 2 | Neches-Lake Bayou | 1,535 | | | | | |
| TX 3 | *Rose City PA 24A** | | | 86 | –32 | | –32 |
| TX 3 | Rose City | | | 3,241 | –1 | 178 | 177 |
| TX 4 | West of Rose City | 492 | | | | | |
| TX 5 | Bessie Heights | 2,147 | | | | | |
| TX 7 | GIWW North | | | 4,806 | –140 | | –140 |
| | ***Subtotal - Neches River*** | **4,610** | **0** | **8,133** | **–173** | **178** | **5** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | | | 1,775 | –18 | | –18 |
| TX 11 | Adams Bayou | | | 599 | –15 | | –15 |
| | ***Subtotal - Sabine River*** | **0** | **0** | **2,374** | **–33** | **0** | **–33** |
| | **Total Fresh Marsh** | **4,610** | **0** | **10,507** | **–206** | **178** | **–28** |

Table 2.5-4, cont'd

| HU # | Hydrologic Unit (HU) Name | Offset Impacts by Acres and Habitat Type (acres) | | | Total Impacts/Benefits by Habitat Type (AAHUs) | | |
|---|---|---|---|---|---|---|---|
| | | No Effect | Impacts Offset by BU Plan | Acres Impacted | Total Loss | Offsetting Benefits of BU Plan | Net FWP Benefit |
| **Intermediate Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 5 | Bessie Heights | | | 6,933 | –14 | 433 | 419 |
| TX 8 | Texas Point | | | 1,742 | –19 | | -19 |
| TX 13 | Groves | | | 437 | –3 | | -3 |
| | ***Subtotal – Neches River*** | **0** | **0** | **9,112** | **–36** | **433** | **397** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | | | 1,144 | –12 | | -12 |
| | ***Subtotal – Sabine River*** | **0** | **0** | **1,144** | **–12** | **0** | **-12** |
| | **Total Intermediate Marsh** | **0** | **0** | **10,256** | **–48** | **433** | **385** |
| **Brackish Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 6 | Old River Cove | | | 8,760 | –116 | 235 | 119 |
| TX 8 | Texas Point | | | 2,546 | –7 | | -7 |
| TX 7 | GIWW North | | | 647 | –8 | | -8 |
| | ***Subtotal – Neches River*** | **0** | **0** | **11,953** | **–131** | **235** | **104** |
| | **Total Brackish Marsh** | **0** | **0** | **11,953** | **–131** | **235** | **104** |
| **Saline Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 8 | Texas Point | | 5,708 | | –5 | 222 | 217 |
| | ***Subtotal – Neches River*** | | **5,708** | | **–5** | **222** | **217** |
| | **Total Saline Marsh** | **0** | **5,708** | **0** | **–5** | **222** | **217** |
| **Total Neches River Impacts** | | 13,828 | 5,708 | 29,198 | –345 | 1,068 | 723 |
| **Total Sabine River Impacts** | | 5,593 | 0 | 4,322 | –67 | 0 | –67 |
| **Total - All Habitats** | | **19,421** | **5,708** | **33,520** | **–412** | **1,068** | **656** |

*Direct impact associated with conversion of wetland to upland PA 24A.

Table 2.5-5
Louisiana – FWP Impacts by and Benefits Habitat Type

| HU # | Hydrologic Unit (HU) Name | Offset Impacts by Acres and Habitat Type (acres): No Impact | Impacts Offset by BU Plan | Acres Impacted | Total Impacts/Benefits by Habitat Type (AAHUs): Total Loss | Offsetting Benefits of BU Plan | Net FWP Impact |
|---|---|---|---|---|---|---|---|
| All HUs in Sabine River Watershed | | | | | | | |
| **Bottomland Hardwood** | | | | | | | |
| LA 1 | Perry Ridge | 2,158 | | | | | |
| LA/TX 1 | Sabine Island | 1,041 | | | | | |
| | Subtotal | 3,199 | | | 0 | | 0 |
| **Cypress/Tupelo Swamp** | | | | | | | |
| LA/TX 1 | Sabine Island | 5,998 | | | | | |
| LA/TX 2 | Blue Elbow | 650 | | | | | |
| | Subtotal | 6,648 | | | 0 | | 0 |
| **Fresh Marsh** | | | | | | | |
| LA 1 | Perry Ridge | | | 18,859 | –65 | | –65 |
| LA 7 | Southeast Sabine | | | 2,634 | –11 | | –11 |
| LA 8 | Southwest Gum Cove | | | 3,615 | –2 | | –2 |
| | Subtotal | | | 25,108 | –78 | | –78 |
| **Intermediate Marsh** | | | | | | | |
| LA 1 | Perry Ridge | | | 4,704 | –53 | | –53 |
| LA 2 | Willow Bayou | | | 35,109 | –328 | | –328 |
| LA 3 | Black Bayou | | | 34,941 | –509 | | –509 |
| LA 4 | West Johnson's Bayou | | | 11,110 | –269 | | –269 |
| LA 5 | Sabine Lake Ridges | | | 9,270 | –218 | | –218 |
| LA 7 | Southeast Sabine | 5,400 | | | | | |
| LA 8 | Southwest Gum Cove | | | 6,605 | –4 | | –4 |
| LA 9 | East Johnson's Bayou | | | 26,138 | –190 | | –190 |
| | Subtotal | 5,400 | | 127,877 | –1,571 | | –1,571 |
| **Brackish Marsh** | | | | | | | |
| LA 2 | Willow Bayou | | | 1,182 | –1 | | –1 |
| LA 3 | Black Bayou | | | 3,195 | –1 | | –1 |
| LA 4 | West Johnson's Bayou | | | 2,078 | –1 | | –1 |
| LA 5 | Sabine Lake Ridges | | | 15,962 | –14 | | –14 |
| LA 6 | Johnson's Bayou Ridge | | | 2,744 | –6 | | –6 |
| | Subtotal | | | 25,161 | –23 | | –23 |
| **Saline Marsh** | | | | | | | |
| LA 5 | Sabine Lake Ridges | | 3,767 | | –35 | 210 | 173 |
| LA 6 | Johnson's Bayou Ridge | | 370 | | –2 | | |
| | Subtotal | | 4,137 | | –37 | 210 | 173 |
| | **Louisiana Impacts Total** | **15,247** | **4,137** | **178,146** | **–1,709** | **210** | **–1,499** |

With adoption of the DMMP, all FWP impacts in Texas will be offset, and no compensating mitigation is proposed in conjunction with construction of the Preferred Alternative. Impacts in Louisiana are minimized to the greatest extent possible by the DMMP, but unavoidable impacts of –1,499 AAHUs remain. When the impacts and DMMP benefits are not subdivided by state but are applied to the project as a whole, a loss of 843 AAHUs remains (Table 2.5-6). A mitigation plan, described in Section 5, has been developed to compensate for unavoidable impacts of the Preferred Alternative.

Table 2.5-6
Net FWP Impacts (AAHUs) for Project as a Whole

| | Bottomland Hardwood | Cypress-Tupelo Swamp | Fresh Marsh | Intermediate Marsh | Brackish Marsh | Saline Marsh | Total |
|---|---|---|---|---|---|---|---|
| **Impacts** | | | | | | | |
| Texas | | | | | | | |
| Neches River watershed | | | –173 | –36 | –131 | –5 | –345 |
| Sabine River watershed | | –22 | –33 | –12 | | | –67 |
| Subtotal | 0 | –22 | –206 | –48 | –131 | –5 | –412 |
| Louisiana | | | | | | | |
| Sabine River watershed | | | –90 | –1,571 | –23 | –37 | –1,709 |
| Total Impacts | 0 | –22 | –296 | –1,619 | –154 | –42 | –2,121 |
| **DMMP Benefits** | | | | | | | |
| Texas | | | | | | | |
| Neches River watershed | | | | | | | |
| Neches River BU Feature | | | 178 | 305 | 363 | | 846 |
| Gulf Shore BU Feature (Texas Point) | | | | | | 222 | 222 |
| Subtotal | 0 | 0 | 178 | 305 | 363 | 222 | 1,068 |
| Louisiana | | | | | | | |
| Sabine River watershed | | | | | | | |
| Gulf Shore BU Feature (Louisiana Point) | | | | | | 210 | 210 |
| Total DMMP Benefits | 0 | 0 | 178 | 305 | 363 | 432 | 1,278 |
| **Net SNWW CIP FWP Impacts** | | | | | | | |
| Texas | | | | | | | |
| Neches River watershed | | | 5 | 269 | 232 | 217 | 723 |
| Sabine River watershed | | –22 | –33 | –12 | | | –67 |
| Net Texas Benefits (positive) | | | | | | | 656 |
| Net Louisiana Impacts (negative) | 0 | 0 | –90 | –1,571 | –23 | 173 | –1,499 |
| Net FWP Impacts | 0 | –22 | –118 | –1,314 | 209 | 390 | –843 |

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# 3.0 AFFECTED ENVIRONMENT

This chapter is divided into 14 sections. Section 3.1 describes the models that were used to characterize existing conditions, and evaluate impacts as presented in Section 4. A description of the environmental setting follows in Section 3.2, followed by separate sections on the physical, natural, cultural, and socioeconomic resources in the SNWW study area that could be affected by the proposed project.

## 3.1 MODELING EXISTING CONDITIONS

Since the primary environmental concerns identified during the scoping process are the interrelated issues of saltwater intrusion, marsh loss, and destruction of wildlife habitat and fishery nursery areas, engineering and ecological models were used to characterize existing conditions related to these concerns, thereby establishing a baseline against which changes associated with project alternatives could be measured. Several engineering models were used to evaluate physical systems and processes in the study area, and an ecological model was used to evaluate the biological effects of project alternatives on habitat.

### 3.1.1 Hydrodynamic Salinity

Concerns that a deeper navigation channel would increase salinity in the Sabine Lake estuarine system were addressed with a 3-dimensional HS model that predicts changes in salinity, circulation, and water elevation due to proposed channel improvements. The ERDC's Coastal and Hydraulics Laboratory (CHL) worked closely with the ICT to calibrate and verify the base model for use in this system. The ICT reviewed the ERDC's model calibration and verification process, provided data and information on hydrologic connectivity, marsh elevation, and bathymetry, and reviewed modeling results as part of the impacts evaluation. For the baseline conditions, modeling was performed using actual depths rather than authorized project depths.

The ERDC's CHL applied an established 3-dimensional estuarine model (ERDC-modified TABS Multi-Dimensional Numerical Modeling System) to compute hydrodynamics and salinity transport for the proposed CIP. The HS model covers the entire study area from the Salt Bayou watershed on the west to near Gum Cove Ridge in Louisiana on the east, and inland to north of IH 10. The model includes forcing due to tides, freshwater inflows, wind, Coriolis, and density gradients due to salinity variation, and accounts for precipitation and evaporation. The code uses a finite-element formulation, which gives it flexibility in matching complex geometry. Over the last decade, the code has been extensively used for a variety of the USACE field projects, including the Houston-Galveston Navigation Channels project, New York Harbor, St. Johns River, Florida, and Atchafalaya Bay in Louisiana. Two of the special features of the code, wetting/drying and "marsh porosity," enable successful modeling of wetlands. A description of the model and its output is provided in a report by the ERDC-CHL (Brown and Stokes, 2009).

HS model salinities were verified against salinity data from June to December 2001. The modeling report provided standard deviations for each of the original modeling stations; these provide a measure of the uncertainty inherent in the model predictions. For the baseline condition, model outputs were provided for all original sampling locations.

### 3.1.2 Other Engineering Models

Several other engineering models were conducted to characterize other existing physical processes in the study area, and to provide baseline information for the assessment of impacts. The most significant of these are:

**Ship Simulation.** The ship simulation was used to determine navigation and safety impacts due to anticipated changes in vessel sizes as a result of the proposed channel widening (Webb, 2003). The main objective of the study was to determine whether the "design" ship could safely operate within the width and depth of the proposed channel dimensions. The simulation was conducted on a channel depth of 50 feet with varying widths. Additional ship simulation was conducted to determine the navigation and safety implications of reducing the offshore entrance channel to a 700-foot width.

**Sediment Study.** A desktop engineering model was applied to determine anticipated shoaling rates along the waterway and estimate any increases in channel erosion (Brown and Stokes, 2009; Parchure et al., 2005). Results from the study were used to estimate the quantity of maintenance material arising from structural alternatives. Erosion concerns along Pleasure Island and East Sabine Lake were also addressed by the analysis. An additional study effort was performed along the Pleasure Island reach and Sabine-Neches Canal to determine whether the channel velocities in these areas would result in increased channel erosion.

**Vessel Effects Study.** A vessel effects study was conducted to determine the potential erosional effects to Pleasure Island from vessel traffic in the Port Arthur and Sabine-Neches canals (Maynord, 2005). Project vessel traffic was modeled with HIVEL2D, a two-dimensional finite element model designed specifically to simulate flow in typical high-velocity channels. The model has been used since the mid-1980s and is maintained by the ERDC-CHL.

**Gulf Shoreline Effects Study.** This ERDC-CHL study was conducted to determine potential erosion impacts to the Gulf shoreline that could be associated with deepening and extending the Entrance Channel. The study area extended 10 miles from the jetties into Texas and Louisiana (Gravens and King, 2003). The STWAVE and GENESIS models were applied to examine wave conditions within a bathymetry grid extending 20 miles along the shoreline and evaluate changes to the shoreline.

### 3.1.3 Wetland Value Assessment Model

The WVA model suite uses a quantitative habitat-based assessment methodology developed to prioritize Louisiana coastal restoration projects submitted for funding under Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) (Louis Berger Group and Toxicological & Environmental Associates [LBG and TEA], 2008). The WVA model is a modification of the widely used Habitat Evaluation Procedure (HEP) models developed by the USFWS (1980). It was developed by the Environmental Workgroup (EnvWG) of the Planning and Evaluation Subcommittee of Louisiana's CWPPRA Technical Committee (USFWS, 2002a). The WVA methodology employs a community approach that assumes that optimal conditions for all fish and wildlife within a specific type of coastal wetland habitat can be

characterized by a group of significant variables, and that existing or future conditions can be compared to that optimum, providing an index of habitat quality similar to those developed under the well-established HEP. Using this methodology, several habitat-specific community models have been developed by the EnvWG, and three were selected for use in this study: the Emergent Marsh Community Model (EMCM), the Swamp Community Model (SCM), and the Bottomland Hardwood Model (BHM). The EMCM can be applied to four coastal marsh communities—fresh, intermediate, brackish, and saline marsh. Hereafter in this report, the term "WVA model" applies to the three components of the WVA model suite (EMCM, SCM, and BHM) that are used in this study. The results of the WVA model, measured in AAHUs, can be combined with cost data to provide a measure of the effectiveness of the proposed project in terms of annualized cost per AAHUs gained.

A WVA Procedural Manual was prepared by the EnvWG to provide guidance in the use of the WVA model (USFWS, 2002b). In addition, a separate procedural manual was prepared for the EMCM (USFWS, 2002c). The BHM and the SCM (LDNR, 1993) were developed outside of the CWPPRA arena and are periodically used by the EnvWG for CWPPRA project evaluation. The original BHM (LDNR, 1993) was utilized for this study. The SCM was subsequently updated by the EnvWG and the updated version was used here (USFWS, 2002d). The SNWW Habitat Workgroup chose to apply the WVA model as formulated by the EnvWG and LDNR because the habitats and environmental stressors in the SNWW study area are the same as those for which they were developed. Appendix C of the FEIS maps and characterizes all significant habitats in the study area, explains how the WVA model evaluates project impacts and benefits, and describes the methods and assumptions used in the modeling process.

The WVA model provides a comprehensive, quantitative measure of FWP changes in the quality and quantity of emergent wetlands and associated aquatic habitat in the SNWW study. However, it was not developed for use in conjunction with aquatic habitats in large waterbodies. Baseline conditions for aquatic habitats in the SNWW study area that are not associated with emergent wetlands were not characterized with the WVA model or any other ecological model. It was determined that use of an ecological model to characterize and evaluate impacts for these resources would not be necessary, due to the nature of the impacts and conditions specific to the study area; more information relative to this decision is presented in Section 4. However, aquatic habitats in the Sabine and Neches rivers, Sabine Lake, the SNWW and GIWW navigation channels, and offshore in the Gulf are described in this section to the extent necessary to compare to FWP alternatives.

The WVA model was chosen as the most appropriate ecological model for the SNWW project based on a number of factors. Although the WVA model was developed specifically to apply to habitat types present in the Chenier Plain region of the Louisiana coastal zone, the same types of coastal habitat (emergent coastal marsh, bottomland hardwoods, and cypress-tupelo swamp) are present throughout the Sabine-Neches coastal watershed in both Texas and Louisiana, and in fact are a continuation of the same system (Daigle et al., 2006; Griffith et al., 2004). In addition, the areas contain the same fish and wildlife communities, similar soils, and topography, and the Sabine-Calcasieu basins share an interconnected hydrology. Furthermore, the types of variables measured by the WVA model are sensitive to the types of changes that have been identified as the highest concerns by resource agencies and the general public for

the SNWW project. Specifically, these are potential changes in salinity, stress and death of marsh vegetation, and further loss or degradation of already stressed coastal marshes. The variables measured by the WVA model are also recognized scientifically and technically as important in characterizing overall habitat quality. Variables utilized in the WVA model outputs could be combined across the different habitat types. A final factor is that variables were established such that data were easily estimated or collected from existing data sources. This was especially important because the study area is exceptionally large (over 2,000 square miles), and therefore extensive field data collection efforts were not practical. The size and habitat diversity of the study area made application of other ecological models very difficult. Other ecological models, such as the Hydrogeomorphic Approach and HEP models, were considered and rejected because extensive field data collection required by these models was not feasible given time and budget constraints.

An ICT was established that (1) identified environmental issues and concerns; (2) evaluated the significance of fish and wildlife and other ecosystem features; (3) recommended and reviewed environmental studies; (4) evaluated potential impacts; and (5) recommended and evaluated potential mitigation measures. The ICT defined the study area as all areas possibly affected by the proposed project. Potential environmental effects in adjacent coastal wetlands were analyzed for an extensive area including Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River Channel up to the new Neches River Saltwater Barrier, the Sabine River Channel to the Sabine Island WMA, the GIWW west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending 10 miles either side of Sabine Pass, and offshore in the Gulf, 15 miles beyond the end of the current channel.

A subcommittee of the ICT, the HW, developed input data and applied the WVA model. The subcommittee analysis provided data on baseline and FWOP conditions and, as explained later in this document, project impacts and mitigation for specific areas. The use of the WVA model and other information provided by the ICT produced a great amount of detailed data regarding the existing and potential future conditions of the study area. This information is included in this chapter's description of the affected environment.

The WVA model created vegetation categories and mapping units in order to describe baseline or existing conditions and predict future conditions with and without the proposed project under various scenarios including various possible mitigation projects. All habitats hydrologically connected to waterways influenced by the proposed channel improvements were divided into "Hydrologic Units" (hydro-units). Hydro-unit boundaries were based upon small watershed divides, or on the basis of other topographic features that serve as hydrologic separators. Vegetation categories were mapped within each of these hydro-units. The WVA methodology for determining the vegetation baseline is briefly described below. Section 4.1 describes the modeling methodology for determining impacts and mitigation plans. See Appendix C for the detailed methodology.

FWOP projections of land loss were developed as a baseline against which project-induced changes could be measured. Base land loss rates were determined by measuring changes of emergent marsh and open-water areas using Geographic Information System (GIS) software between images from 2 or more years.

The time between images generally spanned the most recent 15- to 20-year time period for which reliable data were available. This time period generally fell between the years 1978 and 2001.

After changes in acreages were calculated, the amount of emergent marsh that converted to open water was expressed as a percentage loss per year. Adjustments to FWOP land loss rates were made to account for constructed or funded CWPPRA projects in the east Sabine Lake marshes (Clark et al., 2000; USFWS and Natural Resources Conservation Service [NRCS], 2003), at Black Bayou (LDNR, 1993), and at Perry Ridge (USGS-National Wetlands Research Center [NWRC], 2002a, 2002b), the effects of RSLR on shoreline recession, and RSLR, as described in Appendix C of this FEIS. A spreadsheet that calculates land loss annually was used for all projections.

The WVA model has been assessed for use in conjunction with the SNWW project, as required by EC 1105-2-407. The WVA model is not a USACE corporate model, and therefore certification is not required, but the model must be approved for use. This approval was provided by the Deep-Draft Center for Expertise based upon the results of a model assessment (LBG and TEA, 2008). The assessment evaluated the application of the three WVA model components (EMCM, SCM, and BHM) that were used to quantify impacts and benefits of SNWW CIP alternatives, including BU features and compensatory mitigation. The assessment determined that the model was theoretically appropriate and correctly applied, and it has been approved for use for the SNWW study.

## 3.2 ENVIRONMENTAL SETTING

### 3.2.1 Study Area

The SNWW is located in Jefferson and Orange counties in southeast Texas, and Cameron and Calcasieu parishes in southwest Louisiana. The project area includes the SNWW from the Gulf through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont. Included is the area covered by the possible addition of 13.2 miles of new channel extending beyond the end of the existing channel into the Gulf. The Sabine River Channel, which extends from the mouth of the Neches River to the Port of Orange, is not currently being considered for channel modification and is not addressed in this FEIS.

The study area includes the SNWW and a much broader geographical range covering approximately 2,000 square miles inland. Due to potential additional saltwater intrusion into the Sabine Lake estuary resulting from the CIP, hydrologic features associated with the SNWW and Sabine Lake are an important consideration. In addition, beneficial use of dredged material may include efforts outside of existing PAs and may include areas well outside of the SNWW.

### 3.2.2 Physiography

The study area is located in the Austroriparian Biotic Province (Blair, 1950), which extends from east Texas along the Gulf Coast plain to the Atlantic coast, and the Outer Coastal Plain Mixed Forest Physiographic Province (McNab and Avers, 1994). The study area is characterized by a diversity of

features that are a result of the natural transition between marine and freshwater environments and anthropogenic impacts. The Sabine and Neches rivers consist of flat to gently rolling surface topography with poorly drained floodplains that include dense bottomland forests with extensive complexes of interconnecting coastal prairie, wetlands, and bayous. Farmers and ranchers are the principal users of these prairie and upper marsh areas. Developable uplands are mostly restricted to the west side of the estuary. All of the cities and towns in the study area are located in Texas on the west side of Sabine Pass, Sabine Lake, and upland areas north of Sabine Lake. The timberlands in the flood-prone areas are used primarily as wildlife habitat with some areas commercially lumbered on a small scale. The topography of the study area is essentially featureless, except for the surface expression of four salt domes: Big Hill, Fannett, and Spindletop, Texas, and Hackberry, Louisiana. This area once supported major petroleum reserves, but now only produces limited quantities of oil and gas (USACE, 1982).

Aten (1983:15–20) provides the following description of the northwestern Gulf coast that gives a good description of the study area as well:

> . . .[this area] strikes many visitors as a monotonous repetition of prairies and marshes interspersed with an occasional swamp, barrier beach, or forest. . . . it is a highly dynamic environment that has taken on much of its present form concurrent with human occupation. . . . The basic genesis of the coastal zone land surfaces is that of a series of major river deltas coalesced into an extensive and continuous deltaic plain during the Late Pleistocene. Superimposed on this massive accumulation of deltaic material . . . are the effects of more recent events, such as Late Pleistocene-Holocene sea level fall and rise, and the formation of the modern river deltas, estuaries, . . .
>
> . . . Inland . . . are sandier and slightly rolling terrains . . . [that] support pine and hardwood forests. . . .
>
> . . . The major natural hazard in the area is flooding, which results either from overflow in rivers or from storm tides . . . the tidally influenced waters of the estuaries and streams supported [prehistorically] enormous populations of shellfish, fish, birds, reptiles, and mammals . . . over 125 animal taxa have been recovered archaeologically as food remains. . . .

Due to the abundance of rainfall in this region, the rivers and bayous of this reach provide substantial freshwater inflow into Sabine Lake. However, instream flows to this reach have been altered from their natural hydrograph due to major impoundments in the middle and upper Sabine and Neches River basins. Similar to Aten's (1983) description of the region, most of the Sabine and Neches rivers reach is tidally influenced (Mantz and Dong, 1996). Despite abundant rainfall, navigational dredging has allowed saltwater intrusion into these rivers and bayous (USACE, 1998a) resulting in saltwater wedges typically overlaid with influent fresh water.

The Sabine Lake area is a dynamic estuary only recently subject to extensive flood and ebbs of tidal currents and extensive mixing of fresh and sea water. Sabine Lake was formed from the flooding of an ancient river valley (Kane, 1959) and was later separated from the Gulf by the advancement of the Gulf

shoreline and deposition of the beach ridge/mudflat complex known as the Chenier Plain (Gould and McFarlan, 1959). High-volume freshwater inflow into Sabine Lake helped maintain Sabine Pass as a narrow and relatively shallow link between the Gulf and Sabine Lake (Morton, 1996).

The Gulf in the study area consists of open seas, coastline, and a dredged channel extending from the jettied Sabine Pass seaward. This area is dominated by the Mississippi River Delta. When the Mississippi River occupied one of its western courses, sediment deposits were carried westward by littoral currents that built the Chenier Plain (Davis, 1996). Since the Mississippi River has been emptying through its eastern delta lobe, little new sediment has been reaching the Chenier Plain (USACE, 1975a).

### 3.2.3 Geology

The regional surface geology of the Gulf Coast region consists of sedimentary beds ranging in age from late Eocene to recent, which lie as bands nearly parallel with the coast. Recent deposits form the coastline and successive beds crop out toward the interior. Due to the age of exposure of the rocks, the outcrop areas are successively more eroded and dissected toward the interior. The Pleistocene and Recent formations still retain much of their depositional surface (Texas Water Commission, 1963).

The thick sequence of sedimentary rocks and unconsolidated sediments beneath the present-day Gulf Coastal Plain reflect cyclic marine and continental deposition in the region through the Jurassic, Cretaceous, and Tertiary periods, culminating with predominantly fluvial deposits at the end of the Tertiary period. This pattern continued through the Pleistocene Epoch (i.e., early Quaternary period, about 2 million years before present), during which sedimentation was largely controlled by sea level fluctuations associated with repeated glacial and interglacial episodes (Van Siclen, 1975). During the Holocene, the fluvial Sabine Valley became an estuarine system, eventually becoming completely inundated by the rising sea level. During this interval, an estuarine-lagoonal system became dominant (Pearson et al., 1986).

The primary physiographic environments of the study area consist of two major Pleistocene depositional systems and five major Holocene depositional systems. The major Pleistocene systems include the fluvial-deltaic systems and barrier-strandplain systems. These two systems form the Coastal Zone within the study area, generally at elevations greater than 10 feet above sea level (Brown et al., 1973). The five major Holocene depositional systems include the fluvial systems, strandplain-chenier systems, offshore systems, marsh-swamp systems, and bay-estuary-lagoon systems. The Coastal Zone is underlain by sedimentary deposits that originated in ancient but similar physiographic environments. These ancient sediments were deposited by the same natural processes that are currently active in shaping the present coastline. These processes include longshore drift, beach wash, wind deflation and deposition, tidal currents, wind-generated waves and currents, and levee, point-bar, and flood basin deposition (Brown et al., 1973).

The Quaternary-aged Beaumont Formation covers the entire inland study area and is overlain by the younger Deweyville Formation and Alluvium within the Neches and Sabine River valleys. Quaternary

Alluvium and isolated barrier island deposits outcrop along the coastline. The environments responsible for the deposition of the Beaumont Formation primarily include stream channel, point bar, natural levee, backswamp, and coastal marsh and mudflat deposits. The Beaumont Formation is composed of clay with interbedded silt and sand. Similarly, the environments responsible for the deposition of the Quaternary-aged Deweyville Formation include point bar, natural levee, stream channel, and backswamp deposits. The Deweyville Formation is composed of sand, silt, and clay, with some gravel. The Quaternary Alluvium, which is found immediately adjacent to existing river courses and along the Gulf Coast shore, was deposited primarily in point bar, natural levee, stream channel, backswamp, coastal marsh, mudflat, and narrow beach deposits and is composed of clay, silt, and locally abundant organic matter (Bureau of Economic Geology [BEG], 1982).

### 3.2.4 Climate

The climate of the study area is both tropical and temperate (Soil Conservation Service, 1965). Prevailing winds are generally from the south and southeast with an average speed of about 10 to 11 miles per hour. In the winter months, cold air masses bring in polar air and prevailing northerly winds. Temperatures are moderated by the influence of the winds from the Gulf, resulting in mild winters and relatively cool summer nights. The mean daily temperature ranges from the mid-50s (degrees Fahrenheit [°F]) in December and January to the mid-80s in the summer months. The temperature rarely drops below 22°F or rises above 98°F. Relative humidity levels average approximately 78 percent throughout the year (USACE, 1975a). Another effect of the nearness of the Gulf is abundant rainfall distributed throughout the year. The average annual rainfall is about 52 inches, with monthly precipitation averaging from 3.2 inches to about 6.6 inches. Snow and sleet seldom occur. Heavy fog occurs on an average of 29 days per year. Clear days during the year average about 117; partly cloudy days, 191; and cloudy days, 57. The growing season, or the average period from the last frost in spring to the first frost in fall, is about 294 days.

## 3.3 WATER QUALITY

The Texas Commission on Environmental Quality (TCEQ), formerly the Texas Natural Resource Conservation Commission (TNRCC), and the Louisiana Department of Environmental Quality (LDEQ) have designated certain larger streams or bayous, or segments thereof, as “classified” segments for the purpose of developing water quality criteria (WQC) specific to each segment. Within the study area, there are 25 classified assessment units (subsegments of the primary stream segments), 6 in Louisiana and 19 in Texas. Table 3.2-1 lists segment-specific water quality standards (WQS) for all stream segments in the study area.

### 3.3.1 Water and Elutriate Chemistry

As with all industrialized areas, there is potential for chemical contamination within the Sabine-Neches Estuary. Numerous petroleum-related industries are found along the SNWW, including refineries and transshipment docks near Port Arthur and Beaumont. Petroleum products and crude oil are shipped and

Table 3.2-1
Classified Waterbody Segments and Water Quality Standards

| Segment No. | Segment Name | Uses: Recreation | Uses: Aquatic Life | Uses: Domestic Water Supply | Criteria: Cl (mg/L) | Criteria: $SO_4^{-2}$ (mg/K) | Criteria: TDS (mg/L) | Criteria: DO (mg/L) | Criteria: pH Range (SU) | Criteria: Fecal Coliform #100/ml | Criteria: Temp. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Texas | | | | | | | | | | | |
| 0501 | Sabine River Tidal | CR | H | N/A | N/A | N/A | N/A | 4.0 | 6.0–8.5 | 200 | 95°F |
| 0508 | Adams Bayou Tidal | CR | H | N/A | N/A | N/A | N/A | 4.0 | 6.0–8.5 | 200 | 95°F |
| 0511 | Cow Bayou Tidal | CR | H | N/A | N/A | N/A | N/A | 4.0 | 6.0–8.5 | 200 | 95°F |
| 0601 | Neches River Tidal | CR | I | N/A | N/A | N/A | N/A | 3.0 | 6.0–8.5 | 200 | 95°F |
| 0602 | Neches River Below B.A. Steinhagen Lake | CR | H | PS | 50 | 30 | 150 | 5.0 | 6.0–8.5 | 200 | 91°F |
| 0701 | Taylor Bayou Above Tidal | CR | I | N/A | 400 | 100 | 1,100 | 4.0 | 6.5–9.0 | 200 | 95°F |
| 0702 | Intracoastal Waterway Tidal | CR | H | N/A | N/A | N/A | N/A | 4.0 | 6.5–9.0 | 200 | 95°F |
| 0703 | Sabine-Neches Canal Tidal | CR | H | N/A | N/A | N/A | N/A | 4.0 | 6.5–9.0 | 200 | 95°F |
| 0704 | Hillebrandt Bayou | CR | I | N/A | 250 | 100 | 600 | 4.0 | 6.5–9.0 | 200 | 95°F |
| 2411 | Sabine Pass | CR | E/O | N/A | N/A | N/A | N/A | 5.0 | 6.5–9.0 | 14 | 95°F |
| 2412 | Sabine Lake | CR | H/O | N/A | N/A | N/A | N/A | 4.0 | 6.5–9.0 | 14 | 95°F |
| Louisiana | | | | | | | | | | | |
| 110301 | Sabine River | A, B | C | N/A | N/A | N/A | N/A | 4.0 | 6.0–8.5 | 200 | 95°F |
| 110302 | Black Bayou | A, B | C | N/A | N/A | N/A | N/A | 4.0 | 6.0–8.5 | 200 | 92°F |
| 110303 | Sabine Lake | A, B | C, E | N/A | N/A | N/A | N/A | 4.0 | 6.0–8.5 | 14 | 95°F |
| 110304 | Sabine Pass | A, B | C, E | N/A | N/A | N/A | N/A | 4.0 | 6.0–8.5 | 14 | 95°F |

A Primary contact recreation
B Secondary contact recreation
C Propagation of fish and wildlife
CR Contact recreation
E Oyster propagation
H High aquatic life use
I Intermediate aquatic life use
PS Public water supply
O Oyster waters

Cl = Chloride
$SO_4^{-2}$ = sulfates
DO = dissolved oxygen
mg/L = milligrams per liter
ml = milliliters

piped on- and offshore in this area (Long, 1999). However, based on available data, there is no indication of current water or elutriate contaminant problems along the SNWW. Discussions on hazardous, toxic, and radioactive substances in the study area can be found in Section 3.6.

Stream segments 601, 703, and 2411 constitute the SNWW, and none of these segments are classified as nonsupporting on the Clean Water Act (CWA) Section 303(d) list of impaired waters. While several impaired stream segments (0501, 0508, 0511, 0701, and 0704) are located within the study area boundaries, they would not be affected by the direct or indirect effects of channel deepening or construction of any project features and therefore are not evaluated further.

The USACE has collected and archived a significant amount of water and sediment chemistry data. These data are grouped by channel stations (see figures 2.4-1a–g). Also included is a discussion of elutriate, which provides information on those constituents that are dissolved into the water column during dredging and placement. Since the elutriate represents the dissolved concentrations that would be expected in the water column, they are compared to the Texas Surface Water Quality Standards (TWQS), provided by the TCEQ for the protection of aquatic life, Louisiana Surface Water Quality Standards (LWQS), and EPA WQC. Since the values are from grab samples from a marine environment, the acute marine TWQS are used for comparison. Parameters analyzed are listed in Table 3.2-2.

#### 3.3.1.1 Entrance Channel

Historical water and elutriate data for detected compounds from 1993, 1995, 1996, 1998, and 2004 are presented in PBS&J (2004a, 2004b) and Appendix B. Chromium was the only metal found above detection limits in 1993 elutriate samples in channel station, PA stations, and reference stations. However, all concentrations were well below the LWQS and TWQS for chromium. No parameters were detected in 1993 water samples. Barium was not detected in 1993, but was detected in water samples at all stations in 1995, 1996, and 1998 and in elutriate samples at most stations in 1995, 1996, and all stations in 1998. Chromium was detected at one station and copper at two stations for water in 1995. The copper value in the water sample from station S-SB-95-DA4 (26.5 micrograms per liter [µg/L]) was above the LWQS (3.63 µg/L), the TWQS (13.5 µg/L), and the Gold Book WQC (2.9 µg/L). However, S-SB-95-DA4 is a PA site located over 2 miles offshore from the end of the jetties. No copper was detected in the elutriate sample. Other metals found above detection limits in 1996 included copper in elutriate samples and zinc in both water and elutriate samples. In 1998, arsenic, cadmium, chromium, copper, and zinc concentrations were found above detection limits in water and elutriate samples, and selenium was detected in water samples only. The water copper concentration at the reference station S-SB-98-REF3+4 (3.9 µg/L) was above the LWQS and the WQC, but the copper concentration in the elutriate was below the detection limit. Barium concentrations were higher in elutriate samples than in water samples, indicating a potential release of barium into the water column during dredging and placement. Zinc concentrations for water and elutriates were higher in 1996 than in 1998, although all samples were below the LWQS and TWQS. In the 2004 sampling of the Entrance Channel, while copper, nickel, and zinc appeared to increase slightly upon elutriate preparations and selenium decreased slightly, no LWQS, TWQS, or WQC were exceeded for any channel stations. The proposed Entrance Channel Extension was

also sampled in 2004 (Attachment B of Appendix B), and no WQC were exceeded for any channel station water or elutriate sample (stations were all in Federal waters and WQS were not pertinent for comparison).

Table 3.2-2
Sabine-Neches Waterway and Gulf Intracoastal Waterway
USACE Tested Parameters

| Parameter | Water | Elutriate | Sediment |
|---|---|---|---|
| Ammonia | | X | X |
| Total sulfides | | | X |
| Total volatile solids | | | X |
| Metals | | | |
| Arsenic | X | X | X |
| Barium | X | X | X |
| Cadmium | X | X | X |
| Chromium | X | X | X |
| Copper | X | X | X |
| Lead | X | X | X |
| Mercury | X | X | X |
| Nickel | X | X | X |
| Selenium | X | | |
| Silver | | X | X |
| Zinc | X | X | X |
| Polycyclic aromatic hydrocarbons (PAHs) | | | |
| Acenaphthene | | | X |
| Benzo(a)anthracene | | | X |
| Benzo(e)pyrene | | | X |
| Chrysene | | | X |
| Fluoranthene | | | X |
| Naphthalene | | | X |
| Oil and grease | X | X | X |
| Phenanthrene | | | X |
| Pyrene | | | X |
| Total organic carbon | X | X | X |
| Total PAH | | | X |
| Total polychlorinated biphenyls (PCBs) | | | X |
| Total petroleum hydrocarbons (TPH) | | X | X |

For organics in 1998, total petroleum hydrocarbon (TPH) was found above detection limits in two elutriate samples, and ammonia, which was not measured until 1996, was found in high concentrations for both water and elutriate samples. Total organic carbon (TOC) was not measured until 1990, but was found above detection limits for water and elutriate samples at most stations for all years sampled.

Bioassays have been conducted on samples collected from the Entrance Channel (Espey, Huston & Associates, Inc. [EH&A], 1979, 1983a, 1983b; PBS&J, 1999, 2004b; and Appendix B). Survival of organisms exposed to the liquid phase (water) and suspended particulate phase (elutriate) of sediments from the SNWW Entrance Channel was greater than 50 percent in all of these reports. Therefore, no 96-hour $LC_{50}$ (the concentration of a substance that is lethal to 50 percent of test organisms after a continuous exposure of 96 hours) could be calculated. In such cases, the, $LC_{50}$ is assumed to be equal to 100 percent and the dredged material would not be predicted to be acutely toxic to water column organisms since the Limiting Permissible Concentration for water column toxicity/suspended particulate phase has been met (EPA/USACE, 2003). As noted in Appendix B, this also applies to the Entrance Channel Extension.

#### 3.3.1.2 Sabine Pass Channel

Historical water and elutriate data for detected compounds from 1987, 1990, 1992, and 1998 are presented in PBS&J (2004a). Lead and zinc were the only metals found above detection limits in 1987 at all stations in water and elutriate samples. One water sample from station S-SP-87-06 contained 98.0 µg/L of zinc that slightly exceeds the WQC (85.0 µg/L), the LWQS (90 µg/L), and the TWQS (92.7 µg/L). However, the elutriate value was low indicating no release of zinc to the water column during dredging or placement. Metals were not detected in 1990, and in 1992 the only metal found above detection limits was cadmium (in water) at station S-SP-92-06. In 1998, barium and zinc concentrations were found above detection limits for water and elutriate and were consistently higher in the elutriate samples. This contrasts to the 1987 samples, in which elutriate values were normally lower than water concentrations. Arsenic was detected at most stations in water and two stations for elutriate; cadmium and nickel were found in water only. All values, except the zinc value noted above, were below the WQC, LWQS, and TWQS.

Oil and grease were detected in 1987 in water and elutriate samples. Ammonia, which was not measured until 1996, was found above detection limits in all elutriate samples for 1998. For the organics, in 1987 fluoranthene was above detection limits at one station. TOC was detected in all water and elutriate samples during 1992, and elutriate concentrations were consistently higher than water concentrations.

#### 3.3.1.3 Sabine-Neches Canal

Historical water and elutriate data for detected compounds from 1984, 1987, 1989, 1990, 1994, 1995, 1996, 1997, and 1998 are presented in PBS&J (2004a). Copper was the only metal found above detection limits in 1984; zinc was detected in 1987 water and elutriate samples; and metals were not detected in 1989 water and elutriate. In 1990, chromium was detected in water at one station, and zinc at two water and four elutriate stations. Barium and zinc were detected in water and elutriate samples in 1994. In 1995, barium was detected in all water and elutriate samples. One elutriate at station S-SN-95-15 contained high barium (1,096.0 µg/L). There are no WQC, LWQS, or TWQS for barium, but the Gold Book Criterion for barium in domestic water supplies (EPA, 1986) is 1,000 µg/L. Copper in elutriate samples at two stations was detected at levels greater than the WQC (2.9 µg/L) and the WQS (3.63 µg/L) but not the TWQS

(13.5 µg/L) (6.6 µg/L, S-SN-95-13 and 5.0 µg/L, S-SN-95-17). Barium and zinc were also found above detection limits in 1996 in water and elutriate samples. In 1997, barium, cadmium, copper, and nickel were found at most or all stations in water and elutriate; chromium was found in water only; selenium at one station in water; and zinc at all stations for water and one station for elutriate. In 1998, barium and zinc were found in all water and elutriate, and cadmium at one station for water. Except for the 1995 samples noted above, all values were below the WQC, LWQS, and TWQS. Recent sampling and testing within the Sabine-Neches Canal detected nickel in water sample S-SN-08-04A, and arsenic, copper, nickel, and zinc in sample S-SN-08-4A. However, all concentrations of detected metals were below the WQC, TWQS, and LWQS values. In addition, bis(2-ethylhexl)phthalate was detected at 2.31 milligrams per liter (mg/L) in the elutriate sample.

Oil and grease were detected in 1984 and 1987 in water and elutriate samples. Ammonia was above detection limits for all but one water sample in 1996 and all water and elutriate samples in 1998. For the organics, in 1997 TPH was above detection limits at one station (S-SN-97-02). TOC was detected in all or most water and elutriate samples in 1990, 1994, 1995, 1996, and 1997. Detected concentrations in the historic data for TOC were similar in value for all water and elutriate samples. Both ammonia and TOC were detected in the March 2008 water and elutriate samples. However, ammonia concentrations were below the WQC values for both water and elutriate.

#### 3.3.1.4 Port Arthur Turning Basins

Historical water and elutriate data for detected compounds from 1984, 1987, 1989, 1992, 1994, 1996, and 1998 are presented in PBS&J (2004a). Arsenic was found above detection limits for 1984 and 1998 for elutriate samples only. Barium, for which analyses were not conducted before 1993, was detected for both water and elutriate in 1994, 1996, and 1998 (highest concentrations in 1998); cadmium was found in water samples in 1998; lead in one elutriate sample in 1992; and nickel in 1992 (elutriate only) and 1998 (water only). Copper was detected in both water and elutriates in 1984 and elutriates only in 1992 and 1998. Copper in both elutriate samples for 1984 (5.0 µg/L at stations S-PATB-84-08 and S-PATB-84-09) and one from 1992 (9.4 µg/L at station S-PATB-92-10) exceeded the WQC (2.9 µg/L) and LWQS (3.63 µg/L). One copper value from station S-PTBA-92-08 in 1992 (27.9 µg/L) exceeded the WQC, TWQS (13.5 µg/L), and LWQS. Copper was detected only once in either medium, in 1996 and 1998, below the WQC, LWQS, and TWQS. Zinc was detected in 1987 for water and elutriate, in 1992 at one station for elutriate, in 1994 and 1998 for both media. No zinc values exceeded the WQC, LWQS, or TWQS. Metals were not above detection limits for water or elutriate in 1989. Recent sampling and testing in March 2008 within the Port Arthur Turning Basin detected arsenic, nickel, and zinc in water samples, and arsenic, copper, nickel, and zinc in elutriate samples. However, all concentrations of detected metals were below the WQC, TWQS, and LWQS values.

TOC was above detection limits in water and elutriate samples for all stations in 1992, 1994, and 1996 (PBS&J, 2004a). Detected concentrations in 1996 were lower than the 1992 and 1994 samples, which were similar in value for both water and elutriates. Oil and grease were detected in 1984 and 1987 for water and elutriate samples. All oil and grease values were similar except for an increased concentration

at station S-PATB-87-08 of 40.0 mg/L. No organics were detected for any year for water or elutriate samples. Ammonia was detected in all elutriate samples in 1998. Both ammonia and TOC were detected in the March 2008 water and elutriate samples. However, ammonia concentrations were below the WQC values for both water and elutriate.

#### 3.3.1.5 Taylor Bayou Turning Basin

Historical water and elutriate data for detected compounds from 1989, 1994, 1996, and 1998 are presented in PBS&J (2004a). Of the metals, arsenic was found in both water and elutriate at two stations in 1998. Barium was above detection limits in both media in 1994, 1996, and 1998 (highest concentrations in 1998). Cadmium was found in all water samples and nickel in two water stations in 1998. Zinc was detected in 1994 and 1996 in both water and elutriates at all stations and in 1998 for all elutriate samples only (1998 concentrations were the highest). No WQC, LWQS, or TWQS were exceeded. Metals were not above detection limits for water or elutriate in 1989.

TOC was above detection limits for water and elutriates for all stations in 1994 and 1996, and in 1998 for water only (PBS&J, 2004a). No other organics were detected for any year in water and elutriate samples. Ammonia was detected in all elutriate samples in 1998, as has been seen with all reaches sampled of the SNWW.

#### 3.3.1.6 Port Arthur Canal

Historical water and elutriate data for detected compounds from 1987, 1989, 1990, 1992, 1994, 1996, and 1998 are presented in PBS&J (2004a). For the metals, lead and zinc were found above detection limits in both water and elutriate samples in 1987. Zinc was the only metal detected in 1990, and the elutriate value at station S-PA-90-05 (550.0 μg/L) was well above the WQS (85.0 μg/L), LWQS (90.0 μg/L), and TWQS (92.7 μg/L). Since zinc was not detected in water at that station or in the water or elutriate samples 500 feet up and down stream, and the sediment zinc concentration was not high relative to nearby stations, this value appears to be an error. In 1992, lead was the only metal found above detection limits in the elutriate sample. Barium and zinc were detected in both water and elutriates in 1994, and in 1996 barium was found in both media and zinc in elutriate only. For 1998, arsenic was detected in water samples only at 4 of 14 stations; barium in all water and all but one elutriate sample; cadmium in most water and one elutriate sample; copper in most water samples; and nickel at 4 stations. Zinc was also detected in all water and elutriates, at the highest concentrations when compared to historic values. None of the WQC, LWQS, or TWQS was exceeded. Recent sampling and testing in March 2008 within the Port Arthur Canal detected nickel in water samples, and arsenic, copper, nickel, and zinc in elutriate samples. However, the concentrations of metals in both the water and elutriate samples were below the WQC, TWQS, and LWQS values.

Oil and grease were only detected in water and elutriate samples in 1987. TOC was above detection limits in water and elutriate samples for all stations in 1992, 1994, and 1996. No other organics were detected in any year for water and elutriate samples. Ammonia was detected in one elutriate sample (S-PA-98-01) in

1998. Both ammonia and TOC were detected in the March 2008 water and elutriate samples. However, ammonia concentrations were below the WQC values for both water and elutriate.

#### 3.3.1.7 Neches River Channel

Historical water and elutriate data for detected compounds from 1988, 1990, 1994, 1995, and 1997 are presented in PBS&J (2004a). The 1995 stations were sampled in March and September of that year. Of the metals, zinc was detected in water samples from all or most stations in 1990, 1994, and 1997, and elutriate samples in 1994 and 1995 at most stations. However, all concentrations were well below the WQC, LWQS, and TWQS for zinc. Barium was detected in 1994, 1995, and 1997 at all water and elutriate stations. Cadmium was detected in water and elutriate samples from 1997; nickel was detected in three elutriate samples in 1995 and water in 1997; and lead in one elutriate sample (S-NR-95-21, September) in 1995. In 1995 (September), chromium was detected in two water samples and most elutriate samples. Copper was found in all 1995 (September) elutriate samples; all were well above the TWQS (13.5 µg/L), WQC (2.9 µg/L), and LWQS (3.63 µg/L) ranging from 23.8 µg/L to 55.6 µg/L. However, copper concentrations were below detection limits during the March sampling. No metals were detected in water and elutriate in 1988. Except for the copper concentrations noted above, all values were below WQC, LWQS, and TWQS. Recent water and elutriate sampling and testing in the Neches River Channel occurred in April 2009. Results of the tests show all metal concentrations below WQC, LWQS, and TWQS values.

TOC was above detection limits for water and elutriate samples for all stations in 1990, 1994, 1995, and 1997 (PBS&J, 2004a). No other organics were detected in any year for water and elutriate samples. Both ammonia and TOC were above detection limits for water and elutriate in the April 2009 samples. Chrysene (1.16 µg/L), benzo(a)anthracene (0.45 µg/L), benzo(k)fluranthene (0.53 µg/L), and benzo(a)pyrene (0.51 µg/L) were also found in an elutriate duplicate sample from April 2009. There are no WQSs for these PAHs. However, ammonia concentrations were below the WQC for both water and elutriate.

#### 3.3.1.8 Sabine River Channel

Historical water and elutriate data for detected compounds from 1990 and 1995 are presented in PBS&J (2004a). Of the metals, zinc was detected in two of seven water samples and three of seven elutriate samples, but all concentrations were below TWQS, LWQS, and WQC. No other metals were detected in 1990 water and elutriate samples. In 1995, barium was above detection limits in all water and elutriate samples. Copper was detected in all elutriate samples, which were all above the WQC (2.9 µg/L) and LWQS (3.63 µg/L), ranging from 5.0 µg/L to 7.5 µg/L. Lead was also found in elutriates at one station (S-SR-95-04) but at concentrations well below the LWQS, TWQS, and WQC.

TOC was not detected in 1990, but was found above detection limits in all water and elutriate samples in 1995. No other organics were detected in 1990 or 1995.

#### 3.3.1.9 GIWW – Port Arthur to High Island

Historical water and elutriate data for detected compounds for 1983 and 1993 are presented in PBS&J (2004a). Arsenic was the only metal detected in 1983, and it was found in all water and elutriate samples; however, it was not detected in 1993. In 1993, barium and zinc were found above detection limits in all water and elutriate samples, and in most cases elutriate concentrations were higher than water concentrations. All concentrations were less than the LWQS, TWQS, and WQC.

Oil and grease were detected in water and elutriate samples in 1983. TOC was above detection limits for water and elutriates for all stations in 1993 (PBS&J, 2004a). Ammonia was detected in most elutriate samples from 1983, but in none from the GIWW from 1993.

## 3.4 SEDIMENT QUALITY

Data collected by the USACE since 1983 were analyzed to determine the sediment quality of the SNWW. These samples of maintenance material are collected periodically before a maintenance-dredging event, following noncontaminating procedures approved by the USACE and EPA. Reference station material, for comparison with the maintenance material, is collected from areas in the vicinity of and similar to the maintenance material stations, but which have not been impacted by dredging and dredged material placement. For example, the reference station for the Upper Neches River Channel bioassays and chemistry was located in an oxbow off the channel and surrounded by nonindustrial land; the Lower Neches River Channel reference station was located in the Bessie Heights area where the channel material would be used beneficially; the Sabine-Neches Canal reference station was located in east Sabine Lake, near the Sabine NWR; and offshore reference stations were located in designated reference areas, upcurrent of the channel (PBS&J, 2004a; Appendix B).

There are no sediment quality criteria with which to compare concentrations in the sediment; however, there are several different guidelines that are used to look for a cause for concern in sediment samples. One guideline is the Effects Range Low, or ERL. ERL were developed by a technique that demonstrates no cause and effect from the chemicals in the data set. When ERL derived from sets of data from different areas are compared, the results are inconsistent (USACE, 1998b). Since the ERL are not based on cause and effect data, they are used only to determine a possible "cause of concern." The ERL presented here are those given in the NOAA 1999 Screening Quick Reference Tables (Buchman, 1999). Where applicable, reference stations were examined, and in most cases, concentrations were within a factor of five relative to these stations, which is normal, as an examination of years of data collected from maintenance material along the waterway of Texas will show (USACE database). Also, while "higher than" is used in the following discussion, this only means that one concentration is numerically higher than another. However, there was no replication for these samples, and statistical significance, if any, could not be determined.

The need for determining a "cause for concern" is based on the guidance documents developed by the EPA and USACE. Specifically, the *Inland Testing Manual* (ITM) (EPA/USACE, 1998) and the Regional Implementation Agreement (RIA) (EPA/USACE, 2003), which are guidance manuals in EPA Region 6

for inland (including bays) and ocean placement of dredged material, respectively, use a structured hierarchical procedure for determining data needs relative to decision-making. This involves a series of tiers or levels of intensity of investigation—the tiered approach. Typically, tiered testing involves decreased uncertainty and increased available information with increasing tiers. This approach is intended to ensure the maintenance and protection of environmental quality, as well as the optimal use of resources. Specifically, least effort is required in situations where clear determinations can be made whether unacceptable adverse impacts are likely or not likely to occur based on available information. Most effort is required where clear determinations cannot be made with available information. The tiered approach to testing in this ITM and RIA must be initiated at Tier I. The tiered approach is designed to aid in generating physical, chemical, toxicity, and bioaccumulation information, but not provide more information than is necessary to make factual determinations. Tiered testing results in environmental protection by producing a more efficient compilation of necessary evaluations at reduced costs, especially to low-risk operations. Disposal operations that obviously have low environmental impact generally should not require intensive investigation to make factual determinations.

It is necessary to proceed through the tiers only until information sufficient to make factual determinations has been obtained. For example, if the available information is sufficient to make factual determinations, no further testing is required. The initial tier (Tier I) uses readily available, existing information (including all previous testing). More-extensive evaluation (tiers II, III, and IV) may be needed for materials that have a clear potential for impact or for which Tier I information is inadequate to determine the lack of potential for impacts. Tier II is concerned solely with sediment and water chemistry, including comparison of elutriates to WQSs and WQC. Tier III is concerned with well-defined, nationally accepted toxicity and bioaccumulation testing procedures. Tier IV allows for case-specific laboratory and field testing, and is intended for use in unusual circumstances. The approach is to enter Tier I and proceed as far as necessary to make factual determinations, i.e., there must be enough information available to make determinations on water column impact, benthic toxicity, and benthic bioaccumulation. The tests in the ITM and RIA reflect the present state-of-the-art procedures for dredged material evaluation.

The need to determine a “cause for concern” is driven by the tiered approach. If a “cause for concern” arises, sufficient information must be gathered to determine whether the dredged material is acceptable for in-bay or ocean placement. Therefore, the ERL is used as a tool to determine whether there might be a concern with the dredged material, as WQS were used for elutriates. The WQS are standards that must be met whereas the ERLs have no statutory authority.

## 3.4.1 Sabine-Neches Waterway

### 3.4.1.1 Entrance Channel

Historical sediment data for detected compounds from 1993, 1995, 1996, 1998, and 2004 are presented in PBS&J (2004a, 2004b) and Appendix B. Of the metals, chromium, copper, lead, and nickel were detected at all stations for all years. At PA station S-SB-93-DA3, in 1993, copper was detected at a concentration of 70.0 milligrams per kilogram (mg/kg), much greater than the concentrations found at the reference

stations, channel stations, and other PA stations and the DA3 station in 1995. Therefore, it appears to be an aberrant value. Cadmium was detected at all stations in 1993 and 1998; barium and zinc in 1995, 1996, and 1998 at all stations; and arsenic was detected in 1998 at all stations. The zinc concentrations in 1995 were slightly higher than the reference stations. In 2004, the most-inshore station (adjacent to ODMDS 4) tended to have the highest sediment concentration, and the ERL for arsenic was exceeded at this station. However, the elutriate concentration was well below WQS and WQC, and bioassays indicated no toxicity. There were no trends in the data, and no ERL were exceeded by samples from the Entrance Channel Extension in the 2004 samples. The sediments at the channel stations were mostly silt and clay, whereas sediments from the reference and PA stations generally contained a higher sand content. Since trace metal concentrations tend to be positively correlated to silt/clay concentrations, slightly higher metals concentration would be expected in the channel sediments.

Of the organics, TOC was detected only in 1998 but at high concentrations when compared to the reference station. The TOC values were so much higher that there was likely a change in methodology in 1998 because an error in units would not account for the difference. Total volatile solids (TVS) and ammonia (both not measured until 1993) were detected in 1996 and 1998. The reference stations were below detection limits for TVS and in 1998 for ammonia only. However, concentrations of TVS were at least five times the detection limits and ammonia concentrations were also above detection limits in 1996 (S-J-96-DA4) and in 1998 (S-J-98-02, S-J-98-03, and S-SB-98-02). Total sulfides, which was not measured until 1993, were detected in 1998 at most stations at concentrations higher than the reference stations (S-SB-98-REF3&4) that had concentrations below detection limits.

Solid phase bioassays were conducted on Entrance Channel sediments in 1999 (PBS&J, 1999) and in 2004 (PBS&J, 2004b) and on Entrance Channel Extension sediments in 2004 (Appendix B). In all cases, there were no tests in which survival in the Reference Control was greater than survival in the treatments and the difference exceeded 10 percent (20 percent for the amphipods), requiring statistical analysis. Therefore, the survival data from the solid phase bioassay indicate no potential for environmentally unacceptable toxic impacts to benthic organisms from the placement of dredged material from the Entrance Channel or Entrance Channel Extension. Bioaccumulation data in 2004 likewise indicated no expectation of adverse impacts to benthic organisms from the placement of Entrance Channel or Entrance Channel Extension dredged material.

#### 3.4.1.2 Sabine Pass Channel

Historical sediment data for detected compounds from 1987, 1990, 1992, and 1998 are presented in PBS&J (2004a). Arsenic was above detection limits at one station in 1987 and at all stations in 1998. Chromium, copper, nickel, and zinc were detected at all stations in 1987, 1990, 1992, and 1998. Lead was found in 1987, 1992, and 1998 at all stations. Oil and grease were detected only in 1987 but at all stations; TOC was detected at all stations in 1998 (see subsection 3.3.1.2); total PCBs were detected at two stations in 1987; and TVS was detected in 1998 at all stations. Ammonia was detected at all stations in 1998 with the concentration at station S-SP-98-04 (21.4 mg/kg) much higher than at the other stations.

#### 3.4.1.3 Sabine-Neches Canal

Historical sediment data for detected compounds from 1984, 1987, 1989, 1990, 1994, 1995, 1996, 1997, and 1998 are presented in PBS&J (2004a). Arsenic was detected in 1984, 1987, and 1997 at all stations; barium at all stations from 1994 to 1998; chromium in 1987 through 1997 at all stations; copper at every station for all years except 1998; lead in 1987 and 1994 to 1998 at all stations; mercury in 1997 at most stations; nickel in 1989, 1990, 1997, and 1998 at all stations; and zinc in all years at every station. These values were roughly in the same range in all years. However, one station in 1990 (S-SN-90-09) had a copper concentration of 40.0 mg/kg, much higher than the other stations for which values ranged from 3.3 mg/kg to 8.1 mg/kg. This anomalous value of copper does not indicate a cause for concern, since values were lower in subsequent years. Recent sediment samples collected in March 2008 within the Sabine-Neches Canal showed an arsenic concentration slightly greater (9.7 mg/kg) than the ERL value (8.2 mg/kg). All other detected metal concentrations were below the ERL values.

For the organics, TOC was detected in 1994, 1995, 1997, and 1998 with the concentrations in 1998 higher than in previous years (see subsection 3.3.1.3). Oil and grease were detected in 1984 (highest concentration) and 1987; total PAHs only in 1987; and the PAHs, fluoranthene and benzo(a)pyrene in 1987 and 1989 (highest concentration). In 1997, the PAHs, phenanthrene, pyrene, benzo(a)anthracene, and chrysene, plus TPH were detected at most stations. TVS and ammonia were detected at most stations in 1996 through 1998. Total sulfides were only detected in 1996 at three out of seven stations. All values were roughly in the same ranges in all years. Both ammonia and TOC were detected in the March 2008 sediment sample (S-SN-08-04A).

#### 3.4.1.4 Port Arthur Turning Basins

Historical sediment data for detected compounds from 1984, 1987, 1989, 1992, 1994, 1996, and 1998 are presented in PBS&J (2004a). Arsenic was above detection limits in 1984, 1987, and 1998 at all stations, except for one in 1984. Barium was also found in 1994, 1996, and 1998 at all stations. Chromium, copper, lead, nickel, and zinc were detected in 1987, 1989, 1992, 1997, 1996, and 1998 at all stations, with the exception of lead, which was not detected in 1989. These values were roughly in the same ranges in all years. Recent sediment samples collected and tested in March 2008 detected arsenic concentrations in all samples slightly greater than the ERL value of 8.2 mg/kg. The arsenic concentrations in the samples ranged from 8.7 to 11.9 mg/kg. In addition, one sediment sample (S-PATB-08-08) had a copper concentration (49.6 mg/kg) that slightly exceeded the ERL value of 34.0 mg/kg. Chrysene (at 65.3 micrograms per kilogram [µg/kg] vs. ERL = 384 µg/kg), butylbenzylphthalate (66.9 µg/kg vs. no ERL), and pyrene (at 68.5 µg/kg vs. ERL = 665 µg/kg) were found in sample S-PATB-08-08 in March 2008.

TOC was found in 1994 and 1998 at all stations, the 1998 concentrations being much higher than in 1994 (see subsection 3.3.1.4). Total PAH, fluoranthene, and benzo(a)pyrene were detected in 1987 at all stations. Fluoranthene was found at a higher concentration (24.1 mg/kg) at station S-PATB-87-09 than at the other stations. Benzo(a)pyrene was also found at two of three stations in 1989; benzo(e)pyrene in

1996, at one of three stations; and ammonia in 1998, at all stations. Also, oil and grease, in 1984 and 1987, and TVS in 1998, were detected at all stations. Both ammonia and TOC were detected for all sample stations in March 2008.

#### 3.4.1.5 Taylor Bayou Turning Basin

Historical sediment data for detected compounds from 1989, 1994, 1996, and 1998 are presented in PBS&J (2004a). For the metals, chromium, copper, nickel, and zinc were found in all years at all stations. Zinc concentrations were higher in 1994 and 1998, when compared to the 1989 data; however, there are not enough data to indicate a trend. The concentration of copper at station S-PATB-89-12 was 70.0 mg/kg, much higher compared to the data from other years, including later years and, interestingly, at the same anomalous concentration found at S-SB-93-DA3 (see subsection 3.3.1.1). Therefore, there is no trend of increasing copper concentrations with time. Barium was detected in 1994, 1996, and 1998 at all stations, and arsenic in 1998 at all stations. The barium values were roughly the same ranges in all years.

TOC was detected in all 1994 and 1998 samples, the greatest concentrations occurring in 1998 (see subsection 3.3.1.5). Naphthalene was found at one station in 1996; benzo(a)pyrene at one station each in 1989 (14.1 mg/kg) and 1996 (41.5 mg/kg); and benzo(e)pyrene in 1996. Ammonia and TVS were detected in 1998 at all stations.

#### 3.4.1.6 Port Arthur Canal

Historical sediment data for detected compounds from 1987, 1989, 1990, 1992, 1994, 1996, and 1998 are presented in PBS&J (2004a). Nickel and zinc were found in all years at all stations; chromium and copper in all years at most stations; and lead was found in all years (except 1990) at all stations. Arsenic was detected in 1987 at one station and in 1998 at all stations; and barium was detected in 1994, 1996, and 1998 at all stations. All values were in the same range in all years, with the exception of barium in 1994 and 1996, which had more-elevated concentrations than in 1998 values. Recent sediment samples collected and tested in March 2008 detected arsenic concentrations slightly in excess of ERL values for stations S-PA-08-02 (8.95 mg/kg) and S-PA-08-07 (dup) (9.82 mg/kg). All other metals detected had concentrations below ERL values.

Oil and grease were detected in 1987 at all stations. TOC was found in 1994, 1996, and 1998 at all stations, with the 1998 values being the highest (see subsection 3.3.1.6). In 1987, total PAH and fluoranthene were detected at one station, and benzo(e)pyrene was detected in 1996. Ammonia and TVS were detected at station S-PA-98-01 in 1998. Both ammonia and TOC were detected in all samples tested in March 2008.

#### 3.4.1.7 Neches River Channel

Historical sediment data for detected compounds from 1988, 1990, 1994, 1995, and 1997 are presented in PBS&J (2004a). Chromium, copper, nickel, and zinc were found at most or all stations for each year.

Lead was also detected in all years, except 1990, and at most stations, consistent with what was found at the other reaches for this same year. Arsenic was detected in 1988 and 1997 at most stations; barium was detected in 1994, 1995, and 1997 at all stations; and cadmium was detected at most stations in 1988 and 1997. Two stations (S-NR-88-21 and S-NR-88-18) exhibited greater copper concentrations (30.0 mg/kg) when compared to the other stations. Barium concentrations were higher in 1994 than in subsequent years. All other concentrations fell within similar ranges for all years.

Recent sediment sampling and testing occurred in the Neches River on April 1, 2009. Results of the tests showed arsenic at four sample stations (S-NR-09-05, -06, -10, and -11) slightly exceeding ERLs. The exceeded values ranged from 8.37 to 9.41 mg/kg, as compared to the arsenic ERL of 8.2 mg/kg. All other detected concentrations for the remaining metals were below ERL values. Both ammonia and TOC were found above the detection limits in April 2009.

TOC was above detection limits for 1994, 1995, and 1997 at most stations, with concentrations in 1994 the highest (95.0 to 622.0 mg/kg). Naphthalene, fluoranthene, and benzo(a)pyrene were detected in 1994 and 1995 at a few stations. The concentrations of benzo(a)pyrene in 1994 ranged from 36.0 to 533.0 mg/kg, at higher concentrations than in other years. The greatest concentration of fluoranthene occurred in 1995 at station S-NR-95-19 at 266.8 mg/kg. Total PAH, acenapthene, and benzo(e)pyrene were above detection limits in 1995. Concentrations of acenapthene at some stations are high (ranging from 81.4 to 321.9 mg/kg) relative to other stations. Also, TPH, TVS, and ammonia were found above detection limits at in 1997.

#### 3.4.1.8 Sabine River Channel

Historical sediment data for detected compounds from 1990 and 1995 are presented in PBS&J (2004a). In 1990, chromium, copper, nickel, and zinc were above detection limits at all stations. One copper concentration at station S-SR-90-05 was higher (40.0 mg/kg) than at the other stations, but all other concentrations were within the same ranges. In 1995, barium, chromium, copper, lead, nickel, and zinc were above detection limits at all stations. Mercury was found at stations S-SR-95-02 (0.26 mg/kg) and S-SR-95-06 (0.36 mg/kg). Benzo(a)pyrene was found in 1990 at one station at a concentration of 10.0 mg/kg.

#### 3.4.1.9 GIWW – Port Arthur to High Island

Historical sediment data for detected compounds for 1983 and 1993 in the Port Arthur to High Island segment of the GIWW are presented in PBS&J (2004a). Chromium, copper, lead, nickel, and zinc were above detection limits in both years at most stations. Arsenic was also detected in 1983 at all stations; and barium and cadmium were detected at all stations in 1993. All values were roughly the same for both years. TOC was found in 1993 at all stations, with higher concentrations at stations GIP-PAHI-93-17 (528.0 mg/kg) and GIP-PAHI-93-33 (204.0 mg/kg). Ammonia was also above detection limits in 1983 at all stations.

### 3.4.2 Summary

In summary, an examination of the sediment data presented in PBS&J (2004a), and sediment data recently collected in March 2008 and April 2009, indicates no cause for concern, with the possible exception of elevated PAHs in one reach of the Neches River. There are nine sites listed in Table 3.3-1 that are considered to be priority Hazardous, Toxic, and Radioactive Waste (HTRW) sites, and there is a reach of the Neches River (stations 750 + 000 to 950 + 000, see Figure 2.4-1g) that has higher sediment PAH concentrations than other reaches of the SNWW, but the location of the sites in Table 3.3-1 do not correlate to the higher-PAH reach of the Neches River. Additionally, none of those PAHs are found in the elutriate samples from the higher-PAH reach of the Neches River (Section 3.3), so there is no indication that those PAHs would be released during dredging and/or placement. Taking all of this information into account, there appear to be no reaches of the SNWW that exhibit a cause for concern.

Table 3.3-1
Summary of Priority HTRW Sites within Sabine-Neches Waterway

| Site Name | Site ID | Constituents of Concern | Media Impacted | Status |
|---|---|---|---|---|
| Bailey Waste Disposal Site | 512 | Arsenic compounds, benzene, phenols, pyridenes, naphthalenes, and chlorinated hydrocarbons | Surface water, groundwater, soils | Cleanup complete in 1998; Operation and Maintenance underway since 1999 |
| State Marine | 203 | PAHs, metals | Surface water | Evaluation and cleanup are underway, but the nature and extent of contamination and the risks posed to human health and the environment are unknown |
| Palmer Barge Lines | 548 | Aluminum, barium, chromium, cobalt, iron, lead, magnesium, nickel, zinc, pesticides, volatile organic compounds (VOCs), PAHs, pentachlorophenol (PCP), and benzene | Surface water | Evaluation and cleanup underway since 2000; the EPA is considering various remedial alternatives |
| Star Lake Canal | 471 | Chromium, copper, PAHs, and PCBs | Surface water, sediment | Evaluation and cleanup underway since 2001, but the nature and extent of contamination and the risks posed to human health and the environment are unknown |
| International Creosoting | 30 | Arsenic, chromium, lead, creosote compounds, semivolatile organic compounds (SVOC), and VOCs | Groundwater, sediment, soil, surface water | Clean up underway |
| Maintech International | 410 | PAHs | Groundwater, soils | Cleanup completed in 2000; undergoing Operation and Maintenance |
| Excell | 28 | TPH, benzene, toluene, ethylbenzene, and xylene | Groundwater | Investigation underway |
| Port of Beaumont, Beaumont Elevator | 113 | VOCs, herbicides, and pesticides | Groundwater, soils | Investigation underway |
| Woodcrest Site | 584 | VOCs | Soil | Investigation underway |

Source: Banks Information Solutions (2002).

## 3.5 HYDROLOGY

The study area is located within the Neches-Trinity Coastal Basin, the lower Neches River Basin, the lower Sabine River Basin, and the Calcasieu/Sabine River Basin. The Sabine River Basin is long and narrow with a length of approximately 300 miles. The basin has a watershed area of about 9,756 square miles, including 7,396 square miles in Texas. The Sabine River flows southeasterly from its source in Hunt County, Texas, for about 165 miles to the Texas-Louisiana border in the vicinity of Logansport, Louisiana. From there, the river flows in a southerly direction to Sabine Lake and the Gulf. Land surface elevations in the Sabine River watershed vary from a few feet above sea level near the coast to approximately 700 feet above mean sea level at the headwaters. The Sabine River Tidal section is 24 miles long starting from the confluence with Sabine Lake in Orange County to West Bluff in Orange County. Three large tributaries drain into the Sabine River Tidal section within the study area. These tributaries are Little Cypress, Cow, and Adams bayous.

The Neches River originates in southwest Van Zandt County and flows southeasterly through the Piney Woods of east Texas to the confluence with the Angelina River. The upper Neches River has a watershed of about 7,451 square miles and is approximately 150 miles in length. The Neches River Tidal section is 27 miles long starting from the confluence with Sabine Lake in Orange County to a point 7 miles upstream of IH 10 in Orange County. The hydrology of the Neches River Tidal segment is influenced by tidal and freshwater exchange with Sabine Lake and the Sabine-Neches Canal at the lower end of the stream segment, and by freshwater inflows from Pine Island Bayou and the Neches River at the upper end of the stream segment.

Sabine Lake is formed by the confluence of the Neches and Sabine rivers. The lake is 68.7 square miles in size and is fairly shallow, averaging about 4 to 6 feet in depth. The lake is located at the east side of the SNWW from Port Arthur and Pleasure Island. Sabine Lake has a drainage area of approximately 50,000 square miles in Texas and Louisiana that results in freshwater inflow of about 13 million acre-feet per year (McFarlane, 1996). Between Sabine Lake and the Gulf lies Sabine Pass. It is 2.1 square miles in size and is located from the end of the jetties at the Gulf to SH 82.

In addition to the Neches and Sabine rivers, Sabine Lake and the SNWW are fed by a number of smaller watercourses from both the Texas and Louisiana sides of the lake. From Louisiana, several smaller watercourses including Greens Bayou, Johnson's Bayou, Willow Bayou, Three Bayou, Lighthouse Bayou, Starks Canal, Hog Island Gully, West Cove Canal, and Black Bayou drain the Sabine NWR area and provide water exchange between the Sabine Lake and Calcasieu Lake systems. From Texas, the smaller waterbodies contributing to Sabine Lake and the SNWW include Old River Bayou draining to Old River Cove at the north end of Sabine Lake; Bessie Heights Canal draining the Bessie Heights Marsh area; Taylor Bayou draining the Big Hill Reservoir area and the J.D. Murphree WMA; the Keith Lake Channel draining surrounding lakes and marshland to the SNWW; Salt Bayou draining the McFaddin NWR and Sea Rim State Park; and Star Lake draining the southern areas of the McFaddin NWR and surrounding area. Of these smaller waterbodies, the following areas are of particular concern to this study:

- Bessie Heights Canal, located on the Neches River approximately 10 miles upstream of Rainbow Bridge, drains the Bessie Heights Marsh area and the Bessie Heights Oil and Gas Field. There are numerous small canals associated with the development of the oil field feeding into Bessie Heights Canal. These smaller canals have caused increased saltwater intrusion into the marshlands of the Bessie Heights area.
- Salt Bayou, located in southern Jefferson County, feeds Salt Lake and drains the McFaddin NWR to the eastern portion of the GIWW. A water control structure, known as the Salt Bayou Structure, located at the outlet of Salt Bayou into the GIWW prevents saltwater intrusion via the GIWW into the surrounding marshlands that were affected by the deepening of the GIWW and SNWW. The Salt Bayou Structure works in conjunction with the Salt Lake Structure at Perkins Levee to control salinity levels in the McFaddin NWR, Sea Rim State Park, and the J.D. Murphree WMA. The Salt Bayou system is affected by the SNWW through the opening at the Keith Lake Fish Pass.
- Black Bayou estuary and eastern shoreline of Sabine Lake located in Cameron and Calcasieu parishes. This area has suffered significant erosion and loss of marsh area. According to the Louisiana Coast 2050 report (LCWCR/WCRA, 1998), the Black Bayou mapping unit had lost 4,900 acres of marshland between 1978 and 1990 because of altered hydrology and wave/wake erosion.
- Willow Bayou estuary, located in Cameron Parish primarily in the Sabine NWR. This area has suffered significant Sabine Lake shoreline erosion and loss of interior marsh. From 1974 to 1990, 1,140 acres were lost (LCWCR/WCRA, 1999).

Eleven water quality segments, as designated by TCEQ, are included in the Sabine River, Neches River, Sabine Lake, and Sabine Pass. While these segments do not necessarily pertain to hydrology, they are useful for delineating waterbodies for discussion purposes. These include:

| Segment | Identification |
|---|---|
| 0501 | Sabine River Tidal |
| 0501B | Little Cypress Bayou |
| 0502 | Sabine River Above Tidal |
| 0508 | Adams Bayou Tidal |
| 0508A | Adams Bayou Above Tidal |
| 0511 | Cow Bayou Tidal |
| 0511A | Cow Bayou Above Tidal |
| 0601 | Neches River Tidal |
| 0601A | Star Lake Canal |
| 2411 | Sabine Pass |
| 2412 | Sabine Lake |

Upstream of Sabine Pass (excluding the Sabine and Neches river segments) is the Neches-Trinity Coastal Basin and the Sabine River Basin, which include the following major waterbodies or segments as designated by TCEQ. However, some of these waterbodies do not drain into the SNWW.

| Segment | Identification |
|---|---|
| 0701 | Taylor Bayou Above Tidal |
| 0701D | Shallow Prong Lake |
| 0702 | Intracoastal Waterway Tidal |
| 0702A | Alligator Bayou |
| 0703 | Sabine-Neches Canal Tidal |
| 0704 | Hillebrandt Bayou |
| 0704A | Willow Marsh Bayou |
| 0704B | Kidd Gully |
| 110301 | Sabine River confluence with Old River below Sabine Island WMA to Sabine Lake |
| 110302 | Black Bayou from boundary between segments 1103 and 1106 to Sabine Lake |
| 110303 | Sabine River |
| 110303 | Sabine Pass |
| 110602 | Black Bayou – Intracoastal Waterway to boundary between segments 1103 and 1106 |
| 110701 | Sabine River Basin Coastal Bays and Gulf Waters to the State 3-mile limit |

The coastal watersheds along SNWW are generally flat and consist of coastal forested wetlands and marshes, and prairies. The extensive marshlands occur in areas less than 5 feet above mean sea level and extend inland 4 to 15 miles along the entire Gulf shoreline. Marshes and associated swamps extend up the reaches of the Sabine and Neches rivers.

Although the geomorphology of the system indicates that the Sabine Lake estuary was historically a freshwater environment, a survey of the Sabine River by the USACE in 1879 suggests Sabine Lake may have had at least periods of natural saltwater intrusion. Description of plant communities near the mouth of the Sabine River at Sabine Lake indicated the absence of riparian vegetation typical of freshwater rivers in this region and the presence of salt-tolerant plants (USACE, 1980). It is likely that saltwater intrusion may have occurred with tidal surges from Gulf storms resulting in an estuarine environment.

### 3.5.1 Freshwater Flows

The SNWW contains perennial freshwater flow from both the Neches and Sabine rivers and their tributaries as well as tidal flow from the Gulf. The USGS maintains a set of gauge stations in the study area (http://waterdata.usgs.gov/tx/nwis/rt), including:

| | |
|---|---|
| USGS 08041000 | Neches River at Evadale, Texas |
| USGS 08041500 | Village Creek near Kountze, Texas |
| USGS 08041700 | Pine Island Bayou near Sour Lake, Texas |
| USGS 08030500 | Sabine River near Ruliff, Texas |
| USGS 08042522 | Taylor-Alligator Bayou Pump Station near Port Arthur, Texas |

Of these, the USGS gauge near Evadale on the Neches River (08041000), with peak flow records from 1884 to present, and the gauge near Ruliff on the Sabine River (08030500), with peak flow records from 1924 to present, contain the flow data that can best describe the freshwater inflow into the study area. The Evadale gauge has a drainage area of 7,951 square miles, and the Ruliff gauge has a drainage area of

9,329 square miles. Both gauges are upstream of Sabine Lake. Peak flow records for the Evadale and Ruliff gauges range from 5,890 cubic feet per second (cfs) on October 30, 1970, to 125,000 cfs in 1884 and 11,100 cfs on June 11, 1981, to 121,000 cfs on May 22, 1953, respectively. Typical dry weather flows on both the Sabine and Neches rivers each average about 1,200 cfs. Information developed by the Waterway Experiment Station of the USACE (Vicksburg District) indicated that 10 percentile flows range from 57,100 to 418,500 acre-feet/month; mean flows range from 342,400 to 1,540,000 acre-feet/month; and 90 percentile flows range from 612,500 to 3,302,000 acre-feet/month.

### 3.5.2 Water Exchange Patterns between Calcasieu and Sabine Lakes

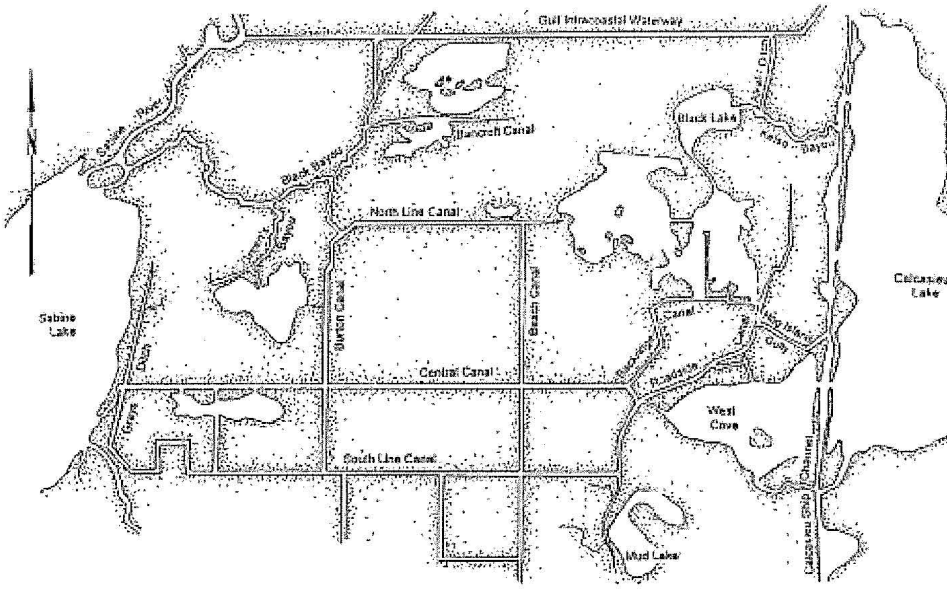
Water exchange between Calcasieu and Sabine lakes occurs through the marsh of the Sabine NWR, located between Calcasieu and Sabine lakes and midway between the GIWW to the north and the Gulf to the south. The GIWW, North Line Canal, Central Canal, and South Line Canal provide hydrologic connections between the two lakes, as shown on Figure 3.5-1. With the exception of a few freshwater marsh impoundments, the area south of the GIWW is tidally influenced, and water level and flow direction can vary daily with tide, wind, stormwater runoff, river stage, barometric pressure, and control-structure operations. Studies of the area have shown that wind is the primary force affecting the flow patterns between the two lakes, resulting in flow patterns that overpower the effects of lunar tides (Paille, 1996).

During prolonged periods of strong southeast and south winds (typically occurring prior to frontal passage), a large volume of Gulf water is forced into Calcasieu and Sabine lakes, raising water levels in the area. The rise in water levels in the lakes causes strong incoming flows to occur in the surrounding marshes. The large area of marsh and shallow open water extending northward from Backridge Canal to Hackberry can also experience a push of water northward. This northward push of water causes water levels in the southern end of the open-water area to lower, facilitating flow into the area from Calcasieu Lake via Hog Island Gully and Kayo Bayou. In addition, the Roadside Canal flows strongly toward the southern end of the open water, importing water from Calcasieu Lake via the Headquarters Canal and West Cove Canal water control structures. During these wind conditions, Backridge Canal flows northward toward the southern end of the open area. At the northern end of the open-water area, these high-tide conditions result in discharge of water through Rycade Canal toward Black Lake. The discharge through Rycade Canal is often very strong as a result of substantial head differential that can be created by the wind-induced lowering of water levels in the southern portion of Black Lake. North Line Canal conveys large volumes of water from wind-induced high-tide areas within the Sabine NWR toward Sabine Lake by way of Black Bayou (Paille, 1996).

During prolonged periods of strong northerly winds (typically occurring after frontal passage), water levels in the nearshore Gulf and within Calcasieu and Sabine lakes lower, often resulting in a continuous outflow from Calcasieu and Sabine lakes. The large area of marsh and shallow open water extending northward from Backridge Canal to Hackberry can also experience a push of water southward and, thus, raising water levels in the southern end of the open water and lowering water levels in the northern end. This southward push of water in the open water often results in a strong flow toward Calcasieu Lake due

**FIGURE 3.5-1**

**MAP OF HYDROLOGIC CONNECTIONS BETWEEN SABINE LAKE AND CALCASIEU LAKE**




Source: Paille, 1996

to the lowering water levels in the lake caused by the outgoing flows. The Backridge and Roadside canals can convey large volumes of water from the high-water-level areas toward Calcasieu Lake via Headquarters Canal and West Cove Canal water structures. Flow patterns in Rycade Canal can vary, however, with the North Line Canal west of Beach Canal typically draining west toward Sabine Lake (Paille, 1996).

During summer months, when winds are typically light and variable, lunar tides generally dominate the flows between Calcasieu and Sabine lakes. Normal flow patterns for ebb tides are similar to frontal passage and for flood tides are similar to conditions prior to frontal passage, but in smaller magnitudes. During ebb tide, GIWW, North Line Canal, Central Canal, and South Line Canal drain the Sabine NWR marsh area simultaneously toward both Calcasieu and Sabine lakes, with no-flow sections in each canal that vary with wind, water levels, river stages, and control-structure operation (Paille, 1996).

### 3.5.3 Flow Diversion, Demands and Discharges

#### 3.5.3.1 Flow Diversions

Flow patterns and salinity in Sabine Lake, surrounding marshes, and tributaries have changed as a result of navigational dredging. In 1876, a sandbar was removed from Sabine Pass to aid in navigation, which consequently facilitated saltwater intrusion into Sabine Lake (USACE, 1975a, 1998a). Since then, channel deepening and widening has exacerbated saltwater intrusion into Sabine Lake and surrounding marshes and tributaries. In addition, Sabine Lake, Calcasieu Lake in Louisiana, and surrounding waterbodies have been connected through man-made canals and the GIWW. Tidal currents emanating from the Gulf transport seawater through Sabine Pass into Sabine Lake and adjacent waterbodies. Although the lake and associated waterbodies are low-energy environments, wind-generated currents strongly influence water movement within the system (Paille, 1996). As a result, a complex hydraulic relationship has developed within this area.

Several saltwater barriers in the study area restrict saltwater intrusion into upstream areas. In Texas, along Taylor Bayou, two saltwater barriers and sets of navigation locks are located approximately 2 miles upstream of the mouth of Taylor Bayou. Originally installed for irrigation purposes, the saltwater barriers along Taylor Bayou now primarily serve as a preventative measure for stopping saltwater intrusion into freshwater marshes and maintaining water level for recreation purposes (JCND, 2002). Additionally, the TPWD also maintains several small saltwater barriers in various locations along the GIWW for the purpose of protecting freshwater marshes and habitat within the J.D. Murphree WMA (JCND, 2002). Saltwater intrusion from the GIWW is controlled by water control structures at Perkins Levee and the opening of Salt Bayou to the GIWW (USACE, 1992), but the marshes remain open to the salinity influence of the SNWW through the Keith Lake Fish Pass. The GIWW structures are manually controlled by the TPWD and can be opened to help drain the area when the marshes have been flooded with higher-salinity waters during hurricanes. In the Texas Point NWR, low rock weirs have been constructed on several small channels in the intermediate and brackish marshes; however, unrestricted flow still is provided through the largest stream in the hydro-unit, Texas Bayou.

The area within the Calcasieu/Sabine River Basin has experienced accelerated marsh deterioration and conversion to shallow open water as a result of the construction of the Calcasieu Ship Channel, the SNWW, and the GIWW. Efforts to combat the increased flow of salt water into the area include both structural and vegetative methods. A 1990 inventory of water control structures along the perimeter and interior of the Calcasieu/Sabine River Basin located 174 structures. Examples of these water-control structures include (Marcantel, 1996):

| Location | Description |
|---|---|
| Louisiana SH 82 at Calcasieu Ship Channel | Three-barrel structure allows only one-way flow into Calcasieu Ship Channel |
| Louisiana SH 27 at Holly Beach, Louisiana | Two-barrel structure allows only one-way flow into the roadside ditch along Louisiana SH 82 |
| Structure at First Bayou | Bulkhead structure with two bays managed so that two-way flow is possible until salinity levels reach or exceed 7 ppt in the road ditch along west Louisiana SH 27 |
| Hog Island Gully | Fixed crest weir with tainter arm gate that remains open until salinity levels reach 12 ppt in Brown Lake (on the north end of the Sabine NWR) |
| West Cove Canal | Fixed crest weir with tainter arm gate that remains open until salinity levels reach 12 ppt in Back Ridge Canal of the West Cove Canal structure |
| Headquarters Canal | Single-barrel structure where gates remain open until salinity levels reach or exceed 12 ppt in Brown Lake |
| Rycade Canal | Bulkhead structure with seven bays managed so that flap gates are allowed to operate when water levels in interior marshes are above marsh level and/or salinity at the structure reaches or exceeds 5 ppt |
| Gray's Ditch Levee/Cattle Walkway | Levee has two openings (one at unnamed bayou and one at Willow Bayou) and forms a barrier along the east bank of Sabine Lake |
| Deep Bayou | Two-barrel structure allows one-way flow out of Deep Bayou into Johnson's Bayou |
| South Starks Canal | Three-barrel structure allows one-way flow to the east |

More recently, two CWPPRA hydrologic restoration projects have been completed in the Black Bayou and Willow Bayou marshes east of Sabine Lake:

- The East Sabine Lake Hydrologic Restoration Project (CWPPRA Project No. CS-32), approved in 2001, has nearly been completed (USGS-NWRC, 2004). Project goals include the reduction of salinities within interior marshes, encouragement of submerged aquatic vegetation (SAV) development, hydrologic restoration of historic flows, reduction of turbidity in open-water areas, and the restoration and protection of marsh through earthen vegetative terraces. Construction Unit 1, completed in 2006, includes a rock weir at Pines Ridge Bayou, two flapgate culverts at Bridge Bayou, a rock plug at Double Island Gully, a 3,000-foot-long foreshore rock dike along the Sabine Lake shore north of Willow Bayou, and approximately 32 miles of vegetated earthen terraces in large shallow open-water areas south of Greens Lake and south of Willow Bayou Canal. Hydrodynamic modeling of proposed Construction Unit II water control structures (fixed crest weirs with boat bays) at Right Prong, Greens, Three, and Willow bayous was completed in 2004 (USFWS-LDNR, 2008a). The modeling predicted that the proposed structures would have very little effect on reducing project area salinities, and therefore Construction Unit 2 components were deleted from the restoration plan in 2006. The Pines Bayou weir was rehabilitated in 2007

due to heavy damage from Hurricane Rita. Four 50-foot-wide gaps were also installed in 2007 in the breakwater near Willow Bayou. Additional in situ earthen terraces are also planned.

- The Black Bayou Hydrologic Restoration Project (CWPPRA Project No. CS-27) was constructed in 2001 for the purpose of restoring coastal marsh habitat and slowing the conversion of wetlands to shallow open water. The project limits the amount of saltwater intrusion into the surrounding marsh and canals from Black Bayou and the GIWW and reduces erosion caused by wave action from nearby boats and tides (USGS-NWRC, 2002c). These elements are (1) approximately 4.3 miles of rock foreshore dike along the south shore of the GIWW; (2) the Black Bayou Cut-off Canal rock weir with boat bay; (3) the Burton Canal weir with boat bay; (4) the Block's Creek rock weir with boat bay; and (5) a self-regulating tide gate for the NO-13 unit wetlands. The objective of the tide gate is to divert fresh water from the GIWW and create a hydrologic head that maximizes freshwater retention time and reduces saltwater intrusion and tidal action. Terracing and vegetative plantings are also planned as part of the CWPPRA project.

Flows into Sabine Lake have been greatly altered from their natural hydrograph due to major impoundments in the middle and upper Sabine and Neches river basins. The flow regime of the lower Sabine River is affected by Toledo Bend Reservoir, which provides electric power, flood control, and irrigation water. Playing a lesser role, but nevertheless affecting water availability in the Sabine River, are a number of smaller reservoirs upstream of Toledo Bend Reservoir in Texas. The larger of these impoundments include lakes Tawakoni, Fork, Cherokee, Martin Creek, and Murval. Additionally, the flow regime of the lower Sabine River is affected by two diversion canals near Sulphur, Louisiana, which were constructed to provide municipal, industrial, and irrigation water to Calcasieu Parish in Louisiana and Orange County in Texas. The diversion pumps currently operate at 20 percent of their capacity that results in an average daily flow of 336 cfs to Calcasieu Parish and 560 cfs to Orange County.

The flow regime of the Neches River is strongly influenced by Sam Rayburn Reservoir and to a lesser extent by B.A. Steinhagen Reservoir. Other reservoirs that affect water availability within the Neches River are upstream of Sam Rayburn Reservoir and include lakes Palestine, Tyler, Jacksonville, Striker, and Nacogdoches.

Saltwater intrusion in the Neches River became a problem with the construction of the first deepwater navigation channel to Beaumont in 1915 (USACE, 1998a). Since that time, salt water has threatened freshwater intakes on the Neches River. In the past, temporary saltwater barriers and freshwater discharges (up to 2,500 cfs) from Sam Rayburn Reservoir were used to prevent encroachment of salt water (Lower Neches Valley Authority [LNVA], 2002; USACE, 1998a). A saltwater barrier was constructed on the Neches River immediately downstream of the confluence of the Neches River and Pine Island Bayou (USACE, 2004b). Operation of the new saltwater barrier will preclude the need for large freshwater releases from Sam Rayburn Reservoir during periods of drought, resulting in a net reduction of freshwater inflow into Sabine Lake (LNVA, 2002; Mosier, 2002). However, provisions for maintaining environmental flows to protect high-quality wetlands downstream of the saltwater barrier during periods of drought are currently being developed (Mosier, 2002). Under this plan, special gate operations for wildlife and environmental management will be coordinated with the USACE. This will include providing enough freshwater inflow to maintain a specific conductance of 2,800 microsiemens or less

(within 10 feet of the surface) at the IH 10 bridge near Beaumont. While freshwater habitats in the Neches River will be maintained by the operation of the new saltwater barrier, it is likely that freshwater inflows into Sabine Lake will be less under drought conditions than historical inflows.

In May 2007, the Texas House of Representatives and Senate passed HB3 and SB3, respectively, which was signed by the Governor on June 15, 2007 (Texas Legislature Online [TLO], 2007). The "Environmental Flows" Act took effect on September 1, 2007 (TLO, 2007). The Act creates an administrative process to determine environmental flow needs for the rivers, bays, and estuaries of Texas. After the needs are established, TCEQ is required to develop and adopt rules to (1) provide environmental flow standards necessary to support the ecology of every river and bay system in Texas; (2) establish an amount of unappropriated water that would be set aside for satisfying the environmental flow standards; and (3) create a process for reducing the amount of water that would be available under a water rights permit, issued after the bill's effective date, to protect the environmental flow standards. TCEQ identified the lower Sabine River as one of the first tier of instream flow studies to be initiated. TCEQ has contracted with the Sabine River Authority of Texas (SRA-TX) for assistance in the Lower Sabine Priority Instream Flow Study. Based on the results of this study, TCEQ will establish environmental flow standards for the Sabine River/Neches River/Sabine Lake system by September 1, 2010.

#### 3.5.3.2 Freshwater Demands and Discharges

Water demands and supplies have been analyzed for the East Texas Region (Region I), consisting of 20 counties as far north as Smith County that includes the City of Tyler (TWDB, 2007). The projected regional water demand for the year 2010 is 896,455 acre-feet. Manufacturing represents 45 percent of the amount and irrigation is 25 percent. Municipal and county demand represents 21 percent of that amount. This demand is projected to increase by 41 percent by the year 2060. Water supply projected for 2010 is 1,158,261 acre-feet, with 80 percent of the supply from surface water. The remainder of the supply is from groundwater. While demand is projected to slightly exceed the existing supply by the year 2060, the recommended water management strategy for the region would result in an additional 324,756 acre-feet of supply (TWDB, 2007). The plan anticipates expanded exports of water to Region C (Dallas-Fort Worth area).

During dry conditions, stream flow is influenced by the discharge from permitted wastewater treatment plants or point sources along tributaries. For the Neches-Trinity Coastal Basin, which includes Taylor Bayou, there are 89 permitted point sources that have a combined permitted flow of 214 million gallons per day (MGD), or 330 cfs. The Neches River Basin has 225 point sources for a combined permitted flow of 1,341 MGD, or 2,070 cfs; and the Sabine River Basin has 166 point sources for a combined permitted flow of 1,647 MGD, or 2,550 cfs. While actual discharges are usually much smaller than the permitted flows, and not all of these point sources are located within the study area, some of the discharges would affect salinity levels in the study area during drought periods.

### 3.5.4 Tides

Tides in the SNWW and Sabine Lake are dominated by the tides emanating from the Gulf, but lag by about 1 hour from offshore to Sabine Pass and by 4 to 5 hours from offshore to the upper reaches of the SNWW. Normal tidal fluctuation in the study area is small with a diurnal range of 1 to 2 feet (Mantz and Dong, 1996).

The Texas Coast Ocean Observation Network (TCOON) maintains tide gauge stations at Sabine Pass, Mesquite Point, Port Arthur, Rainbow Bridge, and Orange. These gauges vary in length of record from 5 to 10 years. The statistics of tidal records at these TCOON gauges can be found on the TCOON website (http://lighthouse.tamucc.edu/TCOON/HomePage). A tidal range varying from 1.03 feet at Sabine Pass to 0.65 foot at Orange can be derived from the tide records. These ranges are typical of the Gulf coast area.

Water levels in the SNWW are also influenced by the prevailing winds from the south-southeast. Water levels generally rise slightly with winds out of the south and south-southeast and fall, sometimes significantly, with winds from the north or northwest. Water surface elevations in the SNWW can vary greatly when driven by wind and storm activity. Water levels as low as –4 feet during strong northwesterly winds and as high as +16 to +18 feet during hurricane surges have been observed.

### 3.5.5 SNWW and Salinity

Tidal flow originating from the Gulf influences the tidal regime of the SNWW, including Sabine Lake and Calcasieu Lake. During periods of drought, the flow in the Neches and Sabine rivers can drop drastically and a saltwater wedge can proceed farther upstream of both the Sabine and Neches rivers from the Gulf (LNVA, 2002; SRA-TX, 2002). While saltwater intrusion has been detected in salinity samples in the Sabine River Tidal reach, a definite saltwater wedge has not been identified because of the fluctuation of freshwater inflows from upstream. A definite saltwater wedge is evident in the Neches River, and a new saltwater barrier located approximately 30 stream-miles upstream of Rainbow Bridge has been installed to prevent saltwater intrusion north of the Port of Beaumont (see subsection 3.5.3.1 for additional discussion).

The strength and intensity of winds and intensity of rainfall influences salinity levels in the SNWW, Sabine Lake, and Calcasieu Lake. The salinity of the water ranges from approximately 34 ppt in the open Gulf to 0 ppt in the upper reaches of the Neches and Sabine rivers. Sabine Lake is predominantly brackish with salinity ranging from 15 ppt at Sabine Pass to 0 ppt at the northern end of the lake near Rainbow Bridge. Calcasieu Lake is also brackish, but generally experiences salinity levels higher than those found in Sabine Lake. Given that both lakes are tidally influenced and water exchange patterns between the two lakes vary with tides and wind, the fluctuating salinity levels can often be extreme. The Sabine NWR and the waterways connecting the two lakes also experience fluctuating salinity levels, however, generally, not in the extremes observed within the two lakes. Sabine Lake relies on freshwater inflow from the Neches and Sabine rivers, while Calcasieu Lake relies primarily on the Calcasieu River for freshwater

inflow. The Sabine NWR relies primarily on rainfall for fresh water, and its salinity increases during periods of drought as the salinity in the two lakes rises (Paille, 1996).

During drought periods, salt water can travel more easily through the deeper SNWW than shallower Sabine Lake, thus the northern reach of the lake and associated marshlands can have the unique condition of having greater salinity levels than those areas to the south. This is because salt water traveling in the SNWW can enter northern marshes that typically have salinity levels buffered by freshwater inflows from the Sabine and Neches rivers. Saltwater entering the northern marshes can result in build-up of salinity concentrations. During periods of normal rainfall, high-salinity water transported by the SNWW is buffered by discharges from upstream reservoirs that have little effect on the salinity levels of Sabine Lake and the surrounding marshes. On the other hand, during periods of high flows, the SNWW and Sabine Lake can experience occasional freshwater conditions (very low salinity levels) due to large quantities of fresh water entering the system from the Sabine and Neches rivers (Coalition to Restore Coastal Louisiana, 2002).

Fifty-six stations provide salinity data measured from the monitoring stations within the study area. Data from the stations can be obtained from TCEQ's Standard Water Quality Monitoring (SWQM) database, which is used to support the Texas Clean Rivers Program and the preparation of Texas Water Quality Inventory (TCEQ, 2002). The locations of these stations range from the USCG station in Sabine Pass upstream to all the tributaries (e.g., Black Bayou, Cow Bayou, Adams Bayou) to the upper reaches of the Neches and Sabine rivers in the study area, and in the GIWW east of the Sabine River and west of Port Arthur. Salinity, as a function of depth from several stations along the SNWW, is of particular interest because the heavier salt water tends to move upstream along the bottom of the deep, stratified channel while freshwater flowing on top of the saltwater current moves downstream. The data from the project area show a clear trend of reduced bottom salinity when moving upstream along the SNWW, from about 25 ppt at Sabine Pass to about 15 ppt at IH 10 on Neches River near Beaumont and 10 ppt at the upper portion of Sabine Lake near the confluence with the Sabine River. The stations at the GIWW (about 7 miles upstream of Sabine Pass) and at Topco Dock (about 6 miles upstream of the GIWW) have bottom salinities of about 23 ppt and 20 ppt, respectively. These values clearly show the level and extent of salinity intrusion along SNWW.

### 3.5.6 Groundwater Hydrology

Groundwater in the project area is withdrawn from the Gulf coast aquifer system. The Gulf coast aquifer consists of complexly interbedded clays, silts, sands, and gravels of Cenozoic age, which are hydrologically connected to form a large, leaky artesian aquifer system that extends from the Rio Grande northeastward across the Gulf Coastal Plain past the Louisiana-Texas border. In the project area, the Gulf coast aquifer is subdivided into several parts, of which the Chicot aquifer is the uppermost (Figure 3.5-2). The Chicot aquifer consists of the Willis, Lissie (Montgomery and Bently), and Beaumont formations, and overlying alluvial deposits. The Chicot aquifer includes all deposits from the land surface to the top of the underlying Evangeline aquifer. The physical basis for separation of the Evangeline and Chicot aquifers is the difference in lithology and permeability (Wesselman, 1971). In some area, clay beds

Figure 3.5-2. Geologic and Hydrologic Units within the Project Area

<table>
<tr><th rowspan="2">System</th><th rowspan="2">Series</th><th colspan="3">Stratigraphic Unit</th><th colspan="3" rowspan="2">Hydrologic Unit</th></tr>
<tr><th colspan="2">Texas</th><th>Louisiana</th></tr>
<tr><td rowspan="7">Quaternary</td><td rowspan="2">Holocene</td><td colspan="2">Quaternary Alluvium</td><td>Quaternary Alluvium</td><td rowspan="5">Chicot Aquifer</td><td rowspan="3">Upper Unit</td><td rowspan="9">Gulf Coast Aquifer</td></tr>
<tr><td rowspan="5">Pleistocene</td><td colspan="2">Beaumont Clay</td><td>Prairie Formation</td></tr>
<tr><td rowspan="3">Lissie Formation</td><td>Montgomery Formation</td><td>Montgomery Formation</td></tr>
<tr><td>Bently Formation</td><td>Bently Formation</td><td rowspan="2">Lower Unit</td></tr>
<tr><td colspan="2">Willis Sand</td><td>Willianna Formation</td></tr>
<tr><td rowspan="2">Tertiary</td><td>Pliocene</td><td colspan="2">Goliad Sand</td><td>Foley Formation</td><td colspan="2">Evangeline Aquifer</td></tr>
<tr><td>Miocene</td><td colspan="2">Fleming Formation</td><td>Fleming Formation</td><td colspan="2">Burkeville Aquiclude</td></tr>
</table>

separate the aquifers, but these beds are not continuous. The higher permeabilities are usually associated with the Chicot aquifer.

The Chicot aquifer has been divided into an upper unit and lower unit. These units are separate by a clay bed; however, in some parts of the study area, the upper and lower units merge to form one large mass of interbedded and interconnected sand and clay. The upper unit of the Chicot typically consists of a basal sand overlain by clay. Most of the sand is part of the Montgomery Formation, and the clay is part of the overlying Beaumont Formation. The lower unit generally consists of two or more massive sands separated by clay. Northwestward, the sands thin and the clay content of the lower unit increases.

The Evangeline aquifer underlies the Chicot aquifer and is the lowermost unit containing fresh to slightly saline groundwater within the project area (see Figure 3.5-2). The Evangeline aquifer consists of the Goliad Sand and upper portions of the Fleming Formation. The aquifer is underlain by the Burkeville aquitard, which forms the lower confining unit for the Evangeline aquifer.

Water well records kept by the TWDB for Orange and Jefferson counties indicate that the majority of water wells in the project area are completed in the upper and lower units of the Chicot aquifer. Of the wells installed in the Chicot, most are completed in the lower unit typically at depths between 400 and 800 feet. Wells completed in the upper unit of the Chicot aquifer were typically completed at depths ranging from 15 feet or less to 300 feet. Groundwater is reportedly used for domestic, public supply, stock, and industrial purposes.

Groundwater recharge to the aquifers occurs by precipitation onto outcrop areas and vertical leakage from overlying aquifers. However, most precipitation runs off and becomes stream flow or evaporates immediately and only a small fraction of the total rainfall recharges the surficial aquifer. Regional groundwater flow in the aquifers is generally southeastward from outcrop areas towards areas of natural discharge (Gabrysch and McAdoo, 1972; Wesselman, 1971). However, superimposed upon this natural discharge regime is artificial discharge caused by groundwater pumping. Because of groundwater development, water levels have declined and cones of depression around areas of groundwater pumping have developed altering the natural flow pattern, and groundwater now flows towards these centers of pumping.

Groundwater quality in the Chicot aquifer varies widely across the study area. In general, the water in the aquifer increases in salinity in the southern part of the study area near the coastline. Groundwater quality data from the TWDB database indicate that groundwater from water wells completed in the Chicot aquifer within the project vicinity generally has total dissolved solids (TDS) concentrations less than 200 mg/L (fresh) to more than 3,000 mg/L (slightly to moderately saline). Most of the groundwater from the Chicot aquifer has an average TDS concentration of less than 1,500 mg/L. Chloride concentrations typically ranged from less than 50 mg/L to over 600 mg/L and averaged around 450 mg/L.

### 3.5.7 Erosion

Several locations in the study area are experiencing significant erosion: the side of Pleasure Island bordering the Port Arthur and Sabine-Neches canals, the eastern shore of Sabine Lake, and the Gulf shoreline in Texas and Louisiana. Each of these areas is discussed below.

The rate of erosion of the Pleasure Island shoreline varied between 4.2 and 16.5 feet per year during the 20-year period 1974 through 1993 (Parchure et al., 2005). Erosion appears to be caused predominantly by surges, stern waves, and rapid drawdown resulting from vessel traffic within the constricted Sabine-Neches waterway (Maynord, 2005). The fetch is limited for the constricted waterway; wind waves are, therefore, relatively small in magnitude and not likely to contribute significantly to existing erosion rates. In addition, the highly erodible and weakly compacted soil on Pleasure Island makes it vulnerable to erosion from any source.

Marsh loss caused by wind-induced wave action is also occurring along the east Sabine Lake shoreline north of Willow Bayou at an average rate of 4.7 feet/year (Greco and Clark, 2005). Visual observations and GIS analyses confirm that the shoreline near the Willow Bayou mouth has shifted towards Willow Bayou leaving a narrow strip of land, which may be on the order of only 30 to 50 feet wide, separating Willow Bayou and Sabine Lake. Tall natural grass grown on this strip of land has not been able to arrest the erosion because the grass roots are not able to hold the soil firmly attached to them. Sabine Lake has a large water surface area, which provides sufficient fetch for significant wave generation and, in the shallow-water depths, the waves breaking on the shore have sufficient energy to cause serious erosion.

Texas Point is undergoing severe beach erosion, with shoreline retreat of up to 1,150 feet between 1974 and 2000 (King, 2007; Morang, 2006). This is the highest rate of shoreline loss on the upper Texas coast and a CEPRA "critical erosion area" (GLO, 2005). In Louisiana, persistent erosion along the shoreline between Ocean View and Holly Beach, on the order of –4.3 feet/year between 1985 and 1998, was recorded here prior to Hurricane Rita (USACE, 1971a, 2004a). Nearer to Louisiana Point, significant accretion over the last 100 years has slowed to +1.2 feet/year, and the behavior of this shoreline has become erratic, with some areas eroding and some aggrading (USACE, 2004a). Hurricane Rita deposited 3.3 feet of new sediment on the Hackberry Beach chenier ridge, and reworked sediment was observed bar welded to the lower shoreface (Farris et al., 2007; Guidroz et al., 2006). Hurricane Ike eroded the beach ridge at the McFadden NWR (Federal Emergency Management Agency, 2008). Impacts to this ridge increase the probability that interior marshes will be exposed to saltwater intrusion in the near future.

## 3.6 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The purpose of the HTRW assessment is to identify indicators of potential hazardous materials or waste issues relating to the study area. A review was conducted of databases maintained by Federal, State, and local regulatory agencies, an aerial photographic review, and interviews with officials from the TCEQ and the USACE to determine the location and status of HTRW sites regulated by the State of Texas and the EPA. A review was also conducted of oil and gas wells and pipelines located within the study area. These

data were obtained from the Texas Railroad Commission (RRC) and the LDNR. Support data for the assessment can be found in PBS&J (2002).

The scope of the regulatory information search included the following Federal and State databases: the National Priority List (NPL); the State Equivalent Priority Sites (State Sites or SPL); Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) Database; Resource Conservation and Recovery Act (RCRA) Generators and Violators List (RCRA-G); RCRA Corrective Actions List (CORRACT); RCRA Treatment, Storage, or Disposal List (RCRA-TSD); TCEQ and LDEQ Underground and Aboveground Storage Tank Database; Leaking Underground Storage Tank Listings (LUST); City/County and Parish Solid Waste Landfill listings (SWL); Emergency Response Notification System (ERNS) database; TCEQ and LDEQ Spills Incident Information System database; National Pollution Discharge Elimination System (NPDES) database; Toxic Release Inventory System (TRIS) database; and Facility Index System (FINDS) database. A total of 1,789 records were identified within the study area during the various regulatory agency database searches. Several of the records are associated with the same facility or property (e.g., a facility/property containing multiple petroleum storage tanks is also the site of several reported spills or emergency response actions). The 1,789 database records are associated with a total of 598 facilities or properties within the study area. On the basis of results of the regulatory agency database searches, the following sites are located within the study area:

- 4 NPL sites;
- 33 CERCLIS sites, 30 sites with No Further Remedial Action Planned designation;
- 9 CORRACT sites;
- 151 RCRA-G sites;
- 11 RCRA-TSD sites;
- 776 petroleum storage tanks at 289 facilities;
- 74 LUST sites;
- 4 State Voluntary Cleanup sites;
- 515 reported ERNS actions at 93 facilities/properties;
- 414 reported spills at 22 facilities/properties;
- 45 TRIS listings associated with 30 facilities;
- 221 FINDS database listings associated with 207 facilities/properties; and
- 2 unpermitted (inactive) municipal SWL.

Aerial photographs of the study area were used to examine the historical use of the SNWW and the surrounding watershed. The photographs depict portions of the study area as it appeared in 1930, 1938, 1955, and 1956. The aerial photographs were obtained from Tobin International, Ltd. Examination of aerial photography indicated that development within the study area was, as it is today, predominantly located west of the Sabine and Neches rivers. Development occurs in the urban centers of Texas that

include Beaumont, Port Arthur, Port Neches, Nederland, Orange, West Orange, Bridge City, and Rose City. The remainder of the Texas portion of the study area is vacant, undeveloped land. With the exception of Vinton, the Louisiana portion of the study area is vacant, undeveloped land. The study area includes a variety of land uses, which include highly developed residential-urban, industrial, recreational, and vacant, undeveloped range-pasture or WMAs.

Urban development within the study area is located adjacent to major highways. An industrial corridor composed of petroleum refineries, petrochemical plants, ship docks, shipyards, ship builders, grain elevators, PAs, warehouses, wastewater treatment plants, and a power plant parallels the SNWW. Utilization of vacant, undeveloped land is for agriculture and oil and gas production. For additional discussion on land use, see subsection 3.14.4.

According to information derived from regulatory agency records and TCEQ regional officials, regional industrial activity has caused measurable impacts to the surface water, sediment, soil, and groundwater in the study area. However, chemical analyses of sediment, elutriate, and surface water samples collected from the waterway indicate that these impacts have apparently been minimal (sections 3.3 and 3.4). The nature and potential for any HTRW site to impact the surrounding environment varies considerably. The majority of the regulated facilities and incident locations (i.e., spills and releases) identified in the regulatory agency database review do not pose a significant environmental concern for the project. However, several facilities within the study area do have a greater potential to impact the environment. These facilities are considered a potential threat based on the nature and extent of contaminants at the site, the location relative to the waterway, and the number of pathways in which the contaminants could reach the waterway. The facilities that are considered priority HTRW sites of concern are summarized in Table 3.3-1.

A baseline evaluation of facilities that pose a potential threat to the project must also consider whether the release of contaminants is ongoing or has been effectively eliminated through remedial efforts. Based on these criteria, State Marine, Palmer Barge Lines, Star Lake Canal, and Beaumont Elevator continue to present an ongoing threat to impact the environment of the study area. The remaining priority sites present a lesser threat due in part to either effective corrective action or distance to the waterway. Detailed site information of each of these facilities is provided in PBS&J (2002).

State Marine (Site ID No. 203) and Palmer Barge Lines (Site ID No. 548) are located on Pleasure Islet south of channel station 250+00 and north of PA 11. These sites are reported to have impacted surface water and are currently undergoing cleanup and evaluation. Star Lake Canal (Site ID No. 471) is located adjacent to the boundary of the cities of Port Arthur and Port Neches, Texas, and midway between PAs 16 and 17. The canal conveys stormwater and industrial wastewater from adjoining industrial facilities and discharges the water to the Neches River near the midpoint of channel stations 130+00 and 230+00. The canal is reported to have impacted surface water and is currently undergoing cleanup and evaluation. The Beaumont Elevator (Site ID No. 113) is located at 1745 Buford Street and adjacent to the waterway west of channel station 930+00. The site is reported to have impacted soil and groundwater and is currently undergoing an investigation.

The Star Lake Canal priority site has potential to affect PA 17. PA 17 is located adjacent to the Neches River in Port Neches, Texas, at river station 260+00. The 392-acre parcel on the west bank of the Neches River has been used as a PA for dredged material for over 40 years. A recent environmental survey of the property identified Recognized Environmental Conditions on the tract including a capped landfill, waste disposal areas containing unknown substances, asbestos-containing material, lead, and furfural. These sites are located inside and close to the southwest boundary of PA 17.

Also, another potential HTRW concern has been identified on adjoining land. A recently updated EPA Region 6 fact sheet (EPA Publication date March 6, 2006) for the Star Lake Canal Superfund Site indicates the Potentially Responsible Parties are planning Remedial Investigations (RI) and a study to determine the nature and extent of contamination. Heavy metals, PCBs, and PAHs have been identified as having migrated or have the potential to migrate to Molasses Bayou, Star Lake Canal, the Neches River, and Sabine Lake. Pentachlorophenol and toxaphene have been found in Jefferson Canal sediments (EPA, 2006). The preliminary area of concern lies outside the eastern and southern boundaries of PA 17.

The Star Lake Canal Superfund site consists of contaminated surface water and sediments in the Star Lake Canal, adjoining Jefferson Canal, and Molasses Bayou (EPA, 2006). The Jefferson Canal and the Star Lake Canal have served as industrial wastewater and stormwater outfalls since the late 1940s. Although the Star Lake Canal borders PA 17, the current configuration of PA 17 distances it from the canal. PA 17 has been leveed to contain dredged material for at least 36 years, as indicated by a 1969 aerial photo. The levee system also acts as a barrier to encroachment of surface water and sediments outside the PA.

RRC files indicate that there are a total of 6,951 permitted well sites located within the study area. These well sites include 6,073 vertical wells and 878 directional wells. The database indicates that the vertical well sites include the following types/status:

- 1,370 are listed as active producing oil/gas wells;
- 2,372 as plugged;
- 1,861 as dry holes;
- 7 as permitted locations;
- 158 as shut-in wells;
- 35 as storage wells;
- 57 as injection wells;
- 28 as saltwater disposal wells;
- 1 as a brine mining well; and
- 184 well sites listed as miscellaneous well types.

One thousand ninety-eight of the producing vertical wells are listed as oil wells, 168 are listed as gas wells, and 104 are listed as producing oil and gas.

The database indicates that directional well sites include the following types/status:

- 226 active producing oil/gas wells;
- 291 plugged wells;
- 202 dry holes;
- 10 injection wells;
- 5 permitted locations;
- 90 shut-in wells;
- 2 storage wells;
- 8 saltwater disposal wells;
- 1 brine mining well; and
- 43 well sites were listed as the miscellaneous well types.

One hundred fifty-eight of the producing directional wells are listed as oil wells, 50 are listed as gas wells, and 18 are listed as producing oil and gas.

A total of 533 pipeline systems were identified within the study area. Five hundred seventeen (517) of the pipelines are listed as active, 16 are listed as inactive. The pipelines are reported to transport the following material:

- 314 transport natural gas;
- 49 crude oil;
- 91 oil and gas;
- 8 LPG;
- 161 gas and condensate; and
- 1 pipeline system was listed as idle.

While the RRC pipeline database is the most comprehensive account of pipelines in the State of Texas, this database does not include every existing pipeline. Therefore, a remote sensing survey for pipelines, wells, and other obstructions in the SNWW navigation channel has been conducted (PBS&J, 2005); field survey data have been matched with the results of record searches that are reported in PBS&J (2002).

## 3.7 AIR QUALITY

### 3.7.1 Regulatory Context

The Clean Air Act (CAA), which was last amended in 1990, regulates air emissions from area, stationary, and mobile sources. The CAA requires the EPA to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment and establishes two types of national air quality standards. Primary standards define the maximum levels of air quality that the

EPA judges necessary, with an adequate margin of safety, to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards define the maximum levels of air quality that the EPA judges necessary to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Air quality is generally considered acceptable if pollutant levels are less than or equal to these established standards on a continuing basis.

The EPA has established NAAQS for seven principal pollutants, called "criteria" pollutants, in 40 Code of Federal Regulations (CFR), Part 50. The criteria pollutants are carbon monoxide (CO), nitrogen dioxide ($NO_2$), ozone ($O_3$), lead (Pb), inhalable particulate matter (PM) with an aerodynamic diameter less than or equal to a nominal 10 microns ($PM_{10}$), fine particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 microns ($PM_{2.5}$), and sulfur dioxide ($SO_2$). These standards are summarized in Table 3.7-1.

Table 3.7-1
National Ambient Air Quality Standards

| Air Constituent | Averaging Time | NAAQS Primary | NAAQS Secondary |
|---|---|---|---|
| Sulfur Dioxide ($SO_2$) | 3 hours | 0.50 ppm | 0.5 ppm |
| | 24 hours | 0.14 ppm | |
| | Annual Arithmetic Mean | 0.030 ppm | |
| Particulate Matter ($PM_{10}$) | 24 hours | 150 $\mu g/m^3$ | 150 $\mu g/m^3$ |
| Particulate Matter ($PM_{2.5}$) | 24 hours | 35 $\mu g/m^3$ | 35 $\mu g/m^3$ |
| | Annual Arithmetic Mean | 15 $\mu g/m^3$ | 15 $\mu g/m^3$ |
| Nitrogen Dioxide ($NO_2$) | Annual Arithmetic Mean | 0.053 ppm | 0.053 ppm |
| Carbon Monoxide (CO) | 1 hour | 35 ppm | --- |
| | 8 hours | 9 ppm | --- |
| Lead (Elemental) (Pb) | Calendar | 1.5 $\mu g/m^3$ | 1.5 $\mu g/m^3$ |
| | Quarter | | |
| | Arithmetic Mean | | |
| | Rolling 3-Month Average | 0.15 $\mu g/m^3$ | 0.15 $\mu g/m^3$ |
| Ozone ($O_3$) | 1 hour | 0.12 ppm | 0.12 ppm |
| | 8 hour (1997 standard) | 0.08 ppm | 0.08 ppm |
| | 8 hour (2008 standard) | 0.075 ppm | 0.075 ppm |

Source: 40 CFR, Part 50, National Primary and Secondary Ambient Air Quality Standards.
--- = An ambient air quality standard has not been promulgated.
ppm = parts per million.
$\mu g/m^3$ = micrograms per cubic meter.

CO is a colorless and practically odorless gas primarily formed when carbon in fuels is not burned completely (Lewis, 1987). It may temporarily accumulate at harmful levels, especially in calm weather during winter and early spring, when fuel combustion may reach a peak and CO is chemically more stable due to the low temperatures. Transportation activities, indoor heating, industrial processes, and open burning are among the anthropogenic (man-made) sources of CO.

$NO_2$, nitric oxide (NO), and other oxides of nitrogen are collectively called nitrogen oxides ($NO_x$). These compounds are interrelated, often changing from one form to another in chemical reactions. $NO_2$ is

commonly measured in ambient air monitors. $NO_x$ emissions are generally emitted in the form of NO, which is oxidized to $NO_2$. The principal anthropogenic sources of $NO_x$ are fuel combustion in motor vehicles and stationary sources such as boilers and power plants. Reactions of $NO_x$ with other atmospheric chemicals can lead to the formation of $O_3$.

Ground-level $O_3$ is a secondary pollutant, formed from daytime reactions of $NO_x$ and (volatile organic compounds (VOCs) rather than being directly emitted by natural and anthropogenic sources. VOCs are released in industrial processes and from evaporation of organic liquids such as gasoline and solvents. Ozone contributes to the formation of photochemical smog.

Pb is a heavy metal that may be present as dust or fumes. Dominant industrial sources of Pb emissions include waste oil and solid waste incineration, iron and steel production, lead smelting, and battery and lead alkyl manufacturing. The lead content of motor vehicle emissions, which was the major source of lead in the past, has significantly declined with the widespread use of unleaded fuel.

The NAAQS for particulate matter is based on two different particle diameter sizes: $PM_{10}$ and $PM_{2.5}$. $PM_{10}$ are small particles that are likely to reach the lower regions of the respiratory tract by inhalation. $PM_{2.5}$ is particulate matter that is considered to be in the respirable range, meaning these particles can reach the alveolar region of the lungs and penetrate deeper than $PM_{10}$. There are many sources of particulate matter, both natural and anthropogenic, including dust from natural wind erosion of soil, construction activities, industrial activities, and combustion of fuels.

$SO_2$ is a colorless gas with a sharp, pungent odor (Lewis, 1987). $SO_2$ is emitted in natural processes, such as volcanic activity, and by anthropogenic sources such as combustion of fuels containing sulfur and the manufacture of sulfuric acid.

The CAA requires the EPA to assign a designation of each region of the U.S. regarding compliance with the NAAQS. The EPA categorizes the level of compliance or noncompliance with each criteria pollutant as follows:

- Attainment – area currently meets the NAAQS
- Maintenance – area currently meets the NAAQS, but has previously been out of compliance
- Nonattainment – area currently does not meet the NAAQS

Ozone nonattainment areas are further classified as extreme, severe, serious, moderate, or marginal depending on the severity of nonattainment.

The TCEQ has the responsibility for developing a plan for maintaining or attaining the NAAQS. This plan, which was submitted to and approved by the EPA, is called the State Implementation Plan (SIP). Similarly, the LDEQ has the responsibility for developing the SIP for Louisiana. For areas that are in nonattainment with the NAAQS, the SIP describes how the area would reach attainment of the air quality standards. The SIP sets emissions budgets for point sources such as power plants and manufacturers,

areawide sources such as dry cleaners and paint shops, off-road mobile sources such as boats and lawn mowers, and on-road sources such as cars, trucks, and motorcycles.

As previously noted, the project study area includes Jefferson and Orange counties. These counties are within an area designated as the Beaumont-Port Arthur (BPA) Air Quality Control Region (AQCR). Ozone is the only criteria pollutant from which the BPA fails to meet the NAAQS. The EPA has classified the BPA area as a "serious" nonattainment area under the 1-hour NAAQS for ozone and a "moderate" nonattainment area with regard to the 8-hour NAAQS for ozone. Under the current attainment classification, the BPA has until June 15, 2010, to attain the 8-hour NAAQS for ozone. However, 8-hour ozone data for 2005, 2006, and 2007 indicate that the BPA area is monitoring attainment of the standard. As a result, the TCEQ adopted a SIP revision that includes a Redesignation Request and a Maintenance Plan for the BPA area (TCEQ, 2008). This maintenance plan is currently pending review by the EPA.

Calcasieu Parish is in the Lake Charles AQCR and Cameron Parish is in the southern Louisiana-southeast Texas AQCR. These parishes are currently classified as being in attainment with the NAAQS for all criteria pollutants.

### 3.7.2 Conformity of Federal Actions

As required by the CAA, the EPA has also promulgated rules to ensure that Federal actions conform to the appropriate SIP. Two rules were promulgated: (1) the Transportation Conformity Rule (40 CFR Part 93); and (2) the General Conformity Rule (40 CFR Part 51, Subpart W). The Transportation Conformity Rule applies to the Federal Highway Administration (FHWA)/Federal Transit Authority projects within maintenance or nonattainment areas. The General Conformity Rule applies to Federal actions, except FHWA and Transit Authority actions, within maintenance or nonattainment areas.

The CAA prohibits Federal agencies from funding, permitting, or licensing any project that does not conform to an applicable SIP. The purpose of this General Conformity requirement is to help ensure that Federal agencies consult with State and local air quality districts to assure these regulatory entities know about the expected impacts of the Federal action and have considered or will include expected emissions in their SIP emissions budget.

The General Conformity Rule provides for emission thresholds above which a General Conformity Determination would be required. For the BPA ozone nonattainment area, which is classified as "moderate" under the 8-hour ozone standard, the emissions threshold is 100 tons per year (tpy) of $NO_x$ or of VOC. Therefore, if the total emissions from the project are estimated to be equal to or greater than this threshold for $NO_x$ or VOC, the USACE must prepare a General Conformity Determination showing how the project conforms or would conform with the SIP for that pollutant, prior to undertaking the action. Even if emissions of $NO_x$ or VOCs are below these levels, a conformity determination would also be required if the increase in emissions due to the project would equal or exceed 10 percent of the total emissions of those pollutants for the entire nonattainment area (i.e., the project is considered a regionally significant action). The General Conformity Determination was submitted to the TCEQ and the EPA for

review concurrently with the DEIS. The TCEQ has provided written concurrence that project emissions are consistent with the most currently approved SIP emissions budgets for the BPA nonattainment area. As Cameron Parish and the Lake Charles area are in attainment with the NAAQS, a general conformity determination would not be required for these areas.

### 3.7.3 Air Quality Baseline Condition

Table 3.7-2 is a summary of emissions for the BPA and Cameron/Calcasieu parishes based on the currently available air emissions inventory information provided by the EPA. The emissions information for each pollutant is broken out by category: area source, highway, off-highway, and point source emissions based on emissions inventory information for 2002. Although this emissions inventory is not current, it contains the most recent data available, and it provides a base from which to compare the proposed project emissions.

Air pollutants within and near the project area are measured by numerous air monitoring stations. Most of the stations in the region measure the concentrations of criteria air pollutants, as well as temperature, wind velocity, wind direction, and other meteorological parameters. The monitors operate continuously and are routinely calibrated and maintained to assure quality data. Monitoring data (2004 through 2008) for counties in the BPA nonattainment area and for Cameron and Calcasieu parishes are presented in Table 3.7-3 to provide an indication of monitored pollutant concentrations relative to the NAAQS.

As previously noted, the BPA area is classified as a “serious” nonattainment area under the 1-hour NAAQS for ozone and a “marginal” nonattainment with the 8-hour NAAQS for ozone. According to the TCEQ, 8-hour and 1-hour ozone design value trends for the BPA ozone nonattainment area from 1991 to 2007 show decreases in both the 8-hour and 1-hour ozone design values. The design values are used in the evaluation of attainment with the ozone standards. The 8-hour ozone design value has decreased by 17.8 percent over the past 17 years, and the 1-hour ozone design value has decreased by 28.7 percent over the past 17 years. The decreases in ozone have occurred despite increases in population in the BPA area. Eight-hour ozone monitoring data for 2005, 2006, and 2007 indicate that the BPA area is monitoring in attainment of the standard. Monitoring data for Calcasieu Parish (Lake Charles Area) also indicate levels above the 8-hour standard.

## 3.8 NOISE

### 3.8.1 Fundamentals and Terminology

Noise is defined as unwanted sound that disrupts or interferes with normal activities, or that diminishes the quality of the environment. Noise is usually caused by human activity and is added to the natural, or ambient, acoustic setting of an area. Exposure to high levels of noise over an extended period can cause health hazards such as hearing loss; however, the most common human response to environmental noise is annoyance. Individuals respond to similar noise events differently based upon various factors that may

Table 3.7-2
Summary of Air Emission Inventory for the Beaumont-Port Arthur Area
and Cameron/Calcasieu Parishes, 2002

| | Source Category | CO (tpy) | $NO_X$ (tpy) | $PM_{10}$ (tpy) | $PM_{2.5}$ (tpy) | $SO_2$ (tpy) | VOC (tpy) |
|---|---|---|---|---|---|---|---|
| Hardin County | Area | 5,758 | 745 | 13,796 | 1,999 | 109 | 2,264 |
| | Highway Vehicles | 9,401 | 1,233 | 31 | 22 | 58 | 719 |
| | Off-Highway | 1,879 | 623 | 29 | 27 | 43 | 191 |
| | Point Source | 296 | 396 | 141 | 86 | 1 | 436 |
| **SUBTOTAL** | | **17,334** | **2,997** | **13,997** | **2,134** | **211** | **3,610** |
| Jefferson County | Area | 6,713 | 1,868 | 13,834 | 2,028 | 1,610 | 11,506 |
| | Highway Vehicles | 43,370 | 8,246 | 186 | 136 | 304 | 3,469 |
| | Off-Highway | 24,459 | 32,690 | 1,804 | 1,663 | 6,044 | 3,330 |
| | Point Source | 8,196 | 24,217 | 1,669 | 1,338 | 27,043 | 10,864 |
| **SUBTOTAL** | | **82,738** | **67,021** | **17,493** | **5,164** | **35,001** | **29,169** |
| Orange County | Area | 1,357 | 723 | 17,745 | 2,022 | 572 | 1,573 |
| | Highway Vehicles | 19,588 | 3,347 | 76 | 55 | 126 | 1,465 |
| | Off-Highway | 5,667 | 1,423 | 89 | 83 | 201 | 737 |
| | Point Source | 8,270 | 10,731 | 1,303 | 1,160 | 3,855 | 3,360 |
| **SUBTOTAL** | | **34,882** | **16,224** | **19,213** | **3,320** | **4,754** | **7,134** |
| **TOTAL – BPA** | | **134,953** | **86,242** | **50,702** | **10,618** | **39,966** | **39,913** |
| Cameron Parish | Area (1996) | 7,571 | 154 | 2,019 | 834 | 133 | 2,121 |
| | Highway Vehicles | 2,415 | 286 | 9 | 6 | 11 | 204 |
| | Off-Highway | 8,858 | 5,543 | 455 | 420 | 2,854 | 3,184 |
| | Point Source | 2,076 | 3,119 | 111 | 93 | 32 | 2,268 |
| **SUBTOTAL** | | **20,920** | **9,102** | **2,594** | **1,354** | **3,030** | **7,777** |
| Calcasieu Parish | Area (1996) | 4,167 | 1,475 | 5,470 | 971 | 115 | 11,311 |
| | Highway Vehicles | 42,091 | 5,802 | 159 | 118 | 198 | 3,425 |
| | Off-Highway | 17,033 | 16,962 | 629 | 616 | 1,389 | 2,243 |
| | Point Source | 10,805 | 34,924 | 4,246 | 3,261 | 53,664 | 9,797 |
| **SUBTOTAL** | | **74,096** | **59,163** | **10,504** | **4,966** | **55,366** | **26,776** |
| **TOTAL CAMERON/CALCASIEU** | | **95,016** | **68,265** | **13,098** | **6,319** | **58,397** | **34,553** |
| **TOTAL BPA/CAMERON/CALCASIEU** | | **229,969** | **154,507** | **63,800** | **16,937** | **98,363** | **74,467** |

Source: EPA (2002a).

Table 3.7-3
Monitored Values[1] Compared with NAAQS, Beaumont-Port Arthur and Cameron/Calcasieu Parishes[2], 2004–2008[3]

| County/ Parish | Year | 24-hour Value for $PM_{2.5}$ ($\mu g/m^3$) | Annual Mean Value for $PM_{2.5}$ ($\mu g/m^3$) | 1-hour Value for $O_3$ (ppm) | 8-hour Value for $O_3$ (ppm) | 24-hour value for $SO_2$ (ppm) | Annual Mean Value for $SO_2$ (ppm) | 1-hour Value for CO (ppm) | 8-hour Value for CO (ppm) | Annual Mean Value for $NO_2$ (ppm) | Quarterly Mean Value for Pb ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hardin | -- | -- | -- | -- | | -- | -- | -- | -- | -- | -- |
| Jefferson | 2004 | 26.8 | 11.57 | 0.132 | 0.091 | 0.068 | 0.004 | -- | -- | 0.010 | -- |
| | 2005 | 36.4 | 15.00 | 0.129 | 0.083 | 0.029 | 0.004 | 3.1 | 1.4 | 0.009 | -- |
| | 2006 | 26.7 | 11.14 | 0.114 | 0.085 | 0.050 | 0.004 | 1.3 | 0.9 | 0.0009 | -- |
| | 2007 | 26.7 | 11.60 | 0.124 | 0.082 | 0.030 | 0.003 | 1.9 | 0.7 | 0.009 | -- |
| | 2008 | 32.6 | 10.41 | 0.110 | 0.078 | 0.034 | 0.003 | 1.8 | 1.0 | 0.008 | -- |
| Orange | 2004 | 29.3 | 12.17 | 0.100 | 0.078 | -- | -- | -- | -- | 0.007 | -- |
| | 2005 | 34.8 | 12.52 | 0.103 | 0.078 | -- | -- | -- | -- | 0.007 | -- |
| | 2006 | 28.8 | 11.31 | 0.103 | 0.078 | -- | -- | -- | -- | 0.008 | -- |
| | 2007 | 28.6 | 10.49 | 0.110 | 0.075 | -- | -- | -- | -- | 0.006 | -- |
| | 2008 | 25.3 | 9.11 | 0.107 | 0.069 | -- | -- | -- | -- | 0.006 | -- |
| Cameron | -- | -- | -- | -- | | -- | -- | -- | -- | -- | -- |
| Calcasieu | 2004 | 29.5 | 10.39 | 0.118 | 0.082 | 0.020 | 0.003 | -- | -- | 0.007 | -- |
| | 2005 | 27.4 | 12.14 | 0.117 | 0.085 | 0.016 | 0.003 | -- | -- | 0.008 | -- |
| | 2006 | 28.4 | 11.51 | 0.125 | 0.080 | 0.010 | 0.002 | -- | -- | 0.009 | -- |
| | 2007 | 23.7 | 9.58 | 0.103 | 0.078 | 0.013 | 0.003 | -- | -- | 0.007 | -- |
| | 2008 | 20.9 | 9.32 | 0.101 | 0.073 | 0.010 | 0.003 | -- | -- | 0.007 | -- |
| | NAAQS | 35 | 15.0 | 0.12 | 0.075 | 0.14 | 0.03 | 35 | 9 | 0.053 | 1.5 |

Source: EPA (2002b).

-- Not available.

[1] Selection of monitored values is based on criteria established in 40 CFR, Part 50. Parameters and data reported here represent those available in EPA's Aerometric Information Retrieval Database (AIRData): "AIRData-Monitor Values Report" as of September 2009.

[2] Data for Hardin County and Cameron Parish were not available in EPA Air Data Report.

[3] 2004–2008 available data to date.

include the existing background level, noise character, level fluctuation, time of day, the perceived importance of the noise, the appropriateness of the setting, and the sensitivity of the individual.

Sounds of the same pressure but different frequencies are not perceived by the human ear as equally loud. The human ear is less sensitive to low frequencies and extremely high frequencies, and most sensitive to the mid-range frequencies that correspond with human speech. Therefore, in order to measure sound in a manner similar to human perception, an adjustment known as "A-weighting" is used. All regulatory agencies require that measurements be taken using the A-weighted sound level (dBA).

Although A-weighted sound measurements indicate the level of environmental noise at any given time, community noise levels vary constantly. Typical noise environments consist of numerous noise sources that vary and fluctuate over time. Because of the varying noise levels within a community, it is necessary to use a descriptor called the equivalent sound level ($L_{eq}$). $L_{eq}$ provides a way to describe the average sound level, in decibels (dB), for any time period under consideration.

Another measurement descriptor of the total noise environment is the Day-Night Sound Level ($L_{dn}$), which is the A-weighted equivalent sound level for a 24-hour period with an additional 10 dB weighting imposed on the equivalent sound levels occurring during nighttime hours (10:00 P.M. to 7:00 A.M.). For example, an environment that has a measured daytime equivalent sound level of 60 dBA and a measured nighttime sound level of 50 dBA, would have a weighted nighttime sound level of 60 dBA (50 + 10), and an $L_{dn}$ of 60 dBA. Numerous Federal agencies including the EPA, Department of Defense, Department of Housing and Urban Development, and Department of Transportation/Federal Aviation Administration (FAA) have adopted this descriptor in assessing environmental impacts. Regulatory agencies generally recognize an $L_{dn}$ of 55 dBA as a goal for the outdoor noise environment in residential areas. Studies have found that outdoor noise environments across the U.S. range from approximately 40 $L_{dn}$ in rural residential areas, to nearly 60 $L_{dn}$ in older urban residential areas, to as much as 90 $L_{dn}$ in congested urban settings (EPA, 1974).

### 3.8.2 Affected Environment

Noise-sensitive receptors are facilities or areas where excessive noise may disrupt normal activity, cause annoyance, or loss of business. Land uses such as residential, religious, educational, recreational, and medical facilities are more sensitive to increased noise levels than are commercial and industrial land uses. Noise-sensitive receptors in the vicinity of the study area are located in the cities of Port Arthur, Port Neches, and Beaumont. The existing noise environment of these communities is affected by a number of sources, most of which are transportation related (i.e., barges, roadway, railway, etc.). Waterborne transportation activities that currently contribute to the region's ambient noise environment include barges, commercial fishing/shrimping vessels, sport and recreation boats, and current maintenance dredging of the canal. Other sources that contribute to the existing noise environment of these communities include activities at nearby commercial enterprises, such as restaurants, marinas, activities at commercial fishing and shrimping businesses, and numerous heavy industrial uses. Ambient noise levels

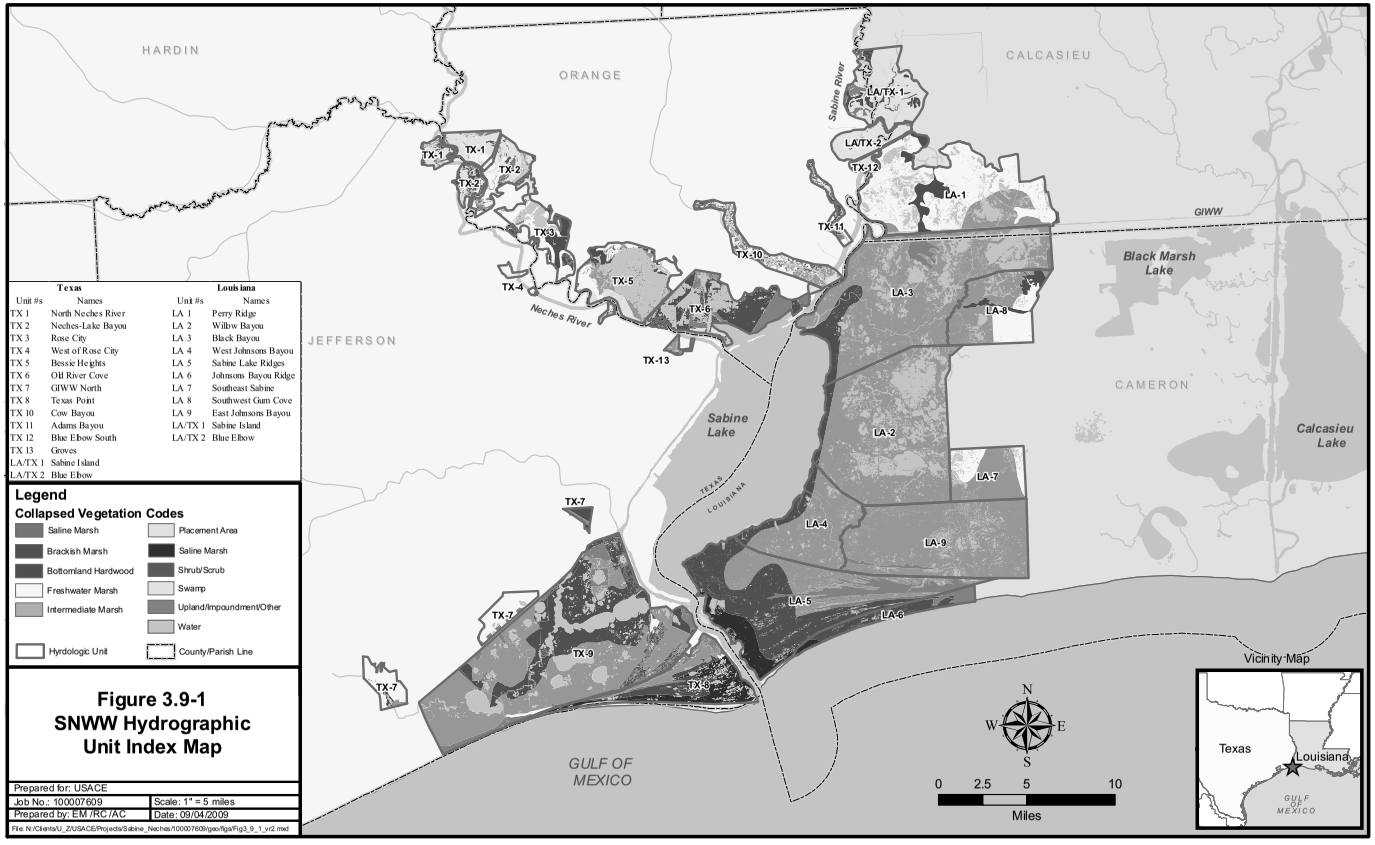
measured in other Texas coastal communities with a similar degree of activity generally ranged between 60.9 and 65.1 $L_{dn}$ (HFP Acoustical Consultants, Inc., 2002).

## 3.9 VEGETATION

### 3.9.1 Introduction

The study area is located within the Gulf Coast Prairies and Marshes and Pinewoods Vegetation Areas (Hatch et al., 1990). A generalized map of the vegetation and land cover types appears on Figure 3.9-1. Maps of each hydro-unit are provided in Appendix C. The vegetation communities include saline to fresh marshes, swamps, bottomland hardwood forests, upland grasslands, and forests. The study area includes an important ecosystem called the Chenier Plain (aka strandplain). Chenier is derived from a French word that means "a place where oaks grow." Cheniers are paleo-beach ridges that parallel the shoreline (USFWS, 1998; White et al., 1987) fanning out (diverging) where they are cut by river mouths. This "fanning out" pattern occurs near Sabine Pass. The ridges are topographically higher than the surrounding area because they are composed of coarse-grained material (sand and shell) that is more resistant to erosion. The formation and maintenance of the cheniers depends on the input of sand deposited by rivers, transported by westerly longshore currents, and reworked by storms. The upland habitat of the cheniers supports the Coastal Live Oak-Sugarberry Series (*Quercus virginiana-Celtis laevigata*), a maritime woodland or forest (woodlots/oak mottes) of the Upper Gulf Coast that is unique to the Chenier Plain and should be considered sensitive habitat (USFWS, 1998). The modern Chenier Plain system occurs in Louisiana and Texas where the linear ridges and swales are evident in topography and vegetation communities. Transitional and upland vegetation communities occur on the ridges, and wetland communities occur in the interridge swales. The Chenier Plain is separated from the Pleistocene Prairie Complex to the north by a broad low area, which is dominated by brackish marshes (LCWCR/WCRA, 1998).

A band of saline and brackish marshes parallels the coast immediately landward at the beach/dune complex and shore areas. This area is widest in the Mississippi delta and narrows to the west. This east-to-west narrowing is evident in the study area. The wetland communities extend up river, bayou, and creek floodplains, becoming increasingly fresh upstream. The forested wetlands occur in the fresher areas of these floodplains and are primarily cypress-tupelo swamps. These swamps occur along with bottomland hardwood forests and other wetlands within the floodplains. Uplands predominate in the north (especially the northwestern) part of the study area and include grassland and forests. Most of the nonforested upland has been converted to agricultural land. The upland forest is predominantly a pine-oak mix forest (USFWS, 1998; White et al., 1987). Chinese tallow, an exotic, invasive species that has been a management problem since the 1970s, occurs in both upland and bottomland areas, especially in disturbed areas such as fallow croplands.


HARDIN
ORANGE
CALCASIEU
JEFFERSON
CAMERON
Sabine River
Neches River
GIWW
Black Marsh Lake
Calcasieu Lake
Sabine Lake
TEXAS
LOUISIANA
GULF OF MEXICO
TX-1
TX-2
TX-3
TX-4
TX-5
TX-6
TX-7
TX-8
TX-9
TX-10
TX-11
TX-12
TX-13
LA/TX-1
LA/TX-2
LA-1
LA-2
LA-3
LA-4
LA-5
LA-6
LA-7
LA-8
LA-9
Texas
Unit #s Names
TX 1 North Neches River
TX 2 Neches-Lake Bayou
TX 3 Rose City
TX 4 West of Rose City
TX 5 Bessie Heights
TX 6 Oil River Cove
TX 7 GIWW North
TX 8 Texas Point
TX 10 Cow Bayou
TX 11 Adams Bayou
TX 12 Blue Elbow South
TX 13 Groves
LA/TX 1 Sabine Island
LA/TX 2 Blue Elbow
Louisiana
Unit #s Names
LA 1 Perry Ridge
LA 2 Willow Bayou
LA 3 Black Bayou
LA 4 West Johnsons Bayou
LA 5 Sabine Lake Ridges
LA 6 Johnsons Bayou Ridge
LA 7 Southeast Sabine
LA 8 Southwest Gum Cove
LA 9 East Johnsons Bayou
LA/TX 1 Sabine Island
LA/TX 2 Blue Elbow
Legend
Collapsed Vegetation Codes
Saline Marsh
Brackish Marsh
Bottomland Hardwood
Freshwater Marsh
Intermediate Marsh
Placement Area
Saline Marsh
Shrub/Scrub
Swamp
Upland/Impoundment/Other
Water
Hyrdologic Unit
County/Parish Line
Figure 3.9-1
SNWW Hydrographic
Unit Index Map
Prepared for: USACE
Job No.: 100007609
Scale: 1" = 5 miles
Prepared by: EM /RC/AC
Date: 09/04/2009
File: N:\Clients\U_ZU\SACE\Projects\Sabine_Neches\100007609\gis\fga\Fig3_9_1_v2.mxd
N
W
E
S
0 2.5 5 10
Miles
Vicinity Map
Texas
Louisiana
GULF OF MEXICO

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### 3.9.2 Protected and Sensitive Habitats in the Study Area

The term "sensitive habitat" should not be confused with the term "critical habitat." Critical habitat is a legal term with respect to the Endangered Species Act (ESA) and refers to a specific geographic area identified by the USFWS for a federally protected species (see Section 3.12). Sensitive habitat is a subjective term, not a legal term, and generally refers to the vulnerability of a habitat. Spatial extent, uniqueness, endemic quality, or vulnerability to ongoing pressures or imminent changes may make a habitat environmentally sensitive (e.g., large historical losses as with the coastal prairie or fresh marsh losses due to saltwater intrusions). For various reasons the following habitats that occur in the study area should be considered sensitive.

The study area contains a high concentration of significant coastal wetlands. The ICT identified 109,175 acres (171 square miles) in Texas and 197,530 acres (309 square miles) in Louisiana of coastal marsh, bottomland hardwood, and cypress-tupelo swamp habitats, which are addressed in the impact evaluation and described in detail in the following subsections.

#### 3.9.2.1 Texas Portion of the Study Area

In Texas, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area:

- Approximately 10,000 acres of fresh to salt marsh in the Chenier Plain west of Sabine Pass, the majority of which consists of the Texas Point NWR. This NWR is part of the Texas Chenier Plain NWR complex (USFWS, 2005a). This area is indicated as hydro-unit (HU) TX 8 on Figure 3.9-1.
- 55,700 acres of fresh to salt marsh located west of the Sabine River between Texas Point and the mouth of the Neches River (TX 7 and 9). Much of this area is protected by the J.D. Murphree WMA and the McFaddin NWR. Managed by the TPWD, the J.D. Murphree WMA totals 24,250 acres of fresh, intermediate, and brackish water wetlands in the Texas Chenier Plain (TPWD, 2005a). It is located just inland of the Texas Point WMA and extends north of the GIWW. The eastern half (approximately 23,000 acres) of the McFaddin NWR is also part of the study area. This NWR is also part of the Texas Chenier Plain NWR complex. The McFaddin NWR protects one of the largest remaining freshwater marshes on the Texas coast and thousands of acres of intermediate to brackish marsh (USFWS, 2005a). It is located adjacent to and just west of Texas Point WMA.
- 22,100 acres of fresh, intermediate, and brackish marshes and 2,850 acres of cypress-tupelo swamp and bottomland hardwoods on the Neches River from the mouth of the river where it empties into Sabine Lake to the City of Beaumont (TX 3 through 6). Approximately 9,580 of these acres consist of open-water areas resulting from breaking and eroding marsh in the marshes at Rose City, Bessie Heights, and Old River Cove. The Nelda Stark Unit and Old River units of the Lower Neches River WMA (TPWD, 2005b) are located in this area.
- 6,490 acres of Neches River cypress-tupelo swamp and bottomland hardwoods and 1,970 acres of fresh marsh between the City of Beaumont and the new Neches River Saltwater Barrier near Pine Island Bayou (TX 1 and 2). A USACE-approved, privately operated, wetlands mitigation bank (the Neches River Cypress Swamp Preserve) is located within this area (USACE, 2005a).

- 4,771 acres of cypress-tupelo swamps, bottomland hardwood, and fresh and intermediate marshes on Cow and Adams bayous (TX 10 and 11). The Adams Bayou Unit of the Lower Neches River WMA (TPWD, 2005b) is located in this area.
- 689 acres of cypress-tupelo swamp west of the Sabine River and south of IH 10 (TX 12).
- 2,737 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp (LA/TX 2). Located north of IH 10 and west of the Sabine River, this area is owned by TxDOT and managed as the USACE-approved Blue Elbow Mitigation Bank (USACE, 2005b). The area includes the Tony Houseman WMA, managed as a cooperative effort between the TxDOT and TPWD (TPWD, 2005c).
- 2,277 acres of cypress-tupelo swamp and bottomland hardwoods west of the Sabine River, across from the Sabine Island WMA in Louisiana (LA/TX 1).
- 6,000 acres of cypress-tupelo swamp, bottomland hardwood forest, and freshwater marsh below the Saltwater Barrier, on Big Thicket National Preservelands in Texas (TX1 and 2).

#### 3.9.2.2 Louisiana Portion of the Study Area

In Louisiana, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area (LCWCR/WCRA, 1998; USGS-NWRC, 2004):

- 71,470 acres of saline, brackish and intermediate marshes in the Louisiana Chenier Plain habitat at Louisiana Point, Blue Buck Point, and Johnson's Bayou areas (LA 4, 5, 6, and 9). Sensitive areas include Sabine Lake Ridges (33,472 acres of chenier ridge, and saline, brackish, and intermediate marsh), Johnson's Bayou Ridge (4,089 acres of saline and brackish marshes, and chenier ridges), West Johnson's Bayou (13,190 acres of brackish and intermediate marsh), and East Johnson's Bayou (26,719 acres of chenier ridge, and fresh, intermediate, and brackish marsh).
- 44,325 acres of brackish, intermediate, and fresh coastal marsh in the western half of the Sabine NWR (LA 3 and 7). The Sabine NWR, as a whole, contains 124,511 acres of fresh, intermediate, and brackish marsh between Calcasieu and Sabine lakes in southwest Louisiana (USFWS, 2005b). Approximately 13,744 acres of marsh within this study area has degraded to open water. This sensitive area contains the Willow Bayou mapping unit (36,291 acres) and 8,034 acres in the west section of the Southeast Sabine mapping unit.
- 46,511 acres of brackish, intermediate, and fresh marsh in an area north of Willow Bayou and south of the GIWW (LA 2 and 8). This sensitive area contains the Black Bayou mapping unit (36,291 acres) and 10,220 acres of fresh and intermediate marsh in the Southwest Gum Cove mapping unit.
- 25,721 acres of fresh and intermediate marsh and bottomland hardwood habitat in the Perry Ridge mapping unit, north of the GIWW and east of the Sabine River (LA 1).
- 650 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp, east of the Sabine River and north of IH 10 (LA/TX 2).
- 7,039 acres of cypress-tupelo swamp and bottomland hardwoods in the Sabine Island WMA, north of the Blue Elbow Swamp and east of the Sabine River (LA/TX 1).

### 3.9.3 Historical Changes

The coastal wetlands of the Calcasieu and Sabine river basins were historically an unbroken stand of coastal wetlands including fresh to brackish marshes and swamps (Marcantel, 1996). Most of the brackish marshes bordered Calcasieu and Sabine lakes. In the 1940s and 1950s, this ecosystem began to fragment and exhibit other significant alterations, due in part to the construction of several major navigation channels (Calcasieu Ship Channel, GIWW, SNWW), which increased salinity throughout the estuary, including the lakes and surrounding marshes (Marcantel, 1996). The presence of the GIWW and activities along the GIWW made several changes to previous hydrologic conditions. Levees associated with the GIWW and other channels changed drainage patterns, flooding some areas, and blocking sheet flow across extensive areas of marsh. Several miles of Salt Bayou, north of Shell Lake, were lost. Taylor Bayou was rerouted to join the GIWW. Concrete water control structures were placed on both sides of the canal at Star Lake, at the outfall of Salt Bayou and the GIWW, and at Little Keith Lake Cut on Port Arthur Canal, which eventually became inoperable (Sutherlin, 1997).

Petroleum exploration has also caused hydrologic changes in the area. Four major oil fields were developed in Texas marshes west of Sabine Lake beginning in the mid-1920s: Bessie Heights (Neches River), Rose City (Neches River), Clam Lake (McFaddin NWR), and Shell Lake (Sea Rim State Park). Gum Island (La Belle Ranch) was developed in Louisiana, east of Sabine Lake. Levees, roads, and canals associated with these operations, as well as accelerated subsidence caused by subsurface water and petroleum extraction, have changed hydrology and contributed to the conversion of marshes to open water (Sutherlin, 1997). The extensive construction of channels for navigation, petroleum exploration, hunting, fishing, and trapping throughout the area has increased saltwater intrusion into the interiors of the marshes (Marcantel, 1996).

The Chenier Plain in the area of Calcasieu and Sabine lakes has been identified as one of the two Louisiana coastal zones that has experienced the most severe land loss. More than 25 percent of the marsh was lost between 1933 and 1990 within the Sabine, Calcasieu, and Mermentau basins (LCWCR/WCRA, 1998). According to the LCWCR/WCRA report, a 1994 study by Barras et al. found that the westernmost area of Louisiana lost approximately 15,950 acres (18 percent) of marsh between 1978 and 1990.

Currently, within the State of Louisiana, there are approximately 3,800 square miles of marsh and over 800 square miles of swamp. It is predicted that approximately 600 square miles of marsh and 400 square miles of swamp would be lost by conversion to open water by the year 2050 (LCWCR/WCRA, 1998). The Calcasieu/Sabine Basin had 317,100 acres of marsh and 170 acres of swamp in 1990. Using current restoration levels, there would be a net loss of 38,400 acres by 2050; however, no swamp loss is predicted (LCWCR/WCRA, 1998).

According to Morton and Paine (1990), Sutherlin (1997), and White et al. (1987), the most extensive losses of interior coastal wetlands in Texas have occurred along the Neches River delta where 12,632 acres of marshes have been converted to open water. This is more than 90 percent of the marshes in the lower Neches River delta. Contributing factors include subsidence associated with subsurface

petroleum and groundwater extraction, eustatic sea level rise, altered hydrology that caused saltwater intrusion, and decreases in sediment and/or nutrient supply.

The inflow of fresh water, primarily from the Sabine and Neches rivers, buffers the salt water emanating from the Gulf; that is, the salt water coming inland, via the SNWW and other channels, is buffered by discharges of fresh water from reservoirs on the Sabine and Neches rivers. Saltwater coming up the Calcasieu Ship Channel is only buffered by rainfall, so the surrounding marshes of the ship channel and Calcasieu Lake are more vulnerable to saltwater intrusion. There is more-active management to protect wetlands from saltwater intrusion around Calcasieu Lake than Sabine Lake (Marcantel, 1996). See Section 3.5 for further discussion on the hydrology.

Saltwater intrusion and its impact on marshes have been managed, in part, by the use of water control structures. In 1990 there were 174 water control structures identified in the Calcasieu and Sabine River basins (Marcantel, 1996). See Section 3.5 of this FEIS for more information regarding water control structures and other hydrologic alterations.

The construction of the GIWW and activities associated with the SNWW had several effects, some of which are:

- altered habitat associated with Salt Bayou (north of Shell Lake);
- severed Salt Bayou north of Star Lake;
- altered course of Taylor Bayou to join GIWW;
- constructed concrete water control structures on both side of canal at Star Lake, at outfall of Salt Bayou and the GIWW, and at Little Keith Lake Cut on Port Arthur Canal, which eventually became inoperable;
- altered habitat and land loss in the Black Bayou watershed;
- altered habitat and land loss in the Willow Bayou watershed;
- shoreline erosion along the banks of the GIWW; and
- blocked sheet flow across marshes.

Roads and levees also altered hydrologic patterns, particularly in the coastal zone where a small change in topographic relief can significantly alter surface hydrology. Openings and water control structures associated with these features also affect the hydrology. Important features include:

- Louisiana SH 27 along east boundary of the Calcasieu/Sabine River Basin (north to south orientation);
- SH 82 (Calcasieu Ship Channel to Sabine Pass) along south boundary forms barriers along the east and south perimeters;
- Rycade Canal (south of Black Lake);
- Gray's Ditch levee/cattle walkway (north to south, Pines Ridge – Johnson's Bayou) forms a barrier along east bank of Sabine Lake (Marcantel, 1996); and

- SH 87 and SH 73 altered hydrology in Orange and Jefferson counties (Sutherlin, 1997).

Wildlife management units within the river basins use levees and other water control structures to manage areas for specific habitat types (Marcantel, 1996):

- Pool 3A on Sabine NWR is managed as a freshwater marsh.
- Round Lake and Lost Lake in the J.D. Murphree WMA are managed as fresh marsh.

According to Morton (1996), the marshes on the eastern shoreline of Sabine Lake and Sabine Pass have remained essentially natural in contrast to the more developed west side that has been greatly altered by the SNWW and associated ports. Also, most of the western shore of Sabine Lake has been elevated by placement of dredged material, and shorelines have been armored to protect against erosion associated with the predominant southeastern winds.

According to Marcantel (1996), the overall condition of the marshes within the Calcasieu/Sabine River Basin have been improving. This is attributed to above-average rainfall and the stabilization of tidal fluctuations and water salinity. Marcantel (1996) warns that the salinity in Sabine Lake needs to continue to be stabilized to avoid the level of management required in Calcasieu Lake. As discussed in Section 3.5, freshwater inflows from the Sabine and Neches rivers are largely moderated by flood control structures and freshwater impoundments upstream. A freshwater inflow study was prepared to establish the basic requirements of the ecosystems of the floodplains and the estuary (Kuhn and Chen, 2005).

Land loss has occurred at high rates in recent decades (Berman, 2005; Morton, 2003; Morton et al., 2005; Shinkle and Dokka, 2004; Titus and Narayanan, 1995). In Louisiana, a net land loss of 21 percent between 1978 and 2000 has been reported in the Chenier Plain subregion of coastal Louisiana, which includes the Sabine estuary (USACE, 2004a). In Texas, the most extensive losses of interior coastal wetlands in the state (12,632 acres between 1930 and 1978) have occurred in the Neches River delta. In total, over 90 percent of the emergent marshes in the Lower Neches River delta have been converted to open water (Morton and Paine, 1990; White et al., 1987), which is more than half of the total wetland loss in the State of Texas (Sutherlin, 1997).

Underlying causes of coastal land loss can be divided into two general categories, natural and man-induced (Morton, 2003). Natural causes include erosion, sediment reduction, submergence due to relative sea level rise, and wetland deterioration. Induced causes include construction and dredging in the coastal zone, upstream dams, river channelization, changes to overland sheet flow, fluid extraction, and climate alterations. NOAA has documented a trend of mean sea level rise at Sabine Pass of 0.2 inch/year from 1958 through 1999 (USDC-NOAA, 2009). The reader is referred to Appendix C for further discussion of the rates and cause of RSLR and coastal land loss.

### 3.9.4 Wetland and Aquatic Vegetation Communities

The following paragraphs include general descriptions of the wetland (including aquatic) vegetation communities that occur in the study area. The descriptions include ecological functions, historical trends,

and vulnerabilities. Detailed descriptions of the vegetation communities within each hydro-unit are provided in the Ecological Modeling Report (Appendix C, Section 7.0), so to avoid duplication, they are not included here.

**Submerged Aquatic Vegetation**

SAV provides important food and cover to a wide variety of fish and wildlife. SAV beds are associated with many kinds of marshes from saline to fresh, as well as in open bay waters. Fresh and intermediate marshes, in particular, often support diverse communities of submerged and floating leaved vegetation. Brackish marshes can support aquatic plants that provide food and cover for several species of fish and wildlife. Although amounts are generally less than those that occur in fresh or intermediate marshes, certain species such as widgeon grass, coontail, and milfoil can be abundant under some conditions, and widgeon grass, in particular, is an important food source for waterfowl. Low-salinity saline marshes may contain widgeon grass, which tolerates a wide range of salinities. Open-water areas in saline marshes generally contain sparse aquatic vegetation and are primarily important as nursery areas for marine organisms.

To a large extent, seagrass distribution in Texas parallels the precipitation and inflow gradients along the Texas coast. Seagrasses are common along the middle to lower coast where rainfall is low and evaporation is high. This correlates with average baywater salinities above 20 ppt. Conversely seagrass is scarce in bays of the upper coast where rainfall and inflows are high and salinities are lower (TPWD, 1999). These areas are also more turbid, which also limits sunlight penetration for seagrass growth (TPWD, 1999).

The TPWD (1999) reports that well-known annual species often occur in at least portions of all Texas bays except for Sabine Lake. However, the low-salinity-tolerant species, widgeon grass, technically not a seagrass because it tolerates very low salinity, can be found in protected parts of the Sabine Lake system. In addition, other SAV found in the study area include Eurasian watermilfoil (*Myriophyllum spicatum*) and freshwater eelgrass (*Vallisneria americanum*). Most available data on distributions of SAV for the Texas Gulf Coast are for seagrass meadows of the Laguna Madre (Onuf, 1995; Pulich et al., 1997; Quammen and Onuf, 1993). Few data are available for the upper Texas coast (Adair et al., 1994). Polyhaline species (18 to 30 ppt) found in the study area include widgeon grass; mesohaline species (5 to 18 ppt) include Eurasian watermilfoil, a nonnative invasive species, and freshwater eelgrass.

Baseline values for SAV, used in the EMCM, were based largely upon previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate, and data collected for CWPPRA or other restoration projects in or near the areas under evaluation.

SAV cover and species type can and do change rapidly in response to a complex interaction of many conditions (e.g., salinity, freshwater introduction, nutrient input, turbidity, water depth, fetch).

**Marshes and Flats**

Coastal marshes include a variety of wetland communities (species assemblages) that are differentiated by salinity, elevation, and soil regimes. Marshes range from saline, brackish, intermediate, to fresh water. Soil saturation is highly correlated with elevation and influences the type of marsh community that an area supports. The terms *Low* and *High* reflect this relationship and may actually reflect only small changes in elevation, but may be significant when compared to the broad, flat areas of the coast. These plant communities, as well as unvegetated flats, commonly form intricate mosaics of the various communities associated with these subtle changes in topography.

Flats may be sparsely vegetated. In general, less than 30 percent vegetative cover will distinguish a flat from a marsh. Tidal flats are periodically flooded by tidal waters. The term flat includes sandbars, mudflats, and other nonvegetated or sparsely vegetated habitats also called salt flats. Sparse vegetation that occurs on salt flats may include glasswort (*Salicornia* spp.), saltwort (*Batis maritima*), and shoregrass (*Monanthochloe littoralis*).

These wetlands serve many ecological functions. Persistent emergent vegetation provides foraging, resting, and breeding habitat for a variety of coastal fish and wildlife species. Detritus from coastal marshes also provides a source of mineral and organic nourishment for organisms at the base of the food chain. Loss of emergent coastal marsh is a serious existing condition in the study area, and it is assumed that this loss would continue due to RSLR (USDC-NOAA, 2009). Existing and potentially accelerated marsh loss associated with channel deepening has been identified as one of the highest concerns by resource agencies and the general public. Mitigation measures should, therefore, maximize emergent marsh creation, maintenance, and protection.

Important features of marshes include the amount of marsh edge (linear distance of open water/vegetation interface) and interspersion that reflects the relative amount of marsh to open water and the degree to which open water is dispersed throughout the marsh. Interspersion is an important characteristic for fresh water and estuarine fish and shellfish nursery and foraging habitat in all marsh types. The marsh/open-water edge provides cover for postlarval and juvenile organisms.

Deeper water is assumed to be less biologically productive than shallow water because sunlight, oxygen, and temperature are reduced as depth increases. Shallow water also provides better bottom access for waterfowl, better foraging habitat for wading birds, and more-favorable conditions for the growth of aquatic vegetation.

Increase in salinity associated with the existing navigation project are one of the most important factors affecting coastal land loss in the study area. As salinity increases, biological productivity in the marsh is reduced thereby increasing vulnerability to land use.

Access by estuarine-dependent fishes and shellfishes, as well as other aquatic organisms, is important in assessing the quality of marsh systems. It is assumed that a high degree of hydrologic connectivity with adjacent systems provides high organism access, as well as providing greater nutrient exchange. Brackish

and saline marshes are assumed to be more important than fresh/intermediate marshes as habitat for estuarine-dependent fish and shellfish.

White and Tremblay (1995) summarize many factors that have contributed to marsh loss in the study area. In most cases, marsh loss occurs by conversion of the marshes to open water. In the lower Neches River Valley, this conversion is caused by subsidence and faulting (sometimes related to oil and gas production), dredged canals, alteration of hydrologic regime (due to channelization and placement of dredged material), decreased input of fluvial sediment (due to upstream dams), and construction of artificial levees. Similar factors are responsible for marsh loss in the Sabine River Basin.

Since 2000, there have been large areas of die-off in the low salt marshes on the Gulf Coast, commonly called Brown Marsh phenomenon (LDNR, 2002a). The area most severely impacted is east of the study area, between the Mississippi and Atchafalaya rivers. Although the causes are unknown, it is believed to be a combination of factors, including weather regimes, and is currently under study.

Low marshes for all salinity types are distinguished by the species composition. Indicator species by marsh type appear below (LDNR, 2002b; McKee et al., 2006; USFWS, 1998). More-extensive species lists appear in Visser and Sasser (1998) and White et al. (1987). Additional descriptions of these marsh types appear in Appendix C, Section 7.0.

**Saline Marsh**

- Smooth cordgrass, oystergrass (*S. alterniflora*) – dominant species in low marsh
- Seashore saltgrass (*Distichlis spicata*)
- Blackrush (*Juncus romerianus*)
- Saline marsh aster (*Symphyotrichum tenuifolius*, syn. *Aster t.*)
- Glasswort – dominant species in high marsh
- Marshhay cordgrass, wiregrass (*S. patens*)
- Sea ox-eye daisy (*Borrichia frutescens*)

**Brackish Marsh**

- Saltmarsh bulrush (*Scirpus robustus*) – (co-)dominant species in low marsh
- Marsh pea (*Vigna luteola*)
- Waterhemp (*Amaranthus tamariscinus*)
- Seashore saltgrass – (co-)dominant species in high marsh
- Dwarf spikerush (*Eleocharis parvula*)
- Marshhay cordgrass, wiregrass – (co-)dominant species in high marsh

**Intermediate Marsh**

- Seashore paspalum (*Paspalum vaginatum*) – (co-)dominant species in low marsh
- Olney bulrush (*Schoenoplectus americanus*, syn., *Scirpus a.*) – (co-dominant species in low marsh
- California bulrush, giant bulrush – (co-)dominant species in low marsh
- Common reedgrass, roseau cane (*P. australis*) – (co-)dominant species in low marsh
- Sand spikerush (*E. montevidensis*)
- Marshhay cordgrass, wiregrass – (co-)dominant species in high marsh
- Bulltongue (*Sagittaria lancifolia*)

**Freshwater Marsh**

- Maidencane (*Panicum hemitomen*) – (co-)dominant species in low marsh
- Giant cutgrass (*Zizaniopsis milacea*) – co-dominant species in low marsh
- Bulltongue – (co-)dominant species in low marsh
- American lotus (*Nelumbo lutea*)
- Watershield (*Brasenia screberi*)
- Duckweed (*Lemna* spp.)
- Fanwort (*Cabomba caroliniana*)
- Squarestem spikerush (*E. quadrangulata*) – co-dominant species in high marsh
- Marshhay cordgrass, wiregrass – co-dominant species in high marsh

In general, the saline marshes are located nearest to the Gulf shoreline. In this area they tend to be linear features, which grade into brackish marshes with increasing distance from the shoreline. Some occur near Sabine Pass in the swales of the Chenier Plain.

Most of the area between the GIWW and the Gulf shoreline is covered with brackish marsh. Most of the marshes on and near the shoreline of Sabine Lake and Sabine Pass are brackish to intermediate, becoming fresher to the north with proximity to the Neches and Sabine rivers. There is generally a gradation from more open-water areas that are saline or brackish to the intermediate marsh areas. These intermediate marshes are encroaching on formerly freshwater areas, but in turn are being encroached upon by brackish waters and marshes.

By altering the natural hydrology, the GIWW and its levees have created a sharper (formerly more gradual) transition from fresh-intermediate water marshes north of the GIWW to brackish-saline marshes on the south side. There are some scattered fresh and intermediate marshes associated with the swales of the Chenier Plain. Some areas with relatively higher elevations support fairly freshwater areas that only seasonally support wetland communities (i.e., “wet prairies”). There are additional freshwater marshes in

the riparian zone of the Neches and Sabine rivers. The central part of the Sabine NWR previously supported more freshwater marshes. However, some of this area has been converted to intermediate and brackish marsh due to saltwater intrusion. This intrusion has encroached from the west (Sabine Lake), east (Calcasieu Lake), and south. Some large levied areas within the Sabine NWR (e.g., Pool 3) are being maintained as freshwater impoundments.

**Shrub/Scrub Wetlands**

These wetlands are generally located adjacent to marshes at somewhat higher elevations. Estuarine intertidal scrub-shrub wetlands are dominated by woody vegetation and periodically flooded by tidal waters. Common species include the black mangrove (*Avicennia germinans*) and big leaf sumpweed (*Iva frutescens*). Sea ox-eye daisy is a woody species that is frequently a co-dominant species in high salt marsh and is described in this report with the marshes.

Freshwater shrub-scrub wetlands are generally associated with riverine systems or in isolated depressional areas (e.g., swales). Common species include buttonbush (*Cephalanthus occidentalis*), rattlebean (*Sesbania* spp.), and alder (*Alnus* spp.).

**Swamps (Forested Wetlands)**

Two types of swamps or forested wetlands occur in the Chenier Plains of Texas and Louisiana (USFWS, 1998). These occur within the floodplains of waterways, primarily the Neches and Sabine rivers. One of these is a true swamp, which is flooded most or all of the year. It is dominated by bald cypress and tupelo gum trees (*Nyssa* sp.). Many swamp species, especially tupelo gum trees and many herbaceous species, are salinity-sensitive. Bald cypress is able to tolerate higher salinities than the other species. These swamps may occur streamside or in abandoned channels or other depressional areas within the floodplain. Swamps with mature sizable trees are considered to be rare and ecologically important because of the historical loss of swamp habitat from timber harvesting, saltwater intrusion, and a reduced growth rate in the subsiding coastal zone. The hardwoods have been logged repeatedly since the turn of the century (USACE, 1998a), so much of this community is secondary growth.

The other forested wetland is also located within the same floodplains. Common tree species of these bottomland hardwoods include water oak (*Quercus nigra*), red maple (*Acer rubrum*), eastern cottonwood (*Populus deltoides*), box elder (*A. negundo*), Carolina ash (*Fraxinus caroliniana*), overcup oak (*Q. lyrata*), sugar maple (*A. saccharum*), bald cypress, tupelo gum, and swamp privet (*Forestiera acuminata*). These are flooded seasonally at high-water events when the waterways overflow their banks. Some bottomland hardwood areas may not be true and/or CWA Section 404 jurisdictional wetlands, but may be more appropriately considered as dry-riparian communities.

Swamps provide unique habitat to many species. Wildlife foods in swamp habitats consist predominantly of soft mast, other edible seeds, invertebrates, and vegetation. Most swamp tree species produce soft mast or edible seeds. A variety of stand structure (overstory, shrub, herb layer) provides habitat for resting, foraging, breeding, nesting, and nursery activities. The hardwoods, especially the cypress trees, have been

logged repeatedly since the turn of the century and as recently as perhaps the 1950s (USACE, 1998a). Though much of the forest is secondary growth, the swamp and bottomland hardwood habitats have medium to high value for food and cover to resident and migratory fish and wildlife.

The hydrology determines the existence and quality of forested wetlands. Seasonal flooding with periodic drying cycles increases nutrient cycling, vertical structure complexity, and recruitment of dominant overstory trees. Seasonal flooding with abundant and consistent riverine/tidal input and water flow-through is considered to be optimal hydrologic characteristic. Optimal conditions for forested wetlands are discussed in the WVA (Appendix C). The WVA model considered several variables (e.g., tree species composition, stand maturity) to assess the overall condition and characterization of the forested wetlands.

**Bottomland Hardwood Forests**

Bottomland hardwood forests are located in river bottomlands, generally in the floodplain. They are commonly associated with and form mosaics of stands with cypress-tupelo swamps and other forested wetlands (e.g., water oak or ash flats); however, they may not actually be considered wetlands. In the lower Sabine and Neches watersheds, bottomland hardwood forests are found on an intricate network of sandy ridges interspersed with wet sloughs that have formed within the rivers' relict meanderbelts. These are highly productive and diverse ecosystems and serve many ecological functions.

Bottomland hardwood wildlife depends heavily on mast, other edible seeds, and tree buds as primary sources of food. Typical hard mast producers in the study area are oaks, pecan (*Carya illinoinensis*), and other hickories. Soft mast and other edible seeds are produced by red maple, sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*), boxelder (*A. negundo*), common persimmon (*Diospyros virginiana*), sweetgum (*Liquidambar styraciflua*), honeylocust (*Gleditsia triacanthus*), red mulberry (*Morus rubra*), bald cypress, tupelo gum, American elm (*Ulmus americana*), and cedar elm (*U. crassifolia*). Nonmast/inedible seed producers are eastern cottonwood, black willow (*Salix nigra*), and American sycamore (*Platanus occidentalis*).

Mature stands of bottomland hardwood are rare and ecologically important. Historical and ongoing timber harvesting has reduced the number of mature stands and increased the ecological importance of those that remain. These stands provide more hard and soft mast, other edible seeds, and buds than younger stands. They provide important wildlife requisites such as snags, nesting cavities, and medium for invertebrate production.

**Upland Grasslands (including Coastal Prairies)**

Virtually all (99 percent) of the original Gulf Coastal Prairies (commonly referred to as Cajun Prairies in Louisiana) community has been converted to agricultural, industrial or other uses although some remnants still exist (Smeins et al., 1991). Undeveloped upland grasslands usually have a mix of the original prairie species and introduced pasture species as well as various forbs and occasional shrubs such as honey mesquite (*Prosopis glandulosa*), eastern baccharis (*Baccharis halimifolia*), and southern wax-myrtle (*Myrica cerifera*). Hatch et al. (1990) list common species for Gulf Coast prairie as follows: little

bluestem (*Schizachyrium scoparium*), coastal bluestem (*S. scoparium* var. *littoralis*), yellow indiangrass (*Sorgastrum nutans*), eastern gammagrass (*Tripsacum dactyloides*), hairy awn muhly (*Muhlenbergia capillaris*), Texas wintergrass (*Stipa leucotricha*), panicgrasses (*Panicum* spp.), several Paspalum species, broomsedge (*Andropogon virginicus*), smutgrass (*Sporobolus indicus*), threeawn grasses (*Aristida* spp.), yankeeweed (*Eupatorium compositifolium*), western ragweed (*Ambrosia cumanensis*), prickly pear (*Opuntia* spp.), several aster species, Texas paintbrush (*Castilleja indivisa*), poppy mallows (*Callirhoe* spp.), phlox (*Phlox* spp.), bluebonnets (*Lupinus* spp.), and evening primrose (*Oenothera* spp.). Because of the higher rainfall and gradual transition to coastal marshes, the Coastal Prairies in the study area, particularly in Louisiana, switchgrass (*P. virgatum*) is more common than in Coastal Prairies farther west.

The upland grasslands, most of which have been converted to agricultural purposes (crops or pasture), are primarily north of the GIWW, inland of the coastal marshes. Upland grasslands also occur south of the GIWW in Louisiana on the uplands provided by Gum Cove and Perry Ridge (Fearn, 1995) and also in small, scattered patches in the uplands of the chenier complex. Only small, scattered remnants of coastal prairie may be found within the study area.

**Upland and Nonwetland Riparian Woodlands and Forests**

Several communities of upland forest occur in the study area, including the Coastal Live Oak-Sugarberry Series, Water Oak-Coastal Live Oak series, Loblolly Pine-Oak Series, and Chinese Tallow Woodland. The Coastal Live Oak-Sugarberry Series is essentially a maritime woodland or forest (woodlots/oak mottes) of the Upper Gulf Coast, which is unique to the Chenier Plain (USFWS, 1998). Associated species include yaupon, cedar elm, and ash (*Fraxinus* spp.) intermixed with open patches of little bluestem grasslands (Bezanson, 2001; Harcombe and Neaville, 1977; Texas Natural Heritage Program [TNHP], 1993). The Water Oak-Coastal Live Oak series is a mostly deciduous, riparian woodland of the floodplains and along bayous in the Upper Coastal Prairie, along the Sabine and Neches rivers. Associated species include pecan, cedar elm, sugarberry, yaupon, hawthorns (*Crataegus* spp.), and deciduous holly (*I. decidua*) (TNHP, 1993). The Loblolly Pine-Oak Series may include post, southern red, white, and water oaks (*Q. stellata*, *Q. falcata*, *Q. alba*, and *Q. nigra*). These occur on higher-elevation uplands that generally have acidic soils. This community often occurs as second growth or after disturbance and is highly variable and is a mix of pine and hardwood species (USFWS, 1998). Overstory species include loblolly pine, slash pine (*Pinus elliottii*), water oak, overcup oak, willow (*Salix* spp.), sweetgum, southern magnolia (*Magnolia grandiflora*), American elm, and sugarberry. Understory species include eastern red cedar (*Juniperus virginiana*), blackcherry (*Prunus serotina*), roughleaf dogwood (*Cornus drummondii*), sugarberry, American beautyberry (*Callicarpa americana*), and poison ivy (*Toxicodendron radicans*). These occur in scattered patches in the uplands in the north part of the study area, but also on Perry and Gum Cove ridges. Another woodland type has been created by the introduction of an exotic species, the Chinese tallow tree, which rapidly invades upland and fresh-brackish wetlands in disturbed areas or abandoned agricultural fields. These woodlands are virtual monocultures of tallow trees, but commonly include native species such as sugarberry, American elm, cedar elm, water oak, and ash (Bruce et al., 1995).

**Beach/Ridge (includes barrier dune complex)**

The current beach communities include a primary and secondary dune complex that is leeward of the unvegetated, beach sands of the shoreline. The primary dunes, located immediately landward of the beach, are taller and offer more protection from wind and hurricane storm surge than the secondary dunes. The secondary dunes, which are landward of the primary dunes, are not as tall and are more densely vegetated. Typical plant species of the primary dunes include sea oats (*Uniola paniculata*), bitter panicum (*P. amarum*), Gulf croton (*Croton punctatus*), beach morning glory (*Ipomea pes-caprae* var. *emarginata*), and fiddleleaf morning glory (*I. stolonifera*). Secondary dune species include marshhay/wiregrass, seashore dropseed (*Sporobolus virginicus*), seashore saltgrass, pennywort (*Hydrocotyle bonariensis*), and partridge pea (*Chamaecrista fasciculata*) (Britton and Morton, 1989; USFWS, 1998). Swales that occur between or within the primary and secondary dune complexes may support brackish-to-intermediate marsh vegetation. The ridge and swale topography of the Chenier Plain represents ancient beach systems. These occur behind the active beach system and exhibit alternating, linear, upland/transitional, and wetland features. The Gulf beach in the study area is heavily eroded and virtually nonexistent in places (e.g., Texas Point) where saline marshes can occur on the coastline.

### 3.9.5 Preparation of Baseline Data Set to Support the WVA Model

Since the primary impact expected with the proposed project is salinity intrusion, units used to evaluate impacts were defined to the greatest extent possible on hydrologic characteristics. Sensitive habitats that are hydrologically connected to waterways influenced by the proposed project were divided into hydro-units. Uplands and developed areas were excluded from the analysis. Baseline habitat types within each hydro-unit were then classified as marsh (fresh, intermediate, brackish, or saline), cypress-tupelo swamp, or bottomland hardwood. Habitat classification definitions were derived from Cowardin et al. (1979). Numerous other sources were used to map and characterize the wetlands. These are described in detail in Appendix C of this FEIS.

Baseline habitats for the Texas hydro-units were classified and mapped with the assistance of the Habitat Workgroup. The TPWD provided habitat mapping for the Keith Lake/Salt Bayou hydro-unit, the Lower Neches WMA (TPWD, 1992), and Cow Bayou (TPWD, 2004). The USFWS (2001) provided habitat maps of the McFaddin NWR and also mapped habitat types on the Neches River using the National Wetlands Inventory (NWI) data (USFWS and GLO, 1992), supplemented and revised as necessary on the basis of expert knowledge and field visits. All other Texas hydro-units were mapped by PBS&J using collapsed NWI data, reviewed and revised as necessary by the Habitat Workgroup.

Hydro-units and habitat types for Louisiana marsh habitats were drawn directly from mapping units developed for the Louisiana CWPPRA program (Chabreck and Linscombe, 1978; Linscombe, 2001; USGS-NWRC, 2004). Nonmarsh habitats on the Sabine River were mapped by PBS&J using NWI data, reviewed and revised by the Habitat Workgroup.

The existing vegetation and conditions, including detailed descriptions and maps for each hydro-unit, may be found in Appendix C (Section 7), so to avoid duplication, they are not included here.

## 3.10 AQUATIC ECOLOGY

### 3.10.1 Freshwater

The study area consists of both freshwater and marine ecosystems. The Sabine and Neches rivers and their tributaries were dominated by fresh water prior to the late 1800s, before Sabine Lake was opened for navigation. It is likely that Sabine Lake was almost entirely fresh, with the exception of saltwater intrusions that emanated from tidal surges during storms or during severe droughts (see Section 3.5 for additional discussions on hydrology). Thus, the biological communities have changed significantly within the past century due to the encroachment of salt water. Most of the tributaries adjacent to Sabine Lake are also influenced by salt water to some extent. Many of the deep navigational channels maintain predominant saltwater wedges that underlie freshwater inflows into the estuary. As a result of this, freshwater species adapted to stenohaline environments may be typically restricted to the upper reaches of the tributaries or occur above (on top of) the saltwater wedge. With high freshwater inflows, Sabine Lake and its tributaries often flush most of the salt water from the estuary resulting in a temporary expansion of freshwater habitat. However, with a return of normal freshwater inflows and tidal currents, Sabine Lake returns to a euryhaline (wide range of salinity) system.

Freshwater fauna typically occur in the tributaries of Sabine Lake including the Sabine and Neches rivers, Taylor, Cow, Adams, and Little Cypress bayous in Texas, Black and Johnson's bayous in Louisiana, as well as numerous other smaller tributaries. Rose City Marsh is predominantly a freshwater environment, and portions of Bessie Heights Marsh, distantly removed from the study area, contain low salinity. In addition, freshwater fauna can be found in the multitude of wetlands, oxbows, ponds, canals, and ditches within the study area.

#### 3.10.1.1 Fisheries

Due to the variety of habitats and the typical diversity of southeastern United States streams, the study area has an exceptionally diverse fish community consisting of approximately 56 freshwater and 25 estuarine species (Hubbs, 1982; USACE, 1975b). Fishery surveys conducted by the TPWD on the Sabine and Neches rivers (TPWD, 1980, 1994) and Taylor, Hildebrand, Cow, Little Cypress, and Adams bayous (TPWD, 1985, 1995a, 1995b) confirm many of these species. Some of these species, including largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), crappie (*Pomoxis* spp.), white bass (*Morone chrysops*), and sunfish (*Lepomis* spp.), are important recreational species. Although little information is available regarding angler use, all of these areas are extensively utilized by sport anglers (Driscoll, 2001). There is little to no commercial freshwater fishing on the Texas side of the study area (Young, 2001). Table 3.10-1 lists species collected by the TPWD from Bessie Heights Marsh using gill nets, and from the Neches River using bag seines (Tirpak, 2002). The number of data lines for gill nets represents the number of samples where at least one individual of that species was encountered per mesh size. The TPWD gill nets are 600 feet in length with 150-foot panels each of 3-, 4-, 5-, and 6-inch

mesh. For bag seines, the "number of data lines" represents the number of samples where at least one individual of that species was encountered. For each gear type, a higher number of lines indicate a higher encounter rate (not necessarily catch rate) for that species and gear.

The LDWF, Inland Fisheries Division, monitors fish populations with an emphasis on sport fish management on the Sabine River at Niblett's Bluff and within associated bayous downstream of Niblett's Bluff. A variety of freshwater species has been collected from this area including largemouth bass, spotted bass (*M. punctulatus*), bowfin (*Amia calva*), black crappie (*P. nigromaculatus*), spotted sucker (*Minytrema melanops*), golden shiner (*Notemigonus crysoleucas*), sunfish, blue catfish (*I. furcatus*), channel catfish, spotted gar (*Lepisosteus oculatus*), shad (*Dorosoma* spp.), and striped mullet (*Mugil cephalus*) (LDWF, var.). According to the LDWF (pers. comm. District Biologist, 2001), angling along the Sabine River is very popular, including tournament fishing for largemouth bass by local anglers.

#### 3.10.1.2 Macroinvertebrates

Both benthic macroinvertebrates and plankton support the food chain in the freshwater zones. Food chains in the larger, slow-moving rivers, bayous, and backwater areas are similar to those found in lakes. In these systems, the food chain consists primarily of plankton, including microscopic algae (phytoplankton) and crustacea (zooplankton) that are suspended in the water column. Diverse communities of plankton occur throughout the freshwater system, but gradually shift to marine taxa as the water enters the estuarine areas. For the most part, plankton communities found in the study area are ubiquitous and common throughout the southern United States. Phytoplankton communities that occur in the freshwater zones of the study area typically include blue-green algae (Cyanophyta), green algae (Chlorophyta), and diatoms (Bacillariophyta). Zooplankton common to this same area include rotifers (Rotifera), calanoid and cyclopoid copepods (Copepoda), seed shrimp (Ostracoda), and *Daphnia* and *Ceriodpahnia* spp. (Cladocera).

In small streams or streams with higher water velocities, benthic macroinvertebrates are the primary basis of the food chain. Species composition in the rivers, bayous, and streams in the study area is similar to other southeastern United States rivers and streams. General groups of organisms commonly found in these areas include aquatic worms (Oligochaeta), scuds (Amphipoda), crayfish (Cambaridae), mayflies (Ephemeroptera), caddsiflies (Trichoptera), water beetles (Coleoptera), midge flies (Chironomidae), water bugs (Hemiptera), dragonflies (Odanata), and mussels (Bivalvia).

Within the tidally influenced zones, where saltwater wedges or intrusion occur, the macrobenthic community is complex and dynamic (see subsection 3.10.2.1 for additional discussions). Community structure in the shallow margins of these tributaries may consist of those organisms common to freshwater environments due to the partitioning between fresh- and saltwater. However, these freshwater organisms are greatly affected by the encroachment of saltwater wedges. McKee and Wolf (1973) consider dissolved solids between 5,000 and 10,000 mg/L to be beyond the tolerance of most freshwater organisms. Persistent saltwater intrusion with saltwater wedges may allow for the encroachment of estuarine organisms.

Table 3.10-1
Species Collected by TPWD from Bessie Heights (Gill Nets) and Neches River (Bag Seines)
January 1986–June 2001

| Family Name/Scientific Name | Common Name | Number of Data Lines | |
|---|---|---|---|
| | | Gill Nets Bessie Heights | Bag Seines Neches River |
| **HYDROZOA** | | | |
| Hydractiniidae | | | |
| *Podocoryna carnea* | Smoothspined snailfur | | 1 |
| **CTENOPHORE** | | | |
| Beroidae | | | |
| *Beroe ovata* | Sea walnut (comb jelly) | | 12 |
| Bolinopsidae | | | |
| *Mnemiopsis mccradyi* | Phosphorus jelly | | 8 |
| **MOLLUSKS** | | | |
| Mactridae | | | |
| *Rangia cuneata* | Atlantic rangia | 2 | 10 |
| **CRUSTACEANS** | | | |
| Penaeidae | | | |
| *Farfantepenaeus aztecus* | Brown shrimp | | 51 |
| *Litopenaeus setiferus* | White shrimp | | 61 |
| *Xiphopenaeus kroyeri* | Seabob | | 1 |
| Palaemonidae | | | |
| *Palaemonetes pugio* | Daggerblade grass shrimp | | 1 |
| *Palaemonetes* sp. | unidentified grass shrimp | | 40 |
| *Macrobrachium ohione* | Ohio shrimp | | 5 |
| Portunidae | | | |
| *Callinectes sapidus* | Blue crab | 95 | 136 |
| *Callinectes similis* | Lesser blue crab | | 8 |
| Xanthidae | | | |
| Family mud crabs | | | 2 |
| Grapsidae | | | |
| *Sesarma reticulatum* | Heavy marsh crab | | 1 |
| Cambariidae | | | |
| *Procambarus clarkii* | Red swamp crawfish | | 2 |
| **BRYOZOANS** | | | |
| Gymnolaemata | | | |
| *Zoobotryon verticillatum* | Sauerkraut bryozoan | 2 | |

Table 3.10-1, cont'd

| Family Name/Scientific Name | Common Name | Number of Data Lines | |
|---|---|---|---|
| | | Gill Nets Bessie Heights | Bag Seines Neches River |
| **FISHES** | | | |
| Lepisoseidae | | | |
| *Lepisosteus oculatus* | Spotted gar | 131 | 1 |
| *Lepisosteus osseus* | Longnose gar | 6 | |
| *Lepisosteus spatula* | Alligator gar | 117 | |
| Elopidae | | | |
| *Elops saurus* | Ladyfish | 10 | 3 |
| Clupeidae | | | |
| *Alosa chrysochloris* | Skipjack herring | 2 | |
| *Dorosoma cepedianum* | Gizzard shad | 145 | 1 |
| *Dorosoma petenense* | Threadfin shad | | 21 |
| *Harengula jaguana* | Scaled sardine | | 2 |
| *Brevoortia patronus* | Gulf menhaden | 10 | 50 |
| Family herrings | | | 3 |
| Engraulidae | | | |
| *Anchoa hepsetus* | Striped anchovy | | 2 |
| *Anchoa mitchilli* | Bay anchovy | | 61 |
| Cyprinidae | | | |
| *Cyprinus carpio* | Common carp | 4 | |
| Ictaluridae | | | |
| *Ameiurus natalis* | Yellow bullhead | 1 | |
| *Ictalurus furcatus* | Blue catfish | 83 | 2 |
| *Ictalurus punctatus* | Channel catfish | 3 | |
| Ariidae | | | |
| *Arius felis* | Hardhead catfish | 117 | 18 |
| *Bagre marinus* | Gafftopsail catfish | | 1 |
| Belonidae | | | |
| *Strongylura marina* | Atlantic needlefish | | 7 |
| Cyprinodontidae | | | |
| *Cyprinodon variegatus* | Sheepshead minnow | | 15 |
| *Fundulus grandis* | Gulf killifish | | 13 |
| *Lucania parva* | Rainwater killifish | | 1 |
| Poeciliidae | | | |
| *Poecilia latipinna* | Sailfin molly | | 2 |
| Atherinidae | | | |
| *Membras martinica* | Rough silverside | | 1 |
| *Menidia beryllina* | Inland silverside | | 57 |

Table 3.10-1, cont'd

| Family Name/Scientific Name | Common Name | Number of Data Lines | |
|---|---|---|---|
| | | Gill Nets Bessie Heights | Bag Seines Neches River |
| Syngnathidae | | | |
| *Syngnathus scovelli* | Gulf pipefish | | 1 |
| Percichthyidae | | | |
| *Morone mississippiensis* | Yellow bass | 20 | |
| *Morone saxatilis* | Striped bass | 2 | 1 |
| Family Percichthyidae | Family temperate basses | 1 | |
| Centrarchidae | | | |
| *Lepomis macrochirus* | Bluegill | 3 | 1 |
| *Lepomis microlophus* | Redear sunfish | 2 | |
| *Micropterus salmoides* | Largemouth bass | 16 | 1 |
| Carangidae | | | |
| *Caranx hippos* | Crevalle jack | | 7 |
| *Trachinotus carolinus* | Florida pompano | | 3 |
| *Chloroscombrus chrysurus* | Atlantic bumper | | 2 |
| *Oligoplites saurus* | Leatherjacket | | 11 |
| Gerreidae | | | |
| *Eucinostomus argenteus* | Spotfin mojarra | | 2 |
| *Eucinostomus gula* | Silver jenny | | 8 |
| Sparidae | | | |
| *Archosargus probatocephalus* | Sheepshead | 29 | 1 |
| *Lagodon rhomboides* | Pinfish | 3 | 8 |
| Sciaenidae | | | |
| *Aplodinotus grunniens* | Freshwater drum | 3 | |
| *Cynoscion arenarius* | Sand seatrout | 1 | 26 |
| *Cynoscion nebulosus* | Spotted seatrout | 72 | 13 |
| *Cynoscion nothus* | Silver seatrout | | 1 |
| *Leiostomus xanthurus* | Spot | 61 | 32 |
| *Micropogonias undulatus* | Atlantic croaker | 24 | 122 |
| *Pogonias cromis* | Black drum | 252 | |
| *Sciaenops ocellatus* | Red drum | 345 | 18 |
| *Menticirrhus americanus* | Southern kingfish | | 5 |
| *Menticirrhus littoralis* | Gulf kingfish | | 1 |
| Muglidae | | | |
| *Mugil cephalus* | Striped mullet | 57 | 95 |
| *Mugil curema* | White mullet | | 14 |
| Polynemidae | | | |
| *Polydactylus octonemus* | Atlantic threadfin | | 2 |

Table 3.10-1, cont'd

| Family Name/Scientific Name | Common Name | Number of Data Lines | |
|---|---|---|---|
| | | Gill Nets Bessie Heights | Bag Seines Neches River |
| Gobiidae | | | |
| *Gobionellus boleosoma* | Darter goby | | 6 |
| *Gobionellus shufeldti* | Freshwater goby | | 5 |
| *Gobiosoma bosc* | Naked goby | | 4 |
| Bothidae | | | |
| *Citharichthys spilopterus* | Bay whiff | | 23 |
| *Etropus crossotus* | Fringed flounder | | 2 |
| *Paralichthys lethostigma* | Southern flounder | 34 | 29 |
| Soleidae | | | |
| *Achirus lineatus* | Lined sole | | 1 |
| *Trinectes maculatus* | Hogchoker | | 1 |
| Tetraodontidae | | | |
| *Sphoeroides parvus* | Least puffer | | 3 |
| Synodontidae | | | |
| *Synodus foetens* | Inshore lizardfish | | 4 |
| Uranocopidae | | | |
| *Astroscopus y-graecum* | Southern stargazer | | 1 |
| Triglidae | | | |
| *Prionotus tribulus* | Bighead searobin | | 7 |
| Cynoglossidae | | | |
| *Symphurus plagiusa* | Blackcheek tonguefish | | 4 |
| **MAMMALS** | | | |
| Myocastoridae | | | |
| *Myocastor coypus* | Nutria | 1 | |

Source: A. Tirpak (2002).

Prior to the implementation of the CWA in the early 1970s, the Neches River, downstream of the saltwater barriers on the Neches River, and Pine Island Bayou were highly impacted by industrial wastewater effluent and saltwater encroachment. Studies by Harrel (1975, 1993), Harrel and Hall (1991), and Harrel et al. (1976) documented the impacts of increased salinity and depressed dissolved oxygen (DO) on benthic macroinvertebrates. The degree of impact was greater downstream in the industrialized portions of the river. Since the implementation of the CWA, water quality has improved with a significant reduction in biochemical oxygen demand (EPA, 1978); however, saltwater intrusion continues to be a problem for freshwater organisms in this area.

## 3.10.2 Marine

### 3.10.2.1 Estuarine Habitats and Fauna

#### *3.10.2.1.1 Open-Bay*

Sabine Lake, when compared to the other estuarine ecosystems in Texas, covers the smallest surface area (43,978 acres/68.6 square miles) and volume; however, it has the largest surrounding marshland (over 185,000 acres/288.6 square miles) (Armstrong et al., 1987; Blackburn et al., 2001). The average depth of Sabine Lake is 6 feet. Due to the large amount of freshwater inflow into Sabine Lake from stormwater runoff, return flows, and diversions, this estuary has the highest loading of nutrients than any other estuary in Texas (Armstrong et al., 1987). Due to its dynamic salinity (see subsection 3.5.5), Sabine Lake supports a diversity of fish species, plankton, and benthic organisms.

**Plankton Assemblages**. Phytoplankton (microscopic algae) are the major primary producers (plant life) in the open bay, taking up carbon through photosynthesis and nutrients for growth. Phytoplankton are fed upon by zooplankton (small crustaceans), fish, and benthic consumers. EH&A (1976), found that phytoplankton in Sabine Lake were comprised primarily of both freshwater and marine diatoms (45 percent) and green algae (36 percent). Species composition changed seasonally with minimum abundance occurring in the winter and maximum in the summer. Zooplankton were most abundant during the summer and early fall, coinciding with higher salinities. The dominant species was the copepod *Acartia tonsa* (85 percent), with several other marine copepods also present. Commensurate with higher salinities, the higher numbers were found in the lowest reaches of the estuary. Freshwater species, including rotifers and cladocerans, were the dominant taxa near the mouth of the rivers. Abundance of zooplankton was lowest in the winter and spring and highest in the summer and fall, which is the opposite in other estuaries (with the exception of Galveston Bay) (Armstrong et al., 1987; EH&A, 1976). Marine zooplankton abundance is apparently related to the greater inflow of fresh water into Sabine Lake and Galveston Bay during the winter and spring (Armstrong et al., 1987).

**Nekton Assemblages**. Nekton assemblages (organisms that swim freely in the water column) consist mainly of secondary consumers, which feed on zooplankton or juvenile and smaller nekton. Sabine Lake supports a diverse nekton population including fish, shrimp, and crabs. Some of these are resident species, spending their entire life in the bay, whereas others are migrant species spending only a portion of their life cycle in the estuary (Armstrong et al., 1987).

Dominant nekton species inhabiting the Sabine Lake estuary are Atlantic croaker (*Micropogonias undulatus*), white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*), Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), red drum (*Sciaenops ocellatus*), blue crab (*Callinectes sapidus*), southern flounder (*Paralichthys lethostigma*), black drum (*Pogonias cromis*), striped mullet, sheepshead (*Archosargus probatocephalus*), and spotted seatrout (*Cynoscion nebulosus*), all of which are estuarine dependent (Chambers and Sparks, 1959; Parker, 1965; Reid, 1957). These species are ubiquitous along the Texas and Louisiana coast and are unaffected by changes in salinity. Seasonal differences occur in abundance with the fall usually being the smallest in biomass and number.

Newly spawned fish and shellfish begin migrating into the bay in winter and early spring with the maximum biomass observed during the summer months (Parker, 1965).

**Recreational and Commercial Fisheries**. Sabine Lake has the second-lowest percentage of the total commercial finfish harvest from all Texas bay systems (Culbertson et al., 2004). Table 3.10-2 lists the TPWD commercial landings for Sabine Lake from 1992 through 2001. From 1992 to 2001, an average of only 1,629 pounds of finfish were commercially harvested in Sabine Lake, with a value averaging $1,540. The amount harvested has declined in recent years. Commercially caught species include Atlantic croaker, black drum, flounder, king whiting (*Menticirrhus americanus*), striped mullet, and sheepshead (Auil-Marshalleck et al., 2001; Culbertson et al., 2004).

The main commercially harvested shellfish species in Sabine Lake are blue crabs (Table 3.10-3). Sabine Lake sustains an important blue crab fishery in Texas and Louisiana. From 1997 through 2001, 27 percent of all blue crabs on the Texas coast were landed from Sabine Lake (Culbertson et al., 2004). From 1990 to 1999, over 1 million pounds of blue crabs were commercially harvested annually from Sabine Lake, with an annual value averaging $843,273 (Culbertson et al., 2004). At one time, white shrimp made up a 330 ton/year fishery. In 1997, this fishery began to decline, possibly as a result of changes in freshwater inflow and concurrent isolation of wetlands from Sabine Lake. This decline was only observed in Sabine Lake while the white shrimp fishery in Galveston Bay and Lake Calcasieu remained the same (Sheridan et al., 1989). Eastern oysters (*Crassostrea virginica*) are not currently commercially harvested from Sabine Lake (see Table 3.10-2); however, they were harvested during 1986 and 1987 (Auil-Marshalleck et al., 2001).

The commercial landings data collected by the LDWF is shown in Table 3.10-3. From 1995 to 2005, an average of 10,375 pounds of finfish were commercially harvested from Sabine Lake, with a value averaging $10,610. These species include alligator gar (*Lepisosteus spatula*) and blue catfish. Shellfish were only harvested in 2001 and 2002, and included 88,362 pounds of blue crab with a value of $76,726 and 908 pounds of white shrimp with a value of $1,223 (Kasprzak, 2007).

Due to the variety of both fresh and saltwater species, recreational fishing is Sabine Lake's largest recreational activity (Davis, 1996). The most sought after species include Atlantic croaker, black drum, gafftopsail catfish (*Bagre marinus*), red drum, sand seatrout (*Cynoscion arenarius*), sheepshead, southern flounder, and spotted seatrout (see subsection 3.10.1.1 for additional discussion on freshwater sport fish). Between May 1982 and May 1992, Sabine Lake (including Sabine Pass) accounted for 10 percent of the annual coastwide recreational fishing landings among bay systems. The majority of these species included Atlantic croaker, southern flounder, black drum, and gafftopsail catfish (Warren et al., 1994). The catch per unit effort in Sabine Lake is 0.35 fish per man-hour of fishing, second only to Galveston Bay. Annual fishing effort is estimated at 500,000 man-hours (Blackburn et al., 2001). The LDWF only collects recreational landings data on a statewide level; there are no data specific to Sabine Lake (Kasprzak, 2007).

Table 3.10-2
Texas Commercial Landings for Sabine Lake
Annual Summaries, 1992–2001

| Species | Year | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1992 | | 1993 | | 1994 | | 1995 | | 1996 | | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
| | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ |
| Fish | | | | | | | | | | | | | | | | | | | | |
| Atlantic Croaker | 0 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.02 | 0.13 | 0.05 | 0 | 0 | 0.01 | 0.04 | 0.11 | 0.75 | -- | -- | -- | -- |
| Black Drum | 0.03 | 0.20 | 0 | 0 | 0.52 | 0.42 | 0 | 0 | 1.17 | 0.83 | 0.70 | 0.49 | 0 | 0 | 0 | 0 | 0 | 0 | 0.86 | 0.60 |
| Flounder | 2.03 | 2.43 | 0.06 | 0.06 | 0 | 0 | 0 | 0 | 0 | 0 | 0.07 | 0.07 | 0 | 0 | 0 | 0 | 0.04 | 0.09 | 0 | 0 |
| King Whiting | 7.22 | 2.02 | 0.1 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -- | -- | -- | -- |
| Mullet | 0 | 0 | 0 | 0 | 0 | 0 | 0.36 | 0.18 | 0.41 | 0.20 | 0.12 | 0.3 | 0.22 | 0.84 | 0.08 | 0.33 | 1.37 | 4.16 | 0.26 | 1.15 |
| Sand Seatrout | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | 0.09 | 0.04 | 0.02 | 0 | 0 | -- | -- | -- | -- |
| Sheepshead | 0.12 | 0.03 | 0.04 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL FISH** | **9.40** | **4.68** | **0.20** | **0.09** | **0.52** | **0.42** | **0.41** | **0.20** | **1.71** | **1.08** | **1.06** | **0.95** | **0.27** | **0.90** | **0.19** | **1.08** | **1.41** | **4.25** | **1.12** | **1.75** |
| Shellfish | | | | | | | | | | | | | | | | | | | | |
| Blue Crabs | 266.31 | 169.49 | 871.53 | 354.64 | 736.07 | 387.67 | 1,278.13 | 952.96 | 1,654.86 | 1,093.93 | 1,670.86 | 1,072.53 | 1,268.24 | 871.04 | 1,796.99 | 1,303.11 | 1,522.64 | 1,108.54 | 1,415.62 | 1,118.82 |
| Oyster Meats | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shrimp (Heads On): | | | | | | | | | | | | | | | | | | | | |
| Brown and Pink | 2.89 | 3.17 | 5.01 | 3.85 | 0 | 0 | 0.69 | 0.94 | 23.83 | 16.81 | 0.92 | 0.59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| White | 19.31 | 13.89 | 21.87 | 15.00 | 14.92 | 18.36 | 9.04 | 8.52 | 8.12 | 8.59 | 0 | 0 | 0 | 0 | 0 | 0 | 42.21 | 66.29 | 0 | 0 |
| Other | 0 | 0 | 0.44 | 0.15 | 0.91 | 0.25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL SHELLFISH** | **288.51** | **186.55** | **898.85** | **373.64** | **751.90** | **406.28** | **1,287.86** | **962.42** | **1,686.81** | **1,119.33** | **1,671.78** | **1,073.12** | **1,268.24** | **871.04** | **1,796.99** | **1,303.11** | **1,564.85** | **1,174.83** | **1,415.62** | **1,118.82** |
| **GRAND TOTAL** | **297.91** | **191.23** | **899.05** | **373.73** | **752.42** | **406.70** | **1,288.27** | **962.62** | **1,688.52** | **1,120.41** | **1,672.84** | **1,074.07** | **1,268.51** | **871.94** | **1,797.18** | **1,304.19** | **1,566.26** | **1,179.08** | **1,416.74** | **1,120.57** |

Source:
Auil-Marshalleck et al. (2001).
Campbell (2001).
Culbertson et al. (2004).

Table 3.10-3
Louisiana Commercial Landings for Sabine Lake
Annual Summaries, 1999–2005

| Species | Year | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | |
| | lbs. | $ | lbs. | $ | lbs. | $ | lbs. | $ | lbs. | $ | lbs. | $ | lbs. | $ |
| Fish | | | | | | | | | | | | | | |
| Alligator gar | 21,439.35 | 19,420.65 | 16,407.65 | 17,375.45 | 10,340.75 | 10,062.80 | 3,812.16 | 4,889.00 | 0 | 0 | 6,522.46 | 8,097.35 | 2,900.49 | 3,256.65 |
| Blue catfish | 0 | 0 | 0 | 0 | 825.36 | 556.20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL FISH** | **21,439.35** | **19,420.65** | **16,407.65** | **17,375.45** | **11,166.11** | **10,619.00** | **3,812.16** | **4,889.00** | **0.00** | **0.00** | **6,522.46** | **8,097.35** | **2,900.49** | **3,256.65** |
| Shellfish | | | | | | | | | | | | | | |
| Blue Crabs | 0 | 0 | 0 | 0 | 88,362.30 | 76,726.45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| White shrimp | 0 | 0 | 0 | 0 | 0 | 0 | 908.00 | 1,022.70 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL SHELLFISH** | **0** | **0** | **0** | **0** | **88,362.30** | **76,726.45** | **908.00** | **1,022.70** | **0** | **0** | **0** | **0** | **0** | **0** |
| **GRAND TOTAL** | **21,439.35** | **19,420.65** | **16,407.65** | **17,375.45** | **99,528.41** | **87,345.45** | **4,720.16** | **5,911.70** | **0.00** | **0.00** | **6,522.46** | **8,097.35** | **2,900.49** | **3,256.65** |

Source: Kasprzak (2007).

Offshore fishing is also popular in the study area. The main recreational species are king mackerel (*Scomberomorus cavalla*), red snapper (*Lutjanus campechanus*), and sand seatrout. From May 1982 to May 1992, offshore recreational fishing in this area accounted for 4 to 7 percent of the annual coastwide private-boat fishing landings (Warren et al., 1994). The main commercially landed species include flounder, mullet, snapper, and blue crab (Table 3.10-4) (Culbertson et al., 2004). From 1997 to 2001, Sabine Lake represented less than 1 percent of the total annual coastwide finfish commercial landings (Culbertson et al., 2004).

#### *3.10.2.1.2 Open-Bay Bottom*

The open-bay bottom includes all areas of Sabine Lake not covered with oyster reefs (Lester and Gonzales, 2001) but does not include the bottoms of ship channels because they are so frequently disturbed by ship passage and maintenance dredging that they never establish a population even approaching a climax community. Benthic organisms are divided into two groups: epifauna, such as crabs and smaller crustaceans, which live on the surface of the bottom substrate, and infauna, such as mollusks and polychaetes that burrow into the bottom substrate (Green et al., 1992). Mollusks and other infaunal organisms are filter feeders that strain suspended particles from the water column. Others, such as polychaetes, feed by ingesting sediments and extracting nutrients. Many of the epifauna and infauna feed on plankton, and are then fed upon by numerous fish and birds (Armstrong et al., 1987; Lester and Gonzales, 2001). The open-bay bottom includes flat areas consisting of mud and sand that contribute large quantities of nutrients and food, making them one of the most important components of this habitat type. EH&A (1976) found that the dominant infauna organism throughout Sabine Lake was the clam (*Rangia cuneata*) and a polychaete of the family Capitellidae. *R. cuneata* was most abundant in areas of lower salinity, whereas polychaetes increased in abundance in areas of higher salinity (EH&A, 1976). Vittor & Associates (1997) found the dominant benthic taxa of Sabine Lake were the polychaetes, *Paraprionospio pinnata* (29.0 percent) and *Mediomastus* sp. (7.7 percent), the oligochaete, *Tubificoides heterochaetus* (23.2 percent), and the bivalve, *R. cuneata* (5.2 percent).

#### *3.10.2.1.3 Oyster Reef*

Eastern oyster reefs are present in several areas of Sabine Lake, Sabine Pass, and Keith Lake, and provide ecologically important functions. Oyster reefs are formed where a hard substrate and adequate currents are plentiful. Currents carry nutrients to the oysters and take away sediment and waste filtered by the oyster. Most oyster reefs are subtidal or intertidal and found near passes and cuts, and along the edges of marshes. Oysters can filter water 1,500 times the volume of their body per hour which, in turn, influences water clarity and phytoplankton abundance (Powel et al., 1992; Lester and Gonzalez, 2001). Due to their lack of mobility and their tendency to bioaccumulate pollutants, oysters are an important indicator species for determining contamination in the bay (Lester and Gonzalez, 2001).

Table 3.10-4
Texas Commercial Offshore Landings
Annual Summaries, 1992–2001

| Species | Year | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1992 | | 1993 | | 1994 | | 1995 | | 1996 | | 1997 | | 1998 | | 1999 | | 2000 | | 2001 | |
| | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ | lbs. (x 1,000) | $ |
| Fish | | | | | | | | | | | | | | | | | | | | |
| Black Drum | 0.19 | 0.08 | 0.09 | 0.03 | 0.02 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.07 | 0.05 | 0.33 | 0.14 | 0.008 | 0.003 |
| Flounder | 4.33 | 4.36 | 1.61 | 1.37 | 1.48 | 1.49 | 2.61 | 2.26 | 0.83 | 0.79 | 0.34 | 0.38 | 0.53 | 0.64 | 52 | 0.64 | 0.45 | 0.63 | 0.22 | 0.33 |
| Sheepshead | 0.21 | 0.10 | 0.14 | 0.04 | 0.02 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0.002 | 0.26 | 0.08 | 0.09 | 0.04 |
| Mullet | 5.15 | 1.45 | 3.3 | 0.93 | 0.1 | 0.05 | 0.17 | 0.08 | 0 | 0 | 0.25 | 0.13 | 0.05 | 0.03 | 0.46 | 0.23 | 0 | 0 | 0.02 | 0.012 |
| Cobia | 0.18 | 0.19 | 0 | 0 | 0 | 0 | 0.13 | 0.16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grouper | 0.20 | 0.31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Snapper | 45.50 | 80.79 | 44.25 | 76.39 | 26.65 | 47.53 | 4.66 | 9.23 | 10.49 | 17.11 | 9.91 | 20.26 | 0.05 | 0.09 | 0.39 | 0.81 | 0.30 | 0.73 | 0.08 | 0.16 |
| **TOTAL FISH** | **55.76** | **87.28** | **49.39** | **78.76** | **28.27** | **49.09** | **7.57** | **11.73** | **11.32** | **17.90** | **10.50** | **20.77** | **0.63** | **0.76** | **52.93** | **1.73** | **1.34** | **1.58** | **0.41** | **0.55** |
| Shellfish | | | | | | | | | | | | | | | | | | | | |
| Blue Crabs | 7.26 | 3.83 | 2.11 | 1.16 | 29.03 | 26.80 | 0 | 0 | 0.28 | 0.11 | 3.60 | 2.42 | 2.47 | 2.04 | 0 | 0 | 16.46 | 12.72 | 0 | 0 |
| **TOTAL SHELLFISH** | **7.26** | **3.83** | **2.11** | **1.16** | **29.03** | **26.80** | **0** | **0** | **0.28** | **0.11** | **3.60** | **2.42** | **2.47** | **2.04** | **0** | **0** | **16.46** | **12.72** | **0** | **0** |
| **GRAND TOTAL** | **63.02** | **91.11** | **51.50** | **79.92** | **57.30** | **75.89** | **7.57** | **11.73** | **11.60** | **18.01** | **14.10** | **23.19** | **3.10** | **2.80** | **52.93** | **1.73** | **17.80** | **14.30** | **0.41** | **0.55** |

Source:
Auil-Marshalleck et al. (2001).
Culbertson et al. (2004).

Many organisms, including mollusks, polychaetes, barnacles, crabs, gastropods, amphipods, polychaetes, and isopods, can be found living on the oyster reef, forming a very diverse community (Sheridan et al., 1989). Oyster reef communities are dependent upon food resources from the open bay and marshes. Many organisms feed on oysters including fish, such as black drum, crabs (*Callinectes* spp.), and gastropods such as the oyster drill (*Thais haemastoma*) (Sheridan et al., 1989; Lester and Gonzales, 2001). When oyster reefs are exposed during low tides, shore birds would use the reef areas as resting places (Armstrong et al., 1987).

The majority of oyster reefs in the study area are located in the southern part of Sabine Lake near Blue Buck Point, in Sabine Pass, and in Keith Lake (GLO, 1996). Oysters are not commercially harvested from Sabine Lake. In Texas, all areas not specifically designated as Restricted, Conditionally Approved, or Approved by the Texas Department of State Health Services (TDSHS) are classified as Prohibited and closed for harvesting of molluscan shellfish (Heideman, 2002; TDSHS, 2008). Louisiana has designated Sabine Lake as a "Public Oyster Area." Commercial harvesting is prohibited and public harvesting methods are restricted to tonging. However, Sabine Lake and its tributaries north of a line from Texas Point to Louisiana are closed to oyster harvesting.

##### *3.10.2.1.4 Salt Marsh*

Sabine Lake has the largest salt marsh coverage (over 185,000 acres) of any bay system in Texas (Blackburn et al., 2001). This emergent vegetation plays an important role in sustaining the health and abundance of life in the estuary. Emergent vegetation contributes to the productivity of the estuary by providing particulate matter, nutrients, structure, protection, substrate, habitat for estuarine species, flood control, and improved water quality. Salt marshes serve as spawning and nursery grounds for many fish and shellfish species (Sheridan et al., 1989; TPWD, 1997). As an example, Table 3.10-1 lists species that have been collected from Bessie Heights Marsh. Refer to subsection 3.9.2.1 for a more detailed description of this habitat type.

#### 3.10.2.2 Offshore Habitats and Fauna

The Gulf is a partially enclosed, oceanic basin connected to the Atlantic Ocean by the Straits of Florida and to the Caribbean Sea by the Yucatan Canal. Numerous currents circulate water throughout the basin. Surface temperatures range from 57°F in January to 88°F in July (GMFMC, 2004). Salinities also vary seasonally ranging from 29 ppt near the coastline to 32 ppt in the open Gulf (Minerals Management Service [MMS], 1997). The nearshore area is predominantly composed of coarse sediments, while fine sediments are found in the deeper areas beyond the 260-foot contour (GMFMC, 2004). Sediment type plays an important role in determining community structure. Each species has optimal habitat and tolerance limits regarding sediment particle size and chemical composition that influences the distribution of fauna in nearshore waters (Britton and Morton, 1989).

#### *3.10.2.2.1 Offshore Sands*

There are few seagrasses or attached algae found in the offshore sands due to the strong currents and unstable sediments. Most of the bottom surface is populated with macroinfauna such as an occasional hermit crab, portunid crab, or ray. Even though there is little life on the sand surface itself, the overlying waters are highly productive. Phytoplankton are abundant, including microscopic diatoms, dinoflagellates, and other algae (Britton and Morton, 1989).

Much of the faunal diversity lies buried in the sand and relies on the phytoplankton for food. Bivalves found in offshore sands include the blood ark (*Anadara ovalis*), incongruous ark (*A. brasiliana*), southern quahog (*Mercenaria campechiensis*), giant cockle (*Dinocardium robustum*), disk dosinia (*Dosinia discus*), pen shells (*Atrina serrata*), common egg cockle (*Laevicardium laevigatum*), cross-barred venus (*Chione cancellata*), tellins (*Tellina* spp.), and the tusk shell (*Dentalium texasianum*). One of the most common species occurring in the shallow offshore sands is the sand dollar (*Mellita quinquiesperforata*) as well as several species of brittle stars (*Hemipholis elongata*, *Ophiolepis elegans*, and *Ophiothrix angulata*). Many gastropods are common, including the moon snail (*Polinices duplicatus*), ear snail (*Sinum perspectivum*), Texas olive (*Oliva sayana*), Atlantic auger (T*erebra dislocata*), Salle's ager (*Terebra salleano*), scotch bonnet (*Phalium granulatum*), distroted triton (*Distrosio clathrata*), wentletraps (*Epitonium* sp.), and whelks (*Busycon* spp.). Crustaceans inhabit these waters including white and brown shrimp (both commercially caught species), rock shrimp (*Sicyonia brevirostris*), blue crabs, mole crabs (*Albunea* spp.), speckled crab (*Arenaeus cribrarius*), box crab (*Calappa sulcata*), calico crab (*Hepatus epheliticus*), and pea crab (*Pinotheres maculatus*). The most abundant infaunal organism, with respect to the number of individuals, are the polychaetes (Capitellidae, Orbiniidae, Magelonidae, and Paraonidae) (Britton and Morton, 1989).

#### *3.10.2.2.2 Artificial Reefs*

In the Gulf, two types of artificial reefs exist, those structures placed to serve as oil and gas production platforms and those intentionally placed to serve as artificial reefs (GMFMC, 2004). The more than 4,500 oil and gas structures in the Gulf form unique reef ecosystems that extend throughout the water column providing a large volume and surface area, dynamic water-flow characteristics, and a strong profile (Ditton and Falk, 1981; Dokken, 1997; Stanley and Wilson, 1990; Vitale and Dokken, 2000). Fish are attracted to oil platforms because these structures provide food, shelter from predators and ocean currents, and a visual reference, which aids in navigation for migrating fishes (Bohnsack, 1989; Duedall and Champ, 1991; Meier, 1989; Vitale and Dokken, 2000). The size and shape of the structure affect community characteristics of pelagic, demersal, and benthic fishes (Stanley and Wilson, 1990). Many scientists feel that the presence of oil platform structures allows for the fish populations to grow, which increases fishery potential (Scarborough-Bull and Kendall, 1992).

The Texas Artificial Reef Program, administered by the TPWD, comprises three concepts. These are Rigs to Reefs, which provides for the recycling of obsolete petroleum platforms into permanent artificial reefs rather than allowing them to be taken ashore as scrap; Ships to Reefs, which at present only includes 12

Liberty Ships from the 1970s and the USTS *Texas Clipper*; and the Near Shore/Shallow Reef program, which is in water too shallow for rigs or ships and uses obsolete bridge and road-bed material and nonfunctional preformed concrete structures like culverts. There are three Near Shore/Shallow Reef sites that are relatively near the proposed new ODMDSs for the Entrance Channel Extension: Basco's Reef, SALT Reef, and Sabine Reef (Appendix B). Basco's Reef (HI-117) is located 23 nautical miles from Sabine Pass in 50 feet of water and has received numerous donations. SALT Reef (HI-85, 18 nautical miles from Sabine Pass, 43 feet of water) and Sabine Reef (HI-117, 22 nautical miles from Sabine Pass, 36 feet of water) have not yet received donations but are formally part of the Artificial Reef Program. SALT Reef, which is closest to the proposed ODMDSs, is 6.6 miles from ODMDS B.

Artificial reefs are colonized by a diverse array of microorganisms, algae, and sessile invertebrates including shelled forms (barnacles, oysters, and mussels), as well as soft corals (bryozoans, hydroids, sponges, and octocorals) and hard corals (encrusting, colonial forms). These organisms (referred to as the biofouling community) provide habitat and food for many motile invertebrates and fishes (GMFMC, 2004).

Species associated with the platforms that are not dependent on the biofouling community for food or cover include the Atlantic spadefish (*Chaetodipterus faber*), lookdown (*Selene vomer*), Atlantic moonfish (*S. setapinnis*), creole-fish (*Paranthias furcifer*), whitespotted soapfish (*Rypticus maculatus*), gray triggerfish (*Balistes capriscus*), and lane snapper (*Lutjanus synagris*), all transients (move from platform to platform) and resident species (always found on the platforms) including red snapper, large tomate (*Haemulon aurolineatum*), and some large groupers. Other resident species that are dependent upon the biofouling community for food or cover include numerous species of blennies, sheepshead, small grazers (butterflyfishes, Chaetodontidae). Highly transient, large predators associated with these structures include barracuda (*Sphyraena barracuda*), almaco jack (*Seriola rivoliana*), hammerhead sharks (*Sphryna* spp.), cobia (*Rachycentron canadum*), mackerels (*Scombridae*), other jacks (*Caranx* sp.), and the little tunny (*Euthynnus alleteratus*) (GMFMC, 2004).

#### 3.10.2.3 Essential Fish Habitat

The DEIS initiated EFH consultation under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Congress enacted amendments to the MSFCMA (PL 94-265) in 1996 that established procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries. Rules published by the NMFS (50 CFR Sections 600.805–600.930) specify that any Federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity that could adversely affect EFH is subject to the consultation provisions of the above-mentioned act and identifies consultation requirements. A letter (Appendix A) was submitted to NMFS requesting a list of EFHs in the study area.

The GMFMC has identified the study area as EFH for adult and juvenile brown and white shrimp, red drum, red snapper, lane snapper, greater amberjack (*Seriola dumerilli*), king mackerel, Spanish mackerel

(*Scomberomorus maculatus*), cobia, Gulf stone crab (*Menippe adina*), gag grouper (*Mycteroperca microlepis*), scamp (*Mycteroperca phenax*), and adult gray snapper (*L. griseus*).

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." When referring to estuaries, it is further defined as "all waters and substrates (mud, sand, shell, rock, and associated biological communities) within these estuarine boundaries, including the sub-tidal vegetation (seagrasses and algae) and adjacent tidal vegetation (marshes and mangroves)" (GMFMC, 2004). No Habitat Areas of Particular Concern (HAPC) identified by the GMFMC are located within the study area.

The following describes the preferred habitat, life history stages, and relative abundance of each EFH managed species based on information provided by GMFMC (2004). Table 3.10-5 describes EFH for each of these species.

**Brown Shrimp**. Brown shrimp eggs are demersal and are deposited offshore. The larvae begin to migrate through passes with flood tides into estuaries as postlarvae. Migrating occurs at night mainly from February to April, with a minor peak in the fall. Brown shrimp postlarvae and juveniles are associated with shallow vegetated habitats in estuaries, but are also found over silty sand and nonvegetated mud bottoms. Postlarvae and juveniles occur in salinity ranging from 0 to 70 ppt. The density of late postlarvae and juvenile brown shrimp are highest in marsh-edge habitat and submerged vegetation, followed by tidal creeks, inner marsh, shallow, open water, and oyster reefs. Muddy substrates seem to be preferred in unvegetated areas. Juvenile and subadult brown shrimp can be found from secondary estuarine channels out to the continental shelf, but prefer shallow estuarine habitats, such as soft, muddy areas associated with plant-water interfaces. Subadult brown shrimp migrate from estuaries, at night, on ebb tides during new and full moon phases in the Gulf. Their abundance offshore correlates positively with turbidity and negatively with hypoxia (low levels of oxygen in the water). Adult brown shrimp inhabit neritic Gulf waters (marine waters extending from mean low tide to the edge of the continental shelf) and are associated with silt, muddy sand, and sandy substrates (GMFMC, 2004). Adult brown shrimp are common within the Sabine Lake estuary during the spring and summer months, while juveniles are abundant in this area in the spring, summer, and fall.

Larval brown shrimp feed on phytoplankton and zooplankton. Postlarvae brown shrimp feed on phytoplankton, epiphytes, and detritus. Juvenile and adult brown shrimp prey on amphipods, polychaetes, and chironomid larvae, but graze on algae and detritus (Pattillo et al., 1997).

**White Shrimp**. White shrimp inhabit Gulf and estuarine waters and are pelagic or demersal, depending on their life stage. Their eggs are demersal and larval stages are planktonic, and both occur in nearshore Gulf waters. Postlarvae migrate into estuaries through passes from May to November with most migration occurring in June and September. Migration is in the upper 6.5 feet of the water column at night and at mid-depths during the day. Postlarval white shrimp become benthic once they reach the estuary. Here they seek shallow water with mud or sand bottoms high in organic detritus or rich marsh where they develop into juvenile white shrimp. Postlarvae and juveniles prefer mud or peat bottoms with large

Table 3.10-5
Essential Fish Habitat – Adult and Juvenile Presence
in the Sabine-Neches Study Area

| Species | ESTUARINE | | MARINE | |
|---|---|---|---|---|
| | Adults | Juvenile | Adults | Juvenile |
| Brown Shrimp<br>(*Farfantepenaeus aztecus*) | *common*<br>March–May<br>June–July<br><br>*rare*<br>August–October<br>November–February | *abundant*<br>March–May<br>June–July<br>August–October<br><br>*common*<br>November–February | major adult area<br>spring, summer, fall<br>spawn year-round at depths<br>greater than 13 meters | spawning area |
| White Shrimp<br>(*Litopenaeus setiferus*) | *common*<br>March–May<br>June–July<br><br>*highly abundant*<br>August–October<br>November–February | *highly abundant*<br>March–May<br>June–July<br>August–October<br>November–February | adult area year-round | not present |
| Red Drum<br>(*Sciaenops ocellatus*) | *rare*<br>March–May<br>June–July<br>August–October<br>November–February<br>*common in Sabine Pass*<br>June–July<br>August–October<br>November–February | *common*<br>March–May<br>June–July<br>August–October<br>November–February | adult area year-round<br>spawn in coastal<br>waters in the<br>fall and winter | not present |
| Gag Grouper<br>(*Mycteroperca microlepis*) | not present | nursery area | adult occurrence | not present |
| Scamp<br>(*Mycteroperca phenax*) | not present | not present | adult occurrence | not present |
| Red Snapper<br>(*Lutjanus campechanus*) | not present | not present | adult occurrence | nursery area<br>year-round |
| Gray Snapper<br>(*Lutjanus griseus*) | not present | nursery area | major adult area<br>year-round<br>spawn June–August | not present |
| Lane Snapper<br>(*Lutjanus synagris*) | not present | nursery area | adult occurrence | nursery area |
| Greater Amberjack<br>(*Seriola dumerilli*) | not present | not present | adult area year-round<br>year-round spawning | nursery area<br>year-round |
| King Mackerel<br>(*Scomberomorus cavalla*) | not present | not present | adult area year-round<br>spawn May–November | year-round<br>nursery area |
| Spanish Mackerel<br>(*Scomberomorus maculatus*) | *rare*<br>March–May<br>June–July<br>August–October<br>November–February<br><br>*common in Sabine Pass*<br>June–July<br>August–October | *rare*<br>March–May<br>June–July<br>August–October<br><br>*not present*<br>March–May<br>(in certain areas)<br>November–February | adult area year-round | nursery area<br>year-round |

Table 3.10-5, cont'd

| Species | ESTUARINE | | MARINE | |
|---|---|---|---|---|
| | Adults | Juvenile | Adults | Juvenile |
| Cobia (*Rachycentron canadum*) | not present | not present | adult area summer<br>spawn in spring and summer | nursery area year-round |
| Gulf Stone Crab (*Menippe adina*) | *rare to not present*<br>March–May<br>June–July<br>August–October<br>November–February | *rare to not present*<br>March–May<br>June–July<br>August–October<br>November–February | adult area year-round<br>spawning from March–October | spawning area March–October |

quantities of decaying organic matter or SAV. Densities are usually highest along marsh edge and in SAV, followed by marsh ponds and channels, inner marsh, and oyster reefs. White shrimp juveniles prefer salinities of less than 10 ppt and occur in tidal rivers and tributaries. As white shrimp juveniles mature, they migrate to coastal areas where they mature and spawn. Adult white shrimp are demersal and inhabit soft mud or silt bottoms (GMFMC, 2004). Adult and juvenile white shrimp are abundant in the Sabine Lake estuary throughout the year. Adult white shrimp also occur throughout the Gulf to depths of about 131 feet.

White shrimp larvae feed on phytoplankton and zooplankton. White shrimp postlarvae feed on phytoplankton, epiphytes, and detritus. Juvenile and adult white shrimp prey on amphipods, polychaetes, and chironomid larvae, but also graze on algae and detritus (Pattillo et al., 1997).

**Red Drum**. Red drum occupy a variety of habitats, ranging from offshore depths of 131 feet to very shallow estuarine waters. Spawning occurs in the Gulf near the mouths of bays and inlets during the fall and early winter. Eggs usually hatch in the Gulf, and larvae are transported with tidal currents into the estuaries where they mature. Adult red drum use estuaries, but tend to migrate offshore where they spend most of their adult life. Red drum occur over a variety of substrates including sand, mud, and oyster reefs and can tolerate a wide range of salinities (GMFMC, 2004).

Estuaries are especially important to larval, juvenile, and subadult red drum. Juvenile red drum are most abundant around marshes, preferring quiet, shallow, protected waters over mud substrate or among SAV. Subadult and adult red drum prefer shallow bay bottoms and oyster reefs (GMFMC, 2004). Adult red drum that migrate into the Gulf are pelagic.

Estuaries are also important for the prey of larval, juvenile, and subadult red drum. Red drum larva feed primarily on shrimp, mysids, and amphipods, while juvenile red drum prefer fish and crabs. Adult red drum feed primarily on shrimp, blue crab, striped mullet, and pinfish (GMFMC, 2004). Within the Sabine Lake estuary, adult and juvenile red drum are common in the summer, fall, and winter, whereas in the Gulf, adult red drum are present year-round.

**Gag Grouper**. Gag grouper are demersal and are most common in the eastern Gulf. Eggs are pelagic and are spawned from December through April. Larvae are pelagic and most abundant in the early spring.

Postlarvae and pelagic juveniles move through inlets into high salinity estuaries from April through May, where they become benthic and settle into grass flats and oyster beds. Older juveniles move offshore in the fall to shallow reef habitat in depths of 3 to 165 feet. Adults prefer depths of 33 to 328 feet and utilize hard bottoms, oil platforms, and artificial reefs. Spawning occurs on the west Florida shelf from December through April (GMFMC, 2004).

Gag grouper feed on estuarine-dependent organisms such as shrimp, small fish, and crabs during their juvenile stages. As they mature and move farther offshore, they become opportunistic predators, feeding on a variety of fish and crustaceans (GMFMC, 2004). Adult gag grouper occur in Gulf waters within the study area.

**Scamp**. Scamp are demersal and widely distributed on shelf areas of the Gulf. Scamp eggs and larvae are pelagic and are spawned offshore in the spring. Juvenile scamp occur on shallow, nearshore hard bottoms and reefs in depths of 40 to 620 feet. Scamp spawn in aggregations from late February to early June.

Juvenile scamp feed on estuarine-dependent organisms such as shrimp, small fish, and crabs. As they mature and move offshore, they become opportunistic predators, feeding on a variety of fish and crustaceans (GMFMC, 2004). Adult scamp occur in Gulf waters within the study area.

**Red Snapper**. Red snapper are demersal and found over sand and rock substrates around reefs, and underwater objects to depths of 656 feet. However, adult red snapper prefer depths ranging from 131 to 360 feet (GMFMC, 2004). Spawning occurs in the Gulf from May to October, at depths of 60 to 122 feet over fine sand substrate. Larvae, postlarvae, and early juveniles occur from July through November in shelf waters. Early and late juveniles are often associated with underwater structures or small burrows, but are also abundant over barren sand and mud bottoms.

Juvenile red snapper feed on shrimp, but after age one, prey primarily on fish and squid. Of the vertebrates consumed, most are not obligate reef dwellers, indicating that red snapper feed away from reefs (GMFMC, 2004). All life stages of the red snapper occur in the Gulf waters within the study area.

**Gray Snapper**. Gray snapper can be demersal, structure, or mid-water dwellers inhabiting marine, estuarine, and riverine habitats. They inhabit depths to about 550 feet in the Gulf. Juvenile gray snapper are common in shallow water around SAV while adult gray snapper tend to congregate in deeper Gulf waters around natural and artificial reefs. Spawning occurs in the Gulf from June to August around structures and shoals. Their eggs are pelagic and the larvae are planktonic, both occurring in Gulf shelf waters and near coral reefs. Postlarvae migrate into the estuaries and are most abundant over *Halodule* and *Syringodium* grassbeds. Juveniles seem to prefer *Thalassia* grassbeds, seagrass meadows, marl bottoms, and mangrove roots, and are found in estuaries, bayous, channels, grassbeds, marshes, mangrove swamps, ponds, and freshwater creeks (GMFMC, 2004).

Juvenile gray snapper feed on estuarine-dependent organisms such as shrimp, small fish, and crabs. Gray snapper are classified as opportunistic carnivores at all life stages (Pattillo et al., 1997). In estuaries, juvenile gray snapper feed on shrimp, larval fish, amphipods, and copepods. Adult gray snapper feed

primarily on fish, but smaller individuals will prey on crustaceans (GMFMC, 2004). Only adult gray snapper are found in the Gulf waters of the study area.

**Lane Snapper**. Lane snapper are demersal, occurring over all substrate types, but are most commonly found near coral reefs and sandy bottoms. Spawning occurs in Gulf waters from March through September. Nursery areas include mangrove and grassy estuarine habitats in southern Texas and Florida and shallow waters with sand and mud bottoms along all Gulf states. Juvenile lane snapper appear to favor grass flats, reefs, and soft bottoms to depths of 66 feet. Adult lane snapper occur offshore in depths ranging from 13 to 433 feet near sand bottoms, natural channels, banks, and artificial and natural structures (GMFMC, 2004).

Juvenile lane snapper feed on estuarine-dependent organisms such as shrimp, small fish, and crabs. Lane snapper are considered to be unspecialized, opportunistic predators, feeding on a variety of crustaceans and fish. However, adult lane snapper tend to prefer fish (GMFMC, 2004). Juvenile lane snapper are found in estuaries and marine waters, while adults are found only in marine waters.

**Greater Amberjack**. Greater amberjack occur throughout the Gulf to depths of 1,300 feet. Adults are pelagic and epibenthic, occurring near reefs and artificial structures. Spawning occurs offshore, and juvenile greater amberjack are associated with floating *Sargassum* and debris (GMFMC, 2004). Adult and juvenile greater amberjack are found in the Gulf within the study area.

**King Mackerel**. King mackerel are pelagic and found in Gulf waters from nearshore to 655 feet. Spawning occurs in the Gulf from May to October. Eggs are pelagic, occurring over depths of 98 to 590 feet. Nursery areas are located in marine waters with juveniles only occasionally entering estuaries (GMFMC, 2004).

While estuaries are important for most of their prey, king mackerel feed on a variety of fishes, but extensively utilizing herrings. Squid, shrimp, and other crustaceans are also fed upon by king mackerel. Adult and juvenile king mackerel are found in the Gulf within the study area.

**Spanish Mackerel**. Spanish mackerel are pelagic, inhabiting depths to 245 feet throughout the coastal zone of the Gulf. Adult Spanish mackerel are usually found from nearshore to the edge of the continental shelf. However, they may also migrate seasonally into estuaries with high salinity, but this migration is infrequent and rare. Spawning occurs in the Gulf from May through October. Larvae typically occur in the Gulf in depths ranging from 30 to 275 feet. Juveniles inhabit the Gulf surf, and sometimes estuarine habitats. However, juvenile Spanish mackerel prefer marine salinities and are not considered estuarine-dependent. Adult and juvenile Spanish mackerel are common in Sabine Pass from June through October. Juvenile Spanish mackerel prefer clean sand bottoms, but the substrate preferences of the other life stages are unknown (GMFMC, 2004).

While Spanish mackerel rarely use estuarine environments, estuaries are important for most of their prey. They feed on a variety of fishes, but extensively utilize herrings. Squid, shrimp, and other crustaceans are also fed upon by Spanish mackerel.

**Cobia**. Cobia are large, pelagic fish occurring from nearshore to depths of 131 feet near artificial and natural structure, including floating objects. In the study area, cobia occur only in the Gulf and do not use estuarine waters.

While cobia rarely use estuarine environments, estuaries are important for most of their prey. They feed on a variety of fishes, but extensively utilize herrings. Squid, shrimp, and other crustaceans are also fed upon by cobia.

**Gulf Stone Crab**. Gulf stone crabs occur in the study area, inhabiting the Gulf and the Sabine Lake estuary. Gulf stone crab seek cover under rock ledges, coral heads, dead shell, and grass clumps. They also inhabit burrows in seagrass flats and along the sides of tidal channels. Larval Gulf stone crabs are planktonic, suspended in the water column. Juvenile Gulf stone crabs prefer seagrass flats, channels, shell bottoms, sponges, and *Sargassum* mats. Once they reach a width of 0.5 inch, they live among oyster shells and rocks in shallow estuaries. Adult and juvenile Gulf stone crabs can tolerate a range of salinity; however, larvae require salinities from 30 to 35 ppt for optimal growth. Broad fluctuations in salinity and temperature can result in high mortality of larval Gulf stone crabs (GMFMC, 2004).

Gulf stone crabs are predatory throughout their life. Juvenile Gulf stone crabs feed on polychaetes, molluscs, and crustaceans. Adult Gulf stone crabs feed mainly on oysters and mussels, but also consume dead or decaying tissue and vegetable matter such as seagrass (GMFMC, 2004).

Gulf stone crabs are dependent upon fertile estuarine waters. High phytoplankton productivity in fertile estuarine waters results in food for oysters, worms, and other organisms, which, in turn, provide food for juvenile and adult stone crabs.

#### 3.10.2.4 Ballast Water

Ballast water is loaded on empty ships to provide weight and stability while traveling from one port to the next. There are thousands of marine species that can be carried from port to port in ballast water, which may ultimately result in the introduction of unwanted aquatic species from foreign ports of origin (Global Ballast Water Management Programme, 2002). As a consequence, invasive, exotic species have been introduced into United States waters through ballast water. Ballast water is the largest single vector for nonindigenous species transfer (EPA, 2001). The USCG does not have a list of species of concern (SOC) that could potentially be introduced through ballast water into the study area (Allen, 2002). However, the EPA has compiled a list of invasive species that have the potential to be unintentionally introduced in Texas, although not necessarily through ballast water alone (Table 3.10-6) (EPA, 2001).

The USCG, under the provisions of the National Invasive Species Act, has implemented a program that consists of a suite of mandatory ballast water management protocols. All vessels, foreign and domestic, equipped with ballast water tanks that operate within U.S. waters are required to comply with 33 CFR Part 51 regarding management protocols. This includes submitting a ballast water exchange report to the National Ballast Information Clearinghouse (NBIC) to ensure compliance with the management requirements (USCG, 2006).

Table 3.10-6
Current and Potential Aquatic Species that Pose a Threat to Texas and Louisiana

| Scientific Name | Common Name | Texas | Louisiana |
|---|---|---|---|
| Shrimp Viruses | | | |
| Taura Syndrome Virus | shrimp virus | 4 | |
| White Spot Syndrome Virus | shrimp virus | 4 | |
| Coelenterates | | | |
| *Phyllorhiza punctata* | spotted jellyfish | P | P |
| Roundworms (phylum Nematoda) | | | |
| *Anguillicola crassus* | eel parasite | P | |
| Mollusks | | | |
| *Corbicula fluminea* | Asian clam | P | P |
| *Crassostrea gigas* | Japanese (or Pacific giant) oyster | 4 | |
| *Dreissena polymorpha* | zebra mussel | P | P |
| *Perna perna* | brown mussel | P | P |
| *Pomacea canalicula* | channeled applesnail | 4 | |
| Crustaceans | | | |
| *Carcinus maenus* | green crab | P | P |
| *Charybdis helleri* | marine swimming crab | P | P |
| *Eriocheri sinensis* | Chinese mittencrab | P | P |
| Fishes | | | |
| *Cichlasoma cyanoguttatum* | Rio Grande cichlid | 4 | 4 |
| *Ctenopharyngodon idella* | grass carp | 4 | 4 |
| *Hypophthalmichthys molitrix* | silver carp | P | 4 |
| *Hypophthalmichthys nobilis* | bighead carp | P | 4 |
| *Mylopharyngodon piceus* | black carp | P | P |
| *Neogobius melanostomus* | round goby | | P |
| *Oreochromis aureus* | blue tilapia | 4 | |
| *Oreochromis mossambicua* | Mozambique tilapia | 4 | |
| Mammals | | | |
| *Myocastor coypus* | nutria | 4 | 4 |
| Algae | | | |
| *Aureoumbra lagunensis* | brown tide algae | 4* | |
| Vascular Plants | | | |
| *Alternathera philoxeroides* | alligatorweed | 4 | 4 |
| *Eichhornia crassipes* | water hyacinth | 4 | 4 |
| *Hydrilla verticillata* | hydrilla | 4 | 4 |
| *Ipomoea aquatica* | waterspinach | P | |
| *Lythrum salicaria* | purple loosestrife | P | P |
| *Panicum repens* | torpedograss | 4 | |
| *Pistia stratiotes* | waterlettuce | 4 | 4 |
| *Salvinia minima* | common salvinia | 4 | 4 |
| *Salvinia molesta* | giant salvinia | 4 | 4 |
| Semi-Aquatic Vascular Plants | | | |
| *Imperata cylindrica* | cogongrass | | P |
| *Pueraria montana* | kudzu | P | 4 |
| *Sapium sebiferum* | Chinese tallow tree | 4 | 4 |

Source: EPA (2001).

P = Potential threat; 4 = Current threat.

* = Cryptogenic (a species whose status as indigenous or nonindigenous remains unresolved).

According to the NBIC (2007) ballast water–reporting database, between 2000 and 2005, 1,279 ballast water exchange reports were submitted for the study area. Of these, 136 represented treated and 90 represented untreated discharges. Treated discharges consisted of either flow-through or empty/refill of ballast tanks.

## 3.11 WILDLIFE

Wildlife native to the study area include those that inhabit the Austroriparian Biotic Province (Blair, 1950). Diversity in the study area is high, with large numbers of vertebrate and invertebrate species. The Austroriparian Biotic Province is situated in the eastern portion of Texas and extends southward to the Gulf coast and east through Louisiana to the Atlantic Ocean. The vertebrate fauna of the Austroriparian Biotic Province in Texas and Louisiana, with few exceptions, is the typical vertebrate fauna of the Austroriparian Biotic Province eastward to the Atlantic seaboard. According to Blair (1950), at least 47 species of mammals, 29 species of snakes, 10 lizards, 2 land turtles, 17 anurans, and 18 urodeles occur or have occurred there.

### 3.11.1 Amphibians

Amphibians common to marsh habitats within the study area are the green treefrog (*Hyla cinerea*), American bullfrog (*Rana catesbeiana*), eastern narrow-mouthed toad (*Gastrophryne carolinensis*), Great Plains narrow-mouthed toad (*G. olivacea*), Blanchard's cricket frog (*Acris crepitans blanchardi*), squirrel treefrog (*H. squirella*), bronze frog (*R. clamitans*), and the southern leopard frog (*R. sphenocephala utricularia*).

Amphibian species that are common to the upland grasslands include the Gulf Coast toad (*Bufo nebulifer*), southern leopard frog, and the northern spring peeper (*Pseudacris crucifer crucifer*).

Amphibian species that are commonly found in forest habitats include the gray treefrog (*H. versicolor*), eastern narrow-mouthed toad, squirrel treefrog, and the Great Plains narrow-mouthed toad (Blair, 1950).

### 3.11.2 Birds

Avian species known to occur year-round within the study area include herons and egrets (Family Ardeidae), gulls, terns, and skimmers (Family Laridae), Anhinga (*Anhinga anhinga*), turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), eastern screech-owl (*Megascops asio*), red-bellied woodpecker (*Melanerpes carolinus*), American crow (*Corvus brachyrhynchos*), tufted titmouse (*Baeolophus bicolor*), Carolina wren (*Thryothorus ludovicianus*), northern cardinal (*Cardinalis cardinalis*), northern mockingbird (*Mimus polyglottos*), house sparrow (*Passer domesticus*), and blue jay (*Cyanocitta cristata*). Winter migrants that reside within the study area may include the long-billed curlew (*Numenius americanus*), lesser yellowlegs (*Tringa flavipes*), least sandpiper (*Calidris minutilla*), mallard (*Anas platyrhynchos*), short-billed dowitcher (*Limnodromus griseus*), cedar waxwing (*Bombycilla cedrorum*), double-crested cormorant (*Phalacrocorax auritus*), yellow-rumped warbler (*Dendroica cornata*), American coot (*Fulica americana*), white-crowned sparrow (*Zonotrichia*

*leucophrys*), dark-eyed junco (*Junco hyemalis*), and the American goldfinch (*Spinus tristis*). Migratory waterfowl are known to be abundant in the study area. In the northern reaches of the study area and in the forested wetlands of Pine Island Bayou, wood ducks (*Aix sponsa*) can be found perching in tree cavities. In more-shallow areas, dabbling ducks, also known as "puddle ducks," can be found in ponded wetlands closely associated with the Neches and Sabine rivers and their tributaries. During winter, they frequent the salt marshes along the immediate coastlines. Some of these species may include northern pintail (*Anas acuta*), American wigeon (*A. americana*), Northern shoveler (*A. clypeata*), green-winged teal (*A. crecca*), cinnamon teal (*A. cyanoptera*), mallard, and gadwall (*A. strepera*). Diving ducks, ducks inhabiting deeper waters such as Sabine Lake, may include redhead (*Aythya americana*), lesser scaup (*A. affinis*), and canvasback (*A. valisineria*). Common geese found foraging in the study area's agricultural fields and freshwater wetlands as well as roosting in salt marshes include snow goose (*Chen caerulescens),* greater white-fronted goose (*Anser albifrons*), Ross's goose (*Chen rossii*), and Canada goose (*Branta canadensis*).

Possible transient species that may occur in the study area during winter migration are chuck-will's-widow (*Caprimulgus carolinensis*), chimney swift (*Chaetura pelagica*), ruby-throated hummingbird (*Archilochus colubris*), eastern kingbird (*Tyrannus tyrannus*), purple martin (*Progne subis*), yellow-throated warbler (*Dendroica dominica*), and the black-and-white warbler (*Mniotilta varia*) (Lockwood and Freeman, 2004).

According to the USFWS Texas Colonial Waterbird Census (USFWS, 2007), 25 documented rookeries occur within the study area. Table 3.11-1 provides information on nesting activities at these rookeries. No documented rookeries occur within the Louisiana portion of the study area (Clark, 2009).

### 3.11.3 Mammals

Common mammals that inhabit forest habitats in the study area include Virginia opossum (*Didelphis virginiana*), Brazilian free-tailed bat (*Tadarida brasiliensis*), nine-banded armadillo (*Dasypus novemcinctus*), swamp rabbit (*Sylvilagus aquaticus*), eastern red bat (*Lasiurus borealis*), eastern gray squirrel (*Sciurus carolinensis*), eastern fox squirrel (*S. niger*), white-footed mouse (*Peromyscus leucopus*), eastern woodrat (*Neotoma floridana*), northern raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and coyote (*Canis latrans*).

Mammals common to upland grassland habitats within the study area include the least shrew (*Cryptotis parva*), hispid pocket mouse (*Chaetodipus hispidus*), pygmy mouse (*Baiomys taylori*), coyote, nine-banded armadillo, Baird's pocket gopher (*Geomys breviceps*), eastern cottontail (*Sylvilagus floridanus*), hispid cotton rat (*Sigmodon hispidus*), and fulvous harvest mouse (*Reithrodontomys fulvescens*).

Mammals that are common to marsh habitat areas include the northern rice rat (*Oryzomys palustris*), nutria (*Myocastor coypus*), swamp rabbit, least shrew, coyote, striped skunk, Virginia opossum, bobcat (*Lynx rufus*), Attwater's pocket gopher (*G. attwateri*), northern raccoon, and common muskrat (*Ondatra zibethicus*) (Blair, 1950).

Table 3.11-1
Number of Nests of Colonial Waterbirds at Selected Rookeries in the Study Area

| Rookery/ID | Common Name | Scientific Name | Census Year 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| McFadden/587-120 | N/A | | | | | | |
| Beaumont Ship Channel/587-121 | N/A | | | | | | |
| Nederland Spoil Area/587-122 | Neotropic cormorant | *Phalacrocorax brasilianus* | 55 | | | | |
| | Anhinga | *Anhinga anhinga* | 4 | | | | |
| | Great egret | *Ardea alba* | 55 | | | | |
| | Snowy egret | *Egretta thula* | 25 | | | | |
| | Little blue heron | *Egretta caerulea* | 5 | | | | |
| | Tricolored heron | *Egretta tricolor* | 12 | | | | |
| | Cattle egret | *Bubulcus ibis* | 140 | | | | |
| | Black-crowned night-heron | *Nycticorax nycticorax* | 2 | | | | |
| | White-faced ibis | *Plegadis chihi* | 2 | | | | |
| | Roseate spoonbill | *Platalea ajaja* | 13 | | | | |
| DuPont Spoils Area XPNSN/587-123 | Neotropic cormorant | *Phalacrocorax brasilianus* | | 10 | 40 | | 10 |
| | Anhinga | *Anhinga anhinga* | | 1 | 4 | | |
| | Great egret | *Ardea alba* | | 2 | 70 | | 17 |
| | Snowy egret | *Egretta thula* | | 25 | 60 | | 20 |
| | Little blue heron | *Egretta caerulea* | | 25 | 35 | | |
| | Tricolored heron | *Egretta tricolor* | | 20 | 45 | | 14 |
| | Cattle egret | *Bubulcus ibis* | | 300 | 260 | | 143 |
| | Black-crowned night-heron | *Nycticorax nycticorax* | | | 1 | | |
| | Yellow-crowned night-heron | *Nyctanassa violacea* | | 2 | | | |
| | Roseate spoonbill | *Platalea ajaja* | | 2 | | | |
| Shangrila/588-009 | Neotropic cormorant | *Phalacrocorax brasilianus* | | | | 50 | 107 |
| | Anhinga | *Anhinga anhinga* | | | | 0 | 4 |
| | Great egret | *Ardea alba* | 15 | | | 350 | 275 |
| | Cattle egret | *Bubulcus ibis* | 30 | | | 150 | 350 |
| | Roseate spoonbill | *Platalea ajaja* | 5 | | | 6 | 4 |
| Taylor Bayou/600-052 | N/A | | | | | | |
| Texaco/601-100 | N/A | | | | | | |
| Texaco Parking Lot/601-101 | N/A | | | | | | |
| Motiva Savannah Ave./601-102 | N/A | | | | | | |
| Motiva Headquarters/ 601-103 | Least tern | *Sternula antillarum* | 15 | 35 | 8 | 30 | 50 |
| | Black skimmer | *Rynchops niger* | 2 | | | | |

Table 3.11-1, cont'd

| Rookery/ID | Common Name | Scientific Name | Census Year | | | | |
|---|---|---|---|---|---|---|---|
| | | | 2001 | 2002 | 2003 | 2004 | 2005 |
| Motiva Old FCC Area/601-104 | Least tern | *Sternula antillarum* | 45 | 15 | 9 | 17 | |
| Motiva West of Headquarters/601-105 | Least tern | *Sternula antillarum* | | 7 | 8 | 70 | 100 |
| | Black skimmer | *Rynchops niger* | | 45 | | 1 | |
| Sydney Island/601-120 | Neotropic cormorant | *Phalacrocorax brasilianus* | | | | | 300 |
| | Great egret | *Ardea alba* | | | | | 500 |
| | Snowy egret | *Egretta thula* | | | | | 221 |
| | Tricolored heron | *Egretta tricolor* | | | | | 140 |
| | Black-crowned night-heron | *Nycticorax nycticorax* | | | | | 12 |
| | White ibis | *Eudocimus albus* | | | | | 2,000 |
| | Roseate spoonbill | *Platalea ajaja* | | | | | 250 |
| Dooms Island/601-121 | N/A | | | | | | |
| Point Hunt Island, Louisiana/601-122 | Neotropic cormorant | *Phalacrocorax brasilianus* | | | 20 | 40 | 300 |
| | Double-crested cormorant | *Phalacrocorax auritus* | | | | 4 | |
| | Great egret | *Ardea alba* | | | 130 | 50 | 500 |
| | Snowy egret | *Egretta thula* | | | 120 | 40 | 221 |
| | Little blue heron | *Egretta caerulea* | | | 2 | 15 | |
| | Tricolored heron | *Egretta tricolor* | | | 80 | | 140 |
| | Cattle egret | *Bubulcus ibis* | | | | 9 | |
| | Black-crowned night-heron | *Nycticorax nycticorax* | | | 2 | 20 | 12 |
| | Yellow-crowned night-heron | *Nyctanassa violacea* | | | | 4 | |
| | White ibis | *Eudocimus albus* | | | | 300 | 2,000 |
| | White-faced ibis | *Plegadis chihi* | | | 80 | | |
| | Roseate spoonbill | *Platalea ajaja* | | | 100 | 80 | 250 |
| Port Arthur/ICWW Bridge/601-140 | N/A | | | | | | |
| Gulf Oil Pit/601-141 | N/A | | | | | | |
| Chevron Plant/601-142 | N/A | | | | | | |
| Motiva West 7th St./601-144 | Neotropic cormorant | *Phalacrocorax brasilianus* | 7 | 20 | 50 | 140 | 90 |
| | Anhinga | *Anhinga anhinga* | | 1 | | | |
| | Great egret | *Ardea alba* | 25 | 110 | 110 | 68 | 52 |

Table 3.11-1, concluded

| Rookery/ID | Common Name | Scientific Name | Census Year 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| | Snowy egret | *Egretta thula* | 50 | 30 | 30 | 37 | 76 |
| | Little blue heron | *Egretta caerulea* | 4 | | 4 | 6 | 20 |
| | Tricolored heron | *Egretta tricolor* | 15 | 10 | 8 | 10 | |
| | Cattle egret | *Bubulcus ibis* | 50 | 50 | 40 | 50 | 22 |
| | Black-crowned night-heron | *Nycticorax nycticorax* | 20 | 12 | 7 | 3 | 3 |
| | Yellow-crowned night-heron | *Nyctanassa violacea* | 1 | | 1 | | |
| | White ibis | *Eudocimus albus* | | | 1 | 4 | 10 |
| | White-faced ibis | *Plegadis chihi* | | | 1 | | 10 |
| | Roseate spoonbill | *Platalea ajaja* | 60 | 55 | 45 | 25 | 6 |
| Backridge Road/601-145 | N/A | | | | | | |
| Premcor/601-146 | Least tern | *Sternula antillarum* | | 197 | 50 | | |
| Beaumonts Cattail Marsh/601-147 | Cattle egret | *Bubulcus ibis* | | 40 | 6 | | |
| Texas Point NWR/601-150 | N/A | | | | | | |
| United Marine Enterprise/601-151 | N/A | | | | | | |
| Sabine Pass/601-160 | N/A | | | | | | |

Source: Texas Colonial Waterbird Census Database (USFWS, 2007).

### 3.11.4 Reptiles

Reptiles known to inhabit forested habitats in the study area are the little brown skink (*Scincella lateralis*), Texas ratsnake (*Elaphe obsoleta*), rough greensnake (*Opheodrys aestivus*), eastern gartersnake (*Thamnophis sirtalis sirtalis*), Texas coralsnake (*Micrurus tener*), and southern copperhead (*Agkistrodon contortrix contortrix*).

Reptiles common to upland grassland habitats include the three-toed box turtle (*Terrapene carolina triunguis*), ornate box turtle (*Terrapene ornata ornata*), green anole (*Anolis carolinensis*), prairie lizard (*Sceloperus consobrinus*), eastern six-lined racerunner (*Aspidoscelis sexlineata sexlineata*), little brown skink, diamond-backed watersnake (*Nerodia rhombifer rhombifer*), Texas ratsnake, Texas spotted whiptail (*A. gularis gularis*), prairie kingsnake (*Lampropeltis calligaster calligaster*), Mediterranean gecko (*Hemidactylus turcicus turcicus*), Texas coralsnake, and the western diamond-backed rattlesnake (*Crotalus atrox*).

Reptiles common to marsh habitats include the diamond-backed watersnake, snapping turtle (*Chelydra serpentina*), stinkpot (*Sternotherus odoratus*), Mississippi mud turtle (*Kinosternon subrubrum*), red-eared slider (*Trachemys scripta elegans*), Texas ratsnake, speckled kingsnake (*Lampropeltis getula holbrooki*), and the western cottonmouth (*Agkistrodon piscivorous leucostoma*) (Bartlett and Bartlett, 1999).

### 3.11.5 Insects

Common terrestrial insects that occur within the study area include the field cricket (*Gryllus* sp.), American cockroach (*Periplaneta americana*), wheel bug (*Arilus cristatus*), leaffooted bug (*Leptoglossus phyllopus*), dog-day cicada (*Tibicen* sp.), green lacewing (*Chrysoperla* spp.), ground beetle (*Scarites subterraneus*), June beetle (*Phyllophaga* sp.), firefly (*Photinus* sp.), blister beetle (*Epicauta* sp.), boll weevil (*Anthonomous grandis*), Asian tiger mosquito (*Aedes albopictus*), deer fly (*Chrysops* sp.), house fly (*Musca domestica*), blow fly (*Calliphora* sp.), giant swallowtail (*Heraclides cresphontes*), cloudless sulphur (*Phoebis sennae eubule*), snout butterfly (*Libytheana* sp.), honey bee (*Apis mellifera*), paper wasp (*Polistes carolina*), and the red imported fire ant (*Solenopsis invicta*) (Drees and Jackman, 1998).

## 3.12 THREATENED AND ENDANGERED SPECIES

Congress enacted the ESA (16 USC 1531 et seq.) of 1973, as amended, to provide a program for the preservation of threatened and endangered species and to provide protection for the ecosystems upon which these species depend for their survival. All Federal agencies are required to implement protection programs for these designated species and to use their authorities to further the purposes of the ESA. An endangered species is one that is in danger of extinction throughout all or a significant portion of its range in the U.S. A threatened species is one likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The USFWS and NMFS are the primary agencies responsible for implementing the ESA. The USFWS is responsible for birds and terrestrial and freshwater species, while the NMFS is responsible for nonbird marine species.

The State of Texas also has regulations to protect endangered species (chapters 67, 68, and 88 of the TPWD Code and sections 65.171–65.184 and 69.01–69.14 of Title 31 of the Texas Administrative Code). These regulations, administered by the TPWD, prohibit commerce in threatened and endangered plants and wildlife and the collection of listed plant species from public land without a permit. In addition, the State of Louisiana, through the LDWF, provides protective status for all threatened and endangered species listed by the USFWS and also to those species listed as threatened or endangered by the State Natural Heritage Program. This assessment addresses State-listed threatened and endangered species; however, the ESA does not protect these species.

Only those species that the USFWS or NMFS lists as threatened and endangered have complete Federal protection under the ESA. Inclusion on the following lists does not imply that a species occurs in the study area, but only acknowledges the potential for occurrence. The USACE prepared a Biological Assessment (BA) to evaluate the potential impacts the SNWW CIP may have on federally listed threatened and endangered species (Appendix G1). The NMFS (n.d.), TPWD's Natural Diversity Database (NDD, 2005a, 2005b), TPWD (2010), and USFWS (2005c, 2009) provided county/parish-level lists of threatened and endangered species of potential occurrence in the study area (Table 3.12-1). In addition, NDD (2006) provided digital map data presenting specific locations of listed species within the study area.

Table 3.12-1
Threatened and Endangered Species[1] of Potential Occurrence
Within the Study Area

| Common Name[2] | Scientific Name[2] | Status[3] | |
|---|---|---|---|
| | | Federal | State |
| **BIRDS** | | | |
| Brown pelican[4] | *Pelecanus occidentalis* | DL | E |
| Red-cockaded woodpecker | *Picoides borealis* | E | E |
| Piping plover | *Charadrius melodus* | T w/CH | T |
| Peregrine falcon[4] | *Falco peregrinus* | DL | T |
| Bald eagle[4] | *Haliaeetus leucocephalus* | DL | T |
| Reddish egret | *Egretta rufescens* | NL | T |
| White-faced ibis | *Plegadis chihi* | NL | T |
| Wood stork | *Mycteria americana* | NL | T |
| Swallow-tailed kite | *Elanoides forficatus* | NL | T |
| Sooty tern | *Onychoprion fuscatus* | NL | T |
| **MAMMALS** | | | |
| Red wolf | *Canis rufus* | E | E |
| Sei whale | *Balaenoptera borealis* | E | NL |
| Blue whale | *Balaenoptera musculus* | E | E |
| Finback whale | *Balaenoptera physalus* | E | E |
| Humpback whale | *Megaptera novaeangliae* | E | NL |
| Sperm whale | *Physeter macrocephalus* | E | E |
| West Indian manatee | *Trichechus manatus* | E | E |
| Louisiana black bear | *Ursus americanus luteolus* | T | T |
| Black bear | *Ursus americanus* | T/SA; NL | T |
| Rafinesque's big-eared bat | *Corynorhinus rafinesquii* | NL | T |
| **REPTILES** | | | |
| Leatherback sea turtle | *Dermochelys coriacea* | E | E |
| Hawksbill sea turtle | *Eretmochelys imbricata* | E | E |
| Kemp's ridley sea turtle | *Lepidochelys kempii* | E | E |
| Loggerhead sea turtle | *Caretta caretta* | T | T |
| Green sea turtle | *Chelonia mydas* | T | T |
| Texas horned lizard | *Phrynosoma cornutum* | NL | T |
| Northern scarletsnake | *Cemophora coccinea copei* | NL | T |
| Timber rattlesnake | *Crotalus horridus* | NL | T |
| Alligator snapping turtle | *Macrochelys temminckii* | NL | T |
| **FISH** | | | |
| Smalltooth sawfish | *Pristis pectinata* | E | E |
| Gulf sturgeon | *Acipenser oxyrhinchus desotoi* | T | NL |
| Dusky shark | *Carcharhinus obscurus* | SOC | NL |
| Sand tiger shark | *Carcharias taurus* | SOC | NL |
| Night shark | *Carcharhinus signatus* | SOC | NL |
| Saltmarsh topminnow | *Fundulus jenkinsi* | SOC | NL |
| Warsaw grouper | *Epinephelus nigritus* | SOC | NL |

Table 3.12-1, cont'd

| Common Name[2] | Scientific Name[2] | Status[3] | |
|---|---|---|---|
| | | Federal | State |
| Speckled hind | *Epinephelus drummondhayi* | SOC | NL |
| **INVERTEBRATES** | | | |
| Elkhorn coral | *Acropora palmata* | T | NL |
| Staghorn coral | *Acropora cervicornis* | T | NL |
| Ivory tree coral | *Oculina varicose* | SOC | NL |

[1] According to USFWS (2009), NMFS (n.d.), NDD (2005a, 2005b, 2006), and TPWD (2010).

[2] Nomenclature and taxonomic orders follow American Ornithologists' Union (AOU, 1998, 2000, 2002, 2003, 2004, 2005, 2006, 2007), Crother et al. (2000, 2001, 2003), Baker et al. (2003), Hubbs et al. (2008), NMFS (n.d.), USFWS (2009), TPWD (2010), and NDD (2005a, 2005b).

[3] E = Endangered; species in danger of extinction throughout all or a significant portion of its range; T = Threatened; species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range; T/SA = Threatened because of similarity of appearance to other listed species; CH = Critical Habitat; SOC = Species of Concern (NMFS); species for which there is some information showing evidence of vulnerability, but not enough data to support listing at this time. These species are afforded no formal protection under the Endangered Species Act of 1973, as amended, but may be protected under other State or Federal laws; DL = Formerly listed as threatened or endangered, but due to significant population increases, has officially been removed from threatened or endangered status.

[4] Recently removed from the Federal list of endangered and threatened species, the brown pelican, the peregrine falcon, and bald eagle retain their state status (74 FR 220:59443–59472; 64 FR 164:46542–46558; 72 FR 130:37346–37372). The brown pelican roosts and nests on islands and spill banks, the peregrine falcon is a statewide migrant in Texas, and bald eagles overwinter on several central Texas lakes (TPWD, 2010).

### 3.12.1 Insects

No federally listed threatened or endangered insect SOC potentially occur within the study area.

### 3.12.2 Flora

No federally listed threatened or endangered plant species or plant SOC potentially occurs within the study area.

### 3.12.3 Fauna

According to the NMFS (n.d), USFWS (2005c, 2009), NDD (2005a, 2005b), and TPWD (2010), 33 federally and/or State-listed threatened and endangered species, and 7 NMFS-designated SOC are of potential occurrence in Jefferson and Orange counties, Texas, and Calcasieu and Cameron parishes, Louisiana (see Table 3.12-1).

Twenty of the 40 species listed in Table 3.12-1 are federally listed as threatened and endangered. These include the endangered red-cockaded woodpecker (*Picoides borealis*), red wolf (*Canis rufus*), sei whale (*Balaenoptera borealis*), blue whale (*B. musculus*), finback whale (*B. physalus*), humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), West Indian manatee (*Trichechus manatus*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), green sea turtle (*Chelonia mydas*), and smalltooth sawfish (*Pristis pectinata*), as well as the threatened, piping

plover (*Charadrius melodus*), Louisiana black bear (*Ursus americanus luteolus*), Gulf sturgeon (*Acipenser oxyrhinchus desotoi*), elkhorn coral (*Acropora palmata*), and staghorn coral (*A. cervicornis*). The USFWS lists the black bear *(U. americanus*) as threatened, only because of its similarity in appearance to the Louisiana subspecies of black bear. This designation, however, only applies within the historic range of the Louisiana black bear and not elsewhere.

Thirteen of the 40 species listed in Table 3.12-1 are identified by the TPWD as State-listed threatened species in Texas. These include brown pelican (*Pelecanus occidentalis*), peregrine falcon (*Falco peregrinus*), bald eagle (*Haliaeetus leucocephalus*), reddish egret (*Egretta rufescens*), white-faced ibis (*Plegadis chihi*), wood stork (*Mycteria americana*), swallow-tailed kite (*Elanoides forficatus*), sooty tern (*Onychoprion fuscatus*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), Texas horned lizard (*Phrynosoma cornutum*), northern scarletsnake (*Cemophora coccinea copei*), timber rattlesnake (*Crotalus horridus*), and alligator snapping turtle (*Macrochelys temminckii*).

Seven of the 40 species listed in Table 3.12-1 are identified by NMFS as SOC: dusky shark (*Carcharhinus obscurus*), sand tiger shark (*Carcharias taurus*), night shark (*C. signatus*), saltmarsh topminnow (*Fundulus jenkinsi*), Warsaw grouper (*Epinephelus nigritus*), speckled hind (*E. drummondhayi*), and ivory tree coral (*Oculina varicosa*). These species do not receive Federal protection under the ESA.

#### 3.12.3.1 Birds

The historic range of the red-cockaded woodpecker (endangered) included 34 east Texas counties. Currently, only 18 Texas counties support this species (Jackson, 1994; USFWS, 1995). Old-growth pines (60 to 70 years or more), often with the centers rotted by red-heart fungus, are the usual nesting sites, but younger, uninfected pines are also used (Hooper et al., 1980; Jackson, 1994). No known current populations occur in any of the study area counties or parishes, and suitable habitat is absent in the study area. Thus, the species is unlikely to occur in the study area.

The piping plover (threatened) is a small shorebird that inhabits coastal beaches and tidal flats. Approximately 35 percent of the known global population of piping plovers winters along the Texas Gulf Coast, where they spend 60 to 70 percent of the year (Campbell, 1995; Haig and Elliott-Smith, 2004). The piping plover population that winters in Texas breeds on the northern Great Plains and around the Great Lakes. The species is a common migrant and rare to uncommon winter resident on the upper Texas coast (Lockwood and Freeman, 2004; Richardson et al., 1998). The USFWS has designated critical habitat for the species in its nesting and wintering range (65 FR 41781–41812). Designation of critical habitat became final on July 10, 2001 (66 FR 36038–36143). Within Louisiana, the USFWS has designated critical wintering habitat for the piping plover along the entire shoreline from the east side of Sabine Pass (Texas-Louisiana border) east approximately 16 miles to the west end of Constance Beach (Unit LA 1, in part). No USFWS-designated Critical Habitat for the piping plover is present within the Texas portions of the project area.

The USFWS recently removed the peregrine falcon, the brown pelican, and the bald eagle from the Federal list of threatened and endangered species, but the Arctic subspecies (*F. p. tundrius*) and the bald eagle retain their State-listed status of threatened in Texas. The brown pelican retains its State-listed status of endangered in Texas. The Arctic subspecies of peregrine falcon is an uncommon migrant statewide and an uncommon winter resident along the Texas Gulf Coast, where it typically occurs near bays and estuaries (Lockwood and Freeman, 2004). Peregrine falcons may occur within the study area during migration; however, no suitable nesting or wintering habitat is present in the study area. NDD (2006) indicates no documented records from the study area; however, the species may occur in winter or as a transient during migration.

The brown pelican is a common resident along the Texas Gulf Coast, occasionally wandering inland during postbreeding in late summer and fall (Lockwood and Freeman, 2004). Brown pelicans breed on barrier, natural estuarine, or dredged material placement islands (Shields, 2002). Richardson et al. (1998) list the species as an abundant year-round resident on the upper Texas coast, which includes Jefferson County, Texas. Shields (2002) indicates that the species is a winter resident along the western Louisiana coast, but does not breed there. Brown pelicans are unlikely to nest in the study area, but are present throughout most of the year. In 2009, the USFWS removed the brown pelican from the list of threatened and endangered wildlife (74 FR 220; 59443–59472; December 17, 2009); however, the brown pelican still receives Federal protection under the Migratory Bird Treaty Act.

The bald eagle is present year-round in Texas and may be found breeding, wintering, and during migration. In Texas, bald eagles breed along the Gulf Coast and on major inland lakes and reservoirs. Additional numbers of bald eagles winter in these habitats. Bald eagles prefer large bodies of water surrounded by tall trees or cliffs, which they use as nesting sites. In 2007, the USFWS removed the bald eagle from the list of threatened and endangered wildlife (72 FR 130; 37345–37372; July 9, 2007); however, the bald eagle still receives Federal protection under provisions of the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. This species may be present within the study area.

The reddish egret (State threatened) is a common resident along the Texas coast. This species inhabits saline and freshwater habitats in all coastal counties, although it is more numerous southward. The reddish egret is also a rare postbreeding visitor over most of Texas, south of the Panhandle (Oberholser, 1974). It is possible that this species may occur within the study area in areas containing appropriate habitat.

The white-faced ibis (State threatened) is a medium-sized wading bird that inhabits freshwater marshes, sloughs, and irrigated rice fields, but also frequents brackish and saltwater habitats. White-faced ibis are permanent residents along the Texas Gulf Coast; however, nesting records exist for many scattered inland localities (Lockwood and Freeman, 2004; Ryder and Manry, 1994). The species is a common migrant/summer resident and uncommon winter resident on the upper Texas coast (Richardson et al., 1998). NDD (2006) indicates no documented records within the study area; however, the species is likely present year-round in the general area.

The wood stork (State threatened) is an uncommon to locally common postbreeding visitor to coastal Texas and inland waters in east and central Texas (Lockwood and Freeman, 2004). Wood storks historically bred in North America along the Gulf Coast from east Texas to Florida, but their range has significantly declined since the 1960s and their North American breeding range is now restricted to Florida, Georgia, and South Carolina (Coulter et al., 1999; Oberholser, 1974). In Texas, wood storks typically occur near freshwater or saltwater wetlands, lakes, or along rivers and streams. The USFWS lists the wood stork as federally endangered in Florida, Alabama, Georgia, North Carolina, and South Carolina, but not in Texas. Wood storks are uncommon to common in summer and fall along the upper Texas coast (Richardson et al., 1998). The species likely occurs in the study area during summer and fall.

The swallow-tailed kite (State threatened) is a medium-sized raptor that historically occurred along the coastal plains, interior lowlands, and riparian areas throughout the southeastern U.S. and Mississippi River Valley, west to central Texas (Meyer, 1995). Beginning in the late 1800s and early 1900s, this species' U.S. range dramatically decreased, likely because of forestry practices, which resulted in the loss of tall trees used for nesting. Today, swallow-tailed kites breed primarily in Florida, with scattered breeding populations in South Carolina, Georgia, Alabama, Mississippi, Louisiana, and southeastern Texas (Meyer, 1995). In Texas, the species is a rare to uncommon migrant throughout the eastern third of the state, with occasional migration records west to the eastern Edwards Plateau (Lockwood and Freeman, 2004). The species is a rare migrant in the study area, with the majority of records occurring between April and June (Richardson et al., 1998; Shackelford and Simons, 2000). NDD (2006) indicates no records within the study area; however, Shackelford and Simons (2000) indicate recent records of migrating birds, and the species may occur in the study area as a migrant.

The sooty tern (State threatened) is a largely pelagic (open ocean) species that nests on isolated tropical and subtropical islands (Schreiber et al., 2002). The species is a rare and local summer resident along the middle and lower Texas Gulf Coast from Matagorda County to Cameron County, where they nest in small numbers on natural and spoil islands, particularly in the Laguna Madre (Lockwood and Freeman, 2004; Oberholser, 1974). Sooty terns are rare in summer along the upper Texas coast (Richardson et al., 1998). It is unlikely that this oceanic species would regularly occur in the study area; however, their occurrence is possible.

#### 3.12.3.2 Terrestrial Mammals

The red wolf (endangered) formerly inhabited a variety of wooded habitats including pine forests, bottomland hardwood forests, swamps, marshes, and coastal prairies (Schmidly, 2004). Most authorities consider the species extirpated, and red wolves are unlikely to occur in the study area.

The TPWD lists the Louisiana black bear (threatened) as a potentially occurring species in the study area, along with the black bear, because of its similarity in appearance to the Louisiana subspecies. The Louisiana black bear historically inhabited east Texas, Louisiana, and southern Mississippi, but now occurs only in small numbers in Mississippi and Louisiana (USFWS, 1992). The last Texas Pineywoods record of native black bear is from the late 1950s, near the town of Livingston in Polk County (Fleming,

1980). There are periodic reports of black bears from various counties of east Texas; however, these bears most likely represent individuals dispersing from neighboring areas in Louisiana (Taylor, 2000). According to Garner (1995), no recent documented sightings of black bears exist from the Texas Gulf Coast. It is unlikely that either subspecies of black bear would occur in the study area.

Rafinesque's big-eared bat (State threatened) occurs eastward from the Pineywoods of Texas throughout the southeastern U.S. This species roosts most frequently in hollowed trees, beneath bark, and under leaf litter, but often roosts in man-made structures such as buildings, wells, and barns (Schmidly, 1991, 2004). According to Schmidly (2004), documented records exist from Jefferson County, and the species may occur in the study area where appropriate habitat occurs.

#### 3.12.3.3 Aquatic Mammals

NMFS identifies five endangered whale species of potential occurrence in the Gulf. These are the sei whale, blue whale, finback (or fin) whale, humpback whale, and sperm whale. These species are generally restricted to deeper offshore waters; therefore, it is unlikely that any of these five species would regularly occur in the study area (NMFS, 2003).

The West Indian (endangered) manatee historically inhabited the Laguna Madre, Gulf, and tidally influenced portions of rivers. It is currently, however, extremely rare in Texas waters, and the most recent sightings are likely individuals migrating or wandering from Mexican waters. Historical records from Texas waters include Cow Bayou, Sabine Lake, Copano Bay, the Bolivar Peninsula, and the mouth of the Rio Grande (Schmidly, 2004). In May 2005, a live manatee was photographed in the Laguna Madre near Port Mansfield (Blankinship, 2005). The West Indian manatee is chiefly a marine species; however, its occurrence in the study area is unlikely.

#### 3.12.3.4 Reptiles

The leatherback sea turtle (endangered) is probably the most-wide-ranging of all sea turtle species. It occurs in the Atlantic, Pacific, and Indian oceans; as far north as British Columbia, Newfoundland, Great Britain, and Norway; as far south as Australia, Cape of Good Hope, and Argentina; and in other waterbodies such as the Mediterranean Sea (National Fish and Wildlife Laboratory [NFWL], 1980). The leatherback is mainly pelagic, inhabiting the open ocean, and seldom approaches land except for nesting (Eckert, 1992) or when following concentrations of jellyfish (TPWD, 2006), when it can be found in inshore waters, bays, and estuaries. It dives almost continuously, often to great depths. Leatherbacks nest primarily in tropical regions and only sporadically along the Atlantic and Gulf coasts of the continental U.S., with one nesting reported as far north as North Carolina (Schwartz, 1976). In the Atlantic and Caribbean, the largest nesting assemblages occur in the U.S. Virgin Islands, Puerto Rico, and Florida (NMFS, 2006a). No nests of this species have been recorded in Texas for at least 70 years (National Park Service [NPS], 2006); the last two, one from the late 1920s and one from the mid-1930s, were both from Padre Island (Hildebrand, 1982, 1986). Apart from occasional feeding aggregations such as the large one of 100 animals reported by Leary (1957) off Port Aransas in December 1956, or possible concentrations in the Brownsville Eddy in winter (Hildebrand, 1983), leatherbacks are rare along the Texas coast,

tending to keep to deeper offshore waters where their primary food source, jellyfish, occurs (NMFS and USFWS, 1992). There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of leatherbacks exist from Jefferson County, Texas (Dixon, 2000); however, the species is unlikely to occur in the project area since only one has been captured by a relocation trawler (1.5 miles offshore of Aransas Pass), and there is no record of a take by a hopper dredge (NMFS, 2003).

The hawksbill sea turtle (endangered) is circumtropical, occurring in tropical and subtropical seas of the Atlantic, Pacific, and Indian oceans (Witzell, 1983). This species is probably the most tropical of all marine turtles, although it does occur in many temperate regions. The hawksbill sea turtle is widely distributed in the Caribbean Sea and western Atlantic Ocean, with representatives of at least some life history stages regularly occurring in southern Florida and the northern Gulf (especially Texas), south to Brazil (NMFS, 2006a). The hawksbill sea turtle generally inhabits coastal reefs, bays, rocky areas, passes, estuaries, and lagoons, where it occurs at depths of less than 70 feet. Like some other sea turtle species, hatchlings are sometimes found floating in masses of marine plants (e.g., sargassum rafts) in the open ocean (NFWL, 1980). In the continental U.S., the hawksbill sea turtles largely occur in Florida where they are sporadic at best. In 1998 the first hawksbill sea turtle nest recorded on the Texas coast was found at Padre Island National Seashore. This nest remains the only documented hawksbill sea turtle nest on the Texas coast (NPS, 2006; Shaver 2006). Elsewhere in the western Atlantic, hawksbills nest in small numbers along the Gulf Coast of Mexico, the West Indies, and along the Caribbean coasts of Central and South America (Musick, 1979). Texas is the only state outside of Florida where hawksbills are encountered with any regularity. Most of these sightings involve posthatchlings and juveniles, and are primarily associated with stone jetties. These small hawksbill sea turtles are believed to originate from nesting beaches in Mexico (NMFS, 2006a). There are no records of hawksbill sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006); no documented records of hawksbill sea turtles exist from Jefferson or Orange counties, Texas (Dixon, 2000), and they are not expected to be present in the project area.

The Kemp's ridley sea turtle (endangered) inhabits shallow coastal and estuarine waters, usually over sand or mud bottoms. Adults are primarily restricted to the Gulf, although juveniles may range throughout the Atlantic Ocean since they have been observed as far north as Nova Scotia (Musick, 1979) and in coastal waters of Europe (Brongersma, 1972). Almost the entire population of Kemp's ridley sea turtles nests on an 11-mile stretch of coastline near Rancho Nuevo, Tamaulipas, Mexico, approximately 190 miles south of the Rio Grande. Sporadic nesting has been reported from Mustang Island, Texas, southward to Isla Aquada, Campeche. Kemp's ridley sea turtles occur in Texas in small numbers and in many cases may well be in transit between crustacean-rich feeding areas in the northern Gulf and breeding grounds in Mexico. It has nested sporadically in Texas in the last 50 years. The number of nestings in Texas, however, has increased over the last decade from 4 nests in 1995 to 51 nests in 2005, 28 of which were from the Padre Island National Seashore (NPS, 2006; Shaver, 2006). Several of the ridley nests were from headstarted individuals. Such nestings, together with the proximity of the Rancho Nuevo rookery, probably account for the occurrence of hatchlings and subadults in Texas. Between 1996

and 2005, maintenance dredging in the Sabine Pass Entrance Channel by hopper dredges resulted in the lethal take of a Kemp's ridley sea turtle in 1997 (Rob Hauch, pers. comm., 2006). In 2006, maintenance dredging in the Sabine Bank Channel resulted in the lethal take of one Kemp's ridley sea turtle (USACE, 2006c). The species is of potential occurrence in the project area.

The loggerhead sea turtle (threatened) is widely distributed in tropical and subtropical seas, occurring in the Atlantic Ocean from Nova Scotia to Argentina, the Gulf of Mexico, the Indian and Pacific oceans (although it is rare in the eastern and central Pacific), and the Mediterranean Sea (Iverson, 1986; Rebel, 1974; Ross, 1982). In the continental U.S., loggerhead sea turtles nest along the Atlantic coast from Florida to as far north as New Jersey (Musick, 1979) and sporadically along the Gulf coast, including Texas. Like the worldwide population, the population of loggerhead sea turtles in Texas has declined. The loggerhead is the most abundant turtle in Texas marine waters, preferring shallow inner continental shelf waters and occurring only very infrequently in the bays. It is often seen around offshore oil rig platforms, reefs, and jetties. Loggerhead sea turtles are probably present year-round but are most noticeable in the spring when one of their food items, the Portuguese man-o-war, is abundant. Loggerheads constitute a major portion of the dead or moribund turtles washed ashore (stranded) on the Texas coast each year. Most of these deaths are the result of accidental capture by shrimp trawlers, where caught turtles drown and their bodies dumped overboard. In 1999, two loggerhead sea turtle nests were confirmed in Texas, while in 2000, five loggerhead sea turtle nests were confirmed (Shaver, 2000). For the last 5 years, up to five loggerhead sea turtle nest per year have been recorded from the Texas coast (Shaver, 2006). Between 1996 and 2005, maintenance dredging in the Sabine Pass Entrance Channel by hopper dredges resulted in the lethal take of a loggerhead sea turtle in 2002 (Rob Hauch, pers. comm., 2006). The species is of potential occurrence in the project area.

The green sea turtle (threatened) is a circumglobal species in tropical and subtropical waters. In U.S. Atlantic waters, it occurs around the U.S. Virgin Islands, Puerto Rico, and continental U.S. from Massachusetts to Texas. Major nesting activity occurs on Ascension Island, Aves Island (Venezuela), Costa Rica, and in Surinam. Relatively small numbers nest in Florida, with even smaller numbers in Georgia, North Carolina, and Texas (Hirth, 1997; NMFS and USFWS, 1991a, 1991b). The green sea turtle in Texas inhabits shallow bays and estuaries where its principal foods, the various marine grasses, grow (Bartlett and Bartlett, 1999). While green sea turtles prefer to inhabit bays with seagrass meadows, they may also be found in bays that are devoid of seagrasses. The green sea turtles in these Texas bays are mainly small juveniles. Adults, juveniles, and even hatchlings are occasionally caught on trotlines or by offshore shrimpers or are washed ashore in a moribund condition. Green turtle nests are rare in Texas. Five nests were recorded at the Padre Island National Seashore in 1998, none in 1999, and one in 2000 (Shaver, 2000). For the last 5 years, up to five nests per year have been recorded from the Texas coast (Shaver, 2006). Since long migrations of green sea turtles from their nesting beaches to distant feedings grounds are well documented (Green, 1984; Meylan, 1982), the adult green sea turtles occurring in Texas may be either at their feeding grounds or in the process of migrating to or from their nesting beaches. The juveniles frequenting the seagrass meadows of the bay areas may remain there until they move to other feeding grounds or, perhaps, once having attained sexual maturity, return to their natal beaches outside of

Texas to nest. There are no records of green sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of green sea turtles exist from Jefferson County, Texas (Dixon, 2000). It is of potential occurrence in the project area.

The Texas horned lizard (State threatened) occurs throughout the western two-thirds of the state in a variety of habitats, but prefers arid to semiarid habitats in sandy loam or loamy sand soils that support patchy bunch-grasses, cacti, yucca, and various shrubs (Dixon, 2000; Henke and Fair, 1998). Dixon (2000) shows historic records from the study area; however, because of the limited terrestrial habitat, it is unlikely they would occur in the study area.

The Northern scarletsnake (State threatened) inhabits loose, sandy soil of pine, hardwood, and mixed forest environments as well as adjacent open, agricultural fields, swamps, and stream banks of extreme east Texas (Tennant, 1998). Dixon (2000) shows historic records from the study area; however, because of the limited terrestrial habitat, it is unlikely they would occur in the study area.

The timber rattlesnake (State threatened) typically inhabits dense thickets and brushy areas along the floodplains of major creeks and rivers throughout the eastern third of Texas. It occurs in a variety of habitats including floodplains and riparian areas, swamps, upland pine and deciduous woodlands, abandoned farmland, and limestone bluffs (Werler and Dixon, 2000). This rattlesnake is most active during the summer and fall, with some activity noted in spring and as late as December (Werler and Dixon, 2000). Documented records exist from Jefferson County, Texas (Dixon, 2000); however, it is unlikely the species would occur in the study area because of the lack of suitable habitat.

The alligator snapping turtle (State threatened) is the largest North American freshwater turtle species. Alligator snapping turtles inhabit deep rivers, lakes, and large streams of the southeastern U.S. (Garrett and Barker, 1987). Documented records exist from Jefferson and Rusk counties, Texas (Dixon, 2000), but the species is unlikely to occur in the study area because of the lack of suitable habitat.

#### 3.12.3.5 Fish and Amphibians

The smalltooth sawfish (endangered) historically was common throughout the Gulf from Texas to Florida, and along the east coast from Florida to Cape Hatteras. The current range of this species has contracted to peninsular Florida, and smalltooth sawfish are relatively common only in the Everglades region at the southern tip of the state. Smalltooth sawfish are usually found in shallow (typically less than 33 feet), warm (water temperatures exceeding 61°F) coastal waters, close to shore, over muddy and sandy bottoms. The most recent verified report of a smalltooth sawfish from Texas waters was in 1998. Since the smalltooth sawfish prefer shallow water, it is unlikely they would be encountered in the project areas that would be dredged.

The Gulf sturgeon (threatened) historically ranged along the northeastern Gulf, in major rivers from the Mississippi delta in Louisiana, east to Charlotte Harbor, Florida, and in marine waters of the central and eastern Gulf (NMFS, 2006b; USFWS and Gulf States Marine Fisheries Commission [GSMFC], 1995). Its current range extends from Lake Pontchartrain and the Pearl River in Louisiana and Mississippi east to

the Suwannee River in Florida. Sporadic records exist from as far west as the Rio Grande between Texas and Mexico, and as east and south as Florida Bay. As with other sturgeon species, the damming of rivers has been the most significant threat to the Gulf sturgeon (NMFS, 2006b). The study area is not within the known historic range of the Gulf sturgeon. Fish are mobile species and frequently occur outside of their normal ranges; however, it is unlikely that the species is present in the study area.

The dusky shark (SOC) is a large shark with a wide-ranging distribution in warm-temperate and tropical continental waters. It is coastal and pelagic in its distribution, where it occurs from the surf zone to well offshore. Habitat for this species does exist in the project area.

The sand tiger shark (SOC) has a broad inshore distribution. In the western Atlantic, this shark occurs from the Gulf of Maine to Florida, in the northern Gulf, in the Bahamas and in Bermuda. They are generally coastal, usually being found in the surf zone down to depths around 75 feet. They may also be found in shallow bays. They usually live near the bottom, but may be found throughout the water column. Their biggest threat is overfishing. Habitat for this species may exist in the project area.

The night shark (SOC) is a deepwater shark reported in waters from Delaware south to Brazil, including the Gulf. This shark is usually found at depths greater than 900 to 1,200 feet during the day and 600 feet at night. Habitat for this shark does not exist in the project area.

The saltmarsh topminnow (SOC) is endemic to the north-central coast of the Gulf from Galveston Bay eastward to western Florida. They tend to live in salt marshes and brackish water. This species requires shallow flooded marsh surfaces for breeding and feeding. Coastal erosion and loss of marsh is thought to be the greatest threat to this species. It is possible that this species occurs in the project area.

The Warsaw grouper (SOC) is a very large fish found in the deepwater reefs of the southeastern U.S. This fish ranges from North Carolina to the Florida Keys and throughout much of the Caribbean and Gulf to the northern coast of South America. This species inhabits deepwater reefs on the continental shelf break in waters 350 to 650 feet deep. Habitat for this species does not exist in the project area.

The speckled hind (SOC) inhabits warm, moderately deep waters from North Carolina to Cuba, including Bermuda, the Bahamas, and the Gulf. The preferred habitat is hard-bottom reefs in depths ranging from 150 to 300 feet. Habitat for this species does not exist in the project area.

#### 3.12.3.6 Invertebrates

Elkhorn coral was listed as threatened on May 9, 2006 (71 FR 26852) and is found on coral reefs in southern Florida and the Bahamas, and throughout the Caribbean. Its northern limit is Biscayne National Park, Florida. This species is particularly susceptible to damage from sedimentation. Neither the project area nor the study area is located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

Staghorn coral was listed as threatened on May 9, 2006 (71 FR 26852) and is found throughout the Florida Keys, the Bahamas, and the Caribbean islands. This coral occurs in the western Gulf, but it is absent from U.S. waters in the Gulf. Neither the project area nor the study area is located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

Colonies of ivory tree coral (SOC) are found to depths of 500 feet on substrates of limestone rubble, low-relief limestone outcrops, and high-relief, steeply sloping prominences. The project area is not located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

## 3.13 CULTURAL RESOURCES

Archival and historical research was conducted to develop a baseline level of knowledge for prehistoric and historic period cultural developments and to identify archeological and historical sites previously recorded in the SNWW project area. Among the research efforts, a review of published historical literature and previous archeological investigation reports yielded information useful for developing a general chronology of cultural developments across the region. Also, archeological reports and official site records maintained by State historic preservation offices in Texas and Louisiana were relied upon to identify previously recorded archeological and historical sites in the project area. Other sources of information included official industrial and agricultural census data as well as historical maps of the area prior to 1900 through 1955.

Cultural resources found in the project vicinity are generally of the following common types. Terrestrial prehistoric sites typically found in the SNWW CIP project vicinity consist of eroded or partially eroded prehistoric shell midden sites. The majority of shell middens are located along the main waterways, oxbows, and near the coast. Approximately 80 percent of these sites are comprised primarily of shells from the brackish-water clam (*Rangia cuneata*) mixed with sparse pottery shards and faunal food remains. Some sites located closer to the coast also contain shells from the eastern oyster. Historic terrestrial sites in the project vicinity are related primarily to Civil War military forts and outposts, although a few National Register structures such as the Sabine Pass Lighthouse and the Rainbow Bridge, are also present. The most typical marine sites in the project area are Civil War shipwrecks.

### 3.13.1 Prehistoric Chronology and Historic Context

#### 3.13.1.1 Prehistoric Chronology

The prehistoric chronology of the Sabine Lake area is not well understood, as the area has received only limited testing (Aten, 1983). However, since the current project area is a part of the upper Texas coast, the three-phased chronological sequence that was developed for that region (Paleoindian to Archaic to Late Prehistoric) can be employed, with each transition marked by significant adaptations in technology and settlement patterns. Chronological designations are Before the Common Era (B.C.E.) and Common Era (C.E.) as per the *American Anthropological Association Style Guide* (2009).

Paleoindian (10,000 B.C.E. to 8000 B.C.E.) populations ranged over most of North America by the end of the Pleistocene. In the northern Gulf region, the Paleoindian culture is identified by the occurrence of large lanceolate, fluted projectile points. Typically, Paleoindian sites are considered to reflect low-density populations and hunter-gatherer subsistence strategies.

The Archaic period (6000 B.C.E. to C.E. 700) is typically subdivided into four components; the Early Archaic (6000 B.C.E. to 2500 B.C.E.), the Middle Archaic (2500 B.C.E. to 1000 B.C.E.), the Late Archaic (1000 B.C.E. to 300 B.C.E.), and the Transitional Archaic (300 B.C.E. to C.E. 700). Evidence of the Early Archaic is scarce along the upper Texas coast, due to either a decrease in human population or the lack of stratified excavations (Story et al., 1990).

Although there is a dearth of information on the Early Archaic along the upper Texas coast, other areas in North America have produced data pointing to a generalized hunting and gathering technology and a minimum band level social organization. Ricklis and Blum (1997) hypothesized that coastal sites were frequented during the winter months as part of a seasonal exploitation pattern.

Coastal sites and shell middens become more frequent during the Middle Archaic, expressing a unique subsistence activity. The Middle Archaic populations displayed a more involved method of seasonal exploitation, as documented by Voellinger (1990) at 41GV22. Evidence found at this site indicates early spring exploitation.

A hunting and gathering pattern of subsistence continued during the Late Archaic in Texas, with pre-Caddo sites marking the beginning of settled village life shortly after 500 B.C.E. in parts of East Texas, as well as a marked rise in bison exploitation as a game resource, as reflected in bison-kill sites in Central Texas.

The Transitional Archaic is marked by an increase in settlement sites, often having large burial mounds. Such sites mark the introduction of, and reliance upon, agriculture that leads to population growth and the emergence of social and political systems (Turner and Hester, 1985).

The Late Prehistoric period (C.E. 700 to C.E. 1600) is marked by the emergence of ceramics and terminates with European contact and interaction. While Aten (1983) has identified six chronological Late Prehistoric periods in the Galveston Bay area, he notes that the Sabine Lake area lacks sufficient controlled excavations to place it within this chronological sequence.

#### 3.13.1.2 Historic Context

European interest in the coastal areas of Texas began almost as soon as the first Spanish explorers landed on the mainland of North America in 1513. Shortly thereafter, the Spanish crown began granting contracts to private investors to colonize and explore the new territory. One expedition led by a Spaniard Panfilo de Narváez ended in disaster. It is due to this unfortunate expedition that we have the earliest report of Europeans coming ashore in the vicinity of Sabine Pass (Weddle, 1985).

European activity in the region decreased over the next 100 years. It was not until the French explorer Rene Robert Cavalier, Sieur de La Salle entered Spanish territory in the northern Gulf in the late seventeenth century that the Spanish government hastened plans to colonize the area. The French continued to visit the region as they explored, established posts, and traded goods as far east as the Trinity River during the late 1600s and 1700s (Bolton, 1970). The early French and Spanish explorers relied on the Sabine and Neches rivers as their principal transportation route.

In 1763, Spain was given the Louisiana Territory by Louis XV of France; however, by 1802 the Spanish crown relinquished control of the Louisiana Territory back to France due to the territory's increasing demands on Spain's resources (Haggard, 1945). Less than 1 year later, Napoleon sold the territory to the United States.

With Louisiana in the hands of the U.S., Spain had a new problem at their border. The close proximity between Spanish and U.S. troops in the area of the Sabine River led to a great deal of tension and brought about an agreement between the two sides in 1806, whereby a strip of land was defined between the two countries that neither would rule. The land called the "Neutral Strip" extended between the Sabine River eastward to the Arroyo Hondo and from the Gulf to the 32nd parallel. The Neutral Strip was a wild ungoverned area open to smuggling, slave trade, and other criminal activity. The area also was the staging ground for military expeditions against Spanish Texas by ostensibly freelance organizations called filibusters (Haggard, 1945).

The Neutral Strip was abolished by the Adams-Onis Treaty of February 1821 whereby Spain relinquished its claims on the Sabine and Neches river area (Gibson et al., 1978). The treaty was ratified by the Mexican government that same year. Also in 1821, the Treaty of Cordova transferred Spanish Texas to the Republic of Mexico (Block, 1976). The land subsequently became a part of the Republic of Texas in 1836, at which time the Republic of Texas and the U.S. encouraged trade across the border formed by the Sabine River.

Goods were moved along the Sabine and Neches rivers as early as 1830 due to the economics of river versus overland transport (Chick, 1988). Settlement and economic use of the region increased from the early days of the Texas Republic through early statehood, and the rivers continued to be used as the primary transportation route until the Civil War.

After Texas's decision to secede from the Union on February 1, 1861, Sabine Pass became an important source of revenue and supplies for the Confederacy. Blockade-runners could operate virtually undetected out of Sabine Pass, shipping large amounts of cotton and other supplies to foreign markets and returning with coffee, sugar, munitions, and medical supplies. The U.S. recognized the importance of Sabine Pass to the Confederacy, and it soon became a focal point for the Union blockade of the Texas Gulf Coast.

Fearing a Union invasion during the Civil War, the citizens of Sabine Pass decided to build a fort to protect their town. Local residents, including many slaves, constructed a dirt and timber earthwork overlooking the Sabine River. On September 24, 1862, the fort was shelled by Union gunboats and

severely damaged. The following March, Major Josephus S. Irvine determined that the site was no longer useful (Block, 1976).

A new fort, Fort Griffin, was constructed a few miles away. With 30 engineers and 500 slaves, Major Julius Kellersberg constructed a triangular fort on an eminence overlooking the Sabine River. The fort was named for the commander of the Twenty-first Texas Battalion, Colonel William H. Griffin (Block, 1976).

Located across Sabine Pass opposite Fort Griffin, the Sabine Pass Lighthouse, which began operation in 1857, was an ideal observation post for the Confederate forces during the Battle of Sabine Pass. In September 1863, four Union gunboats leading a strong amphibious invasion force attacked Fort Griffin. At the Battle of Sabine Pass, Lieutenant Richard Dowling and a 46-man garrison disabled two of the attacking vessels and scattered the remainder of the Union ships (Block, 1976).

The U.S. strengthened its position at Sabine Pass with the arrival of the USS *Hatteras* and became more aggressive in the autumn of 1862. Union vessels conducted raids into the region as far north as Beaumont on the Neches River, destroyed much of the town of Sabine Pass, and bombarded and forced the temporary abandonment of Fort Griffin at Sabine Pass using both sail and steam vessels (Francavigilia, 1998). In January 1863, the Confederate forces fought back when they burned and destroyed the USS *Dan* near the Sabine Pass Lighthouse and captured the Union Vessel USS *Morning Light* and the schooner *Velocity* off Sabine Pass using the cotton-clad side-wheel steamers *Josiah H. Bell* and *Uncle Ben* (Francaviglia, 1998; Hardison, 1998).

The standoff between the two forces culminated with the Battle of Sabine Pass in September 1863. Under the direction of Lieutenant Richard W. Dowling, a 45-minute battle resulted in a Confederate victory. Lieutenant Dowling and his 46 men captured two gunboats, the USS *Sachem* and the USS *Clifton* and 350 prisoners, with an additional 61 U.S. soldiers and sailors missing or killed. Without losing a man, Dowling and the Guards prevented an invasion of Texas. The location of this battle is now preserved as the Sabine Pass Battleground and Historic Site (41JF36). A bronze statue of Dowling overlooks the 57.5-acre park.

The U.S. failed to establish itself in Texas during the war; however, the Union blockade did hinder the growth of burgeoning port cities in the state and all but decimated the economy of Sabine Pass for years to come (McGuff and Roberson, 1974).

## 3.13.2 Previous Investigations

### 3.13.2.1 Terrestrial Investigations and Recorded Sites

During 1939 and 1940, Gus Arnold of the University of Texas at Austin conducted an archeological survey in the region as a part of a larger east Texas study sponsored by the Works Progress Administration (Im, 1975). Arnold identified 28 sites within the project vicinity. Unfortunately, Arnold never published his results and the only record of his work exists as a Master of Arts thesis from the

University of Texas (Im, 1975). In this thesis, Im presents each site's general location, a short description, temporal components found, and a brief description of the artifacts (Im, 1975). Im noted the similarities between the ceramic artifacts collected by Arnold and those from the Lower Mississippi Valley and "supposed" (Im, 1975) that there were Mississippi Valley sherds among Arnold's collection. However, Im was not able to separate the Lower Valley sherds out of the collection, having particular difficulty in separating sherds dating to the Plaquemine and Coles Creek periods. Im concluded by noting that it seemed that sandy paste sherds occur more frequently early in the chronology and grog-tempered sherds later. Furthermore, he identified two culture areas in east Texas that he termed Caddoan and non-Caddoan with a boundary between the two areas located approximately 80 to 100 miles from the Gulf coast (Im, 1975).

After Arnold, McIntire (1958) recorded several sites in west Louisiana, and then used these sites to extend the Red River Chronology into that part of the state. In the late 1960s, Lawrence Aten and Charles Bollich undertook a survey in the Sabine Lake area of Louisiana and Texas (Aten and Bollich, 1969). Of the 14 sites visited by Aten and Bollich, four are within the project vicinity. Aten and Bollich (1969) attempted to order their ceramic artifacts by paste type (sandy paste and grog-tempered) with the assumption that sandy paste sherds would dominate the earlier assemblages. The authors (1969:Figure 4) concluded that both paste categories existed throughout the history of pottery making in the area with sandy paste sherds being a bit more numerous early in the sequence.

In 1973, the Texas Archeological Survey conducted an archeological survey along the Sabine and Neches rivers for the USACE (McGuff and Roberson, 1974). They visited 81 sites, 61 of which are located near the project area. McGuff and Roberson (1974) provided information on site description, condition, and impacts. Of the 81 sites visited, McGuff and Roberson (1974) listed 21 as potentially eligible for the National Register of Historic Places (NRHP).

In 1978, the USACE, Fort Worth District, sponsored two surveys of the lower Sabine River. The University of Southwestern Louisiana (now University of Louisiana, Lafayette) Center for Archeological Studies inventoried sites along the Sabine River from Toledo Bend Reservoir to the GIWW (Gibson, 1978). Gibson visited 12 sites in the project vicinity and determined that 10 of the sites were potentially eligible for National Register listing. In conjunction with the Gibson study, the University of New Orleans Archeological and Cultural Research Program inventoried sites along the Sabine River and its tributaries from the GIWW south to the Gulf (Beavers, 1978). Forty-two sites were visited by Beavers (1978), 19 of which are located in the project vicinity that he recommended for additional work.

The most recent archeological inventory was conducted by the Brazos Valley Research Associates for the City of Beaumont's Colliers Ferry Wetlands and Recreational Area and Nature Preserve (Moore and Aronow, 1993). No cultural resources were located during this survey, although they do discuss site 41JF1, which they noted was covered by 2 to 3 feet of dredged deposits.

While there has been a substantial amount of cultural resources inventory work done in the project area, there has been a distinct lack of more-detailed investigations involving archeological test excavations.

Several sites in the project vicinity have been subjected to some minimal level of formal testing: 41JF26, 41JF31 (Aten, 1983); 41OR58 (Rogers, 1991); 41CM141 (Servello and Blanchard, 1992); and 41JF11 and 41JF35 (Raab and Smith, 1983). Excavations were either limited to National Register eligibility testing or were not formally reported. The one site where extensive excavation has taken place is the Gaulding site (41JF27), excavated by the Texas Archeological Society (Aten and Bollich, 2002).

In addition to these traditional types of terrestrial archeological investigations, recent geological and remote-sensing investigations of submerged landforms located offshore have suggested that older prehistoric sites may have survived despite long-term inundation and sea level changes in the submerged relict Sabine River valley. A study by the MMS (Stright, 1990) located two possible *Rangia* midden sites approximately 16 miles offshore of the Louisiana/Texas border in the Gulf. Stright's work appears to confirm predictions published by Coastal Environments, Inc. (Pearson et al., 1986) that intact archeological sites may be located along relict tributaries associated with the now submerged Sabine River Valley.

#### 3.13.2.2 Marine Investigations and Reported Shipwrecks

Several previous marine archeological investigations have occurred on the SNWW. Of these, four reports are pertinent to the current project. The four investigations discussed here are Bond and Foster (1993), Hoyt and Schmidt (1997), and Hoyt et al. (1994, 1998).

EH&A conducted a magnetometer survey on the lower Neches River in 1992 (Bond and Foster, 1993). Work was conducted under USACE permit number 19611 for the LNVA to identify possible shipwrecks at four potential saltwater barrier locations. Several magnetic anomalies were recorded during this survey, none of which were recommended as potential historic properties.

EH&A performed a remote-sensing survey of the Sabine Pass Channel and an assessment of the American Civil War–era shipwreck the USS *Clifton* (41JF65) under contract with the USACE in 1994 (Hoyt et al., 1994). Work was conducted in order to identify historic properties that might have been adversely affected by the USACE maintenance-dredging program and to locate and assess the wreck of the *Clifton*. EH&A was tasked with determining its potential for impacts during future jetty maintenance and repair activities (Hoyt et al., 1994). The remote-sensing survey recorded 26 localities that were recommended for diver investigation to identify whether they were historic shipwrecks. The report concluded that the wreck of the *Clifton* was eligible for listing in the NRHP. Further field investigations of the wreck, in the form of remote-sensing investigations and/or archeological excavation, were recommended should it be threatened by future projects.

EH&A followed up its 1994 work in the Sabine Pass Channel with diving assessments of the 26 localities identified in the previous work (Hoyt and Schmidt, 1997). This work was conducted in 1996 under contract with the USACE to determine whether the 26 localities were potential cultural resources. EH&A determined that 15 localities contained modern construction debris; 4 localities, although unidentified, were small and/or deeply buried objects not indicative of shipwrecks; 4 localities had been displaced or removed from the study area; 1 locality was located outside the impact area and within a previously

dredged area and therefore likely was modern in origin; and 2 (L25 and L26) remained unidentified and not fully investigated. The latter were located in an area where project dredging had been completed and therefore were not recommended for further investigation. However, EH&A recommended that additional investigations be conducted, should future plans include channel widening at this location, due in part to the localities' possible association with a recorded American Civil War shipwreck in the area.

EH&A conducted archival research, a remote-sensing survey, and a terrestrial survey in 1997 for the USACE (Hoyt et al., 1998). Work was conducted to identify possible cultural resources at a proposed site for the Neches River Saltwater Barrier, north of Beaumont in the vicinity of Pine Island Bayou. Archival research identified a single historic structure in the study area, a navigation light, which was not physically located during the survey. Numerous magnetic anomalies and side-scan sonar images were recorded during the remote-sensing survey. None of these anomalies was identified as possible cultural resources, and further archeological investigations were not recommended.

As part of the marine investigation, PBS&J researched several databases and secondary sources in order to produce a list of shipwrecks, archeologically sensitive areas, State Archeological Landmark (SAL) and NRHP sites potentially located within the study area. Such sources include PBS&J's shipwreck database, the shipwreck files at the Texas Historical Commission's (THC) Office of the State Marine Archeologist, the shipwreck files at the Louisiana Division of Archaeology (LDA), the NOAA Automated Wreck and Obstruction Information System, the MMS shipwreck database, the GLO's Resource Management Codes, the NPS's NRHP listings, the THC's SAL listings, and the THC's Historical Marker Program. In addition to these databases, cartographic resources such as NOAA's historical and modern navigation charts were useful in identifying possible shipwreck locations. Additional secondary sources such as Lytle and Holdcamper's (1975) Merchant Steam Vessels of the United States and the United States Bureau of Navigation's (various years) Merchant Vessel Losses of the United States were important sources for identifying historic and modern vessel losses.

PBS&J conducted a marine remote-sensing survey for the current FEIS along portions of the SNWW in Jefferson and Orange counties, Texas, and Cameron Parish, Louisiana, throughout February 2003. The survey covered the Outer Bar Channel, the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel. The survey included the assessment of potential historic properties, oyster reefs, pipelines and wells, and potential obstructions to navigation in the survey area. PBS&J's survey identified 27 potential historic properties, of which 15 would be impacted by the proposed project. Two previously recorded magnetic anomalies, L25 and L26 (Hoyt and Schmidt, 1997), were also identified as potential shipwrecks. PBS&J recommended that all 27 potential historic properties be avoided by bottom-disturbing activities. Anomalies for which avoidance is not feasible were recommended for further archeological investigations in the form of close-order remote-sensing surveys to aid differentiation between anomalies requiring diver assessment and anomalies associated with debris.

The results of the remote-sensing survey can be found in the report titled, *Historic Properties Identification, Oyster Reef Identification, and Pipeline and Obstruction Identification for the Sabine/*

*Neches Waterway Widening and Deepening, Jefferson and Orange Counties, Texas, and Cameron Parish, Louisiana*, prepared for the USACE by PBS&J dated September 2005 (Enright and Gearhart, 2005). Project plans have been modified since the study was conducted. The 27 anomalies located during the February 2003 survey are included on the current project plans.

The density of reported shipwrecks increases at the northwest corner of Sabine Lake where the SNWW divides near the mouth of the Neches River and Stewts Island. Farther up the Neches River, reported shipwrecks are present near Deer Bayou, Smith Bluff Cutoff, and Bethlehem Steel in Beaumont. In addition to these shipwrecks, the National Defense Reserve Fleet maintains a reserve of vessels on the Neches River near Beaumont that can be activated to help meet U.S. shipping requirements during a national emergency. Many are mothballed World War II naval vessels moved from the Reserve Naval Station Orange facility. This large fleet of intact and floating naval vessels may also extend into the old river channel that was cut off at Smith Bluff. Although not technically shipwrecks, many of these vessels are of sufficient age to meet NRHP eligibility requirements and may represent important World War II–era military developments associated with the study area.

A high density of reported shipwrecks is present in Sabine Pass. Sabine Pass and the adjacent Gulf coast are deemed to be archeologically sensitive in regards to the potential for historic shipwrecks, some of which include the CSS *Clifton*, three steam-driven vessels (*Pearl Plant*, USS *Dan*, and CSS *Sachem*), three sail-driven vessels (schooners *Manhassett* and *Revenge* and USS *Morning Light*), as well as an unknown quantity of jettisoned cargo lost in the area during the American Civil War. Sabine Pass is also home to the Sabine Pass Lighthouse, which is listed on the NRHP.

No remote-sensing survey has been conducted for the Sabine Bank Channel, the proposed Extension Channel, or the existing or proposed ODMDSs. The USACE researched the MMS files on known and potential historic shipwrecks in the Gulf portion of the SNWW project area. The MMS locations are only approximate because many wreck locations cannot be determined with certainty and are reported by lease block only. The approach corridor to Sabine Pass is a high probability area for shipwrecks. Numerous shipwrecks have been documented in the area including vessels that participated in the Battle of Sabine Pass during the American Civil War. Several shipwrecks have been reported in the vicinity of these anomalies, including *Terry Walker*, *Beulah*, *Esther*, *Kile No. 1*, *L.A. Burnham*, and one unidentified wreck (u128). Other wrecks reported in the general vicinity of the Outer Bar Channel include *Ella*, *Hattie*, *John Sealy*, *Manhassett*, USS *Morning Light*, and *Revenge*.

#### 3.13.2.3 National Register Properties

There are two sites listed on the NRHP that are located adjacent to the proposed SNWW CIP: Rainbow Bridge and the Sabine Pass Lighthouse. Rainbow Bridge is the cantilever bridge crossing the Neches River just upstream from Sabine Lake. It allows SH 87 and SH 73 to connect Port Arthur with Bridge City. The Sabine Pass Lighthouse was described above. There is also one SAL (site 41JF65, the USS *Clifton*), also discussed above, that is located adjacent to the proposed SNWW CIP.

# 3.14 SOCIOECONOMIC RESOURCES

## 3.14.1 Introduction

This section presents detailed economic and demographic characteristics of the study area. Information evaluated within this section includes population, demographic, and community cohesion factors, employment, labor force characteristics, economics, tax base, land use, transportation, community services, aesthetics, future development and development restrictions, life, health, and safety, and Environmental Justice (EJ).

Two geographic levels have been selected to analyze the socioeconomic components of the proposed study area. These two levels have been chosen to capture more fully the socioeconomic setting and its relationship to the regional economy. These two geographic levels are the study area and the detailed study area.

### 3.14.1.1 Study Area

For the purposes of this section, the following counties and parishes are used as units of socioeconomic analysis: Hardin, Jefferson, and Orange counties in Texas, and Cameron and Calcasieu parishes in Louisiana. Also the following cities are discussed: Beaumont, Port Arthur, Port Neches, Nederland, Vidor, Orange, and Bridge City in Texas; and Lake Charles in Louisiana. Also, census data and other socioeconomic data are provided for the BPA Metropolitan Statistical Area (MSA) (includes Hardin, Jefferson, and Orange counties, Texas), although some portions of these MSAs are not part of the study area. The Lake Charles MSA is the only other MSA within the study area, but it is not included because it includes only Calcasieu Parish (which is already discussed). Also, wherever it was possible, the Texas portion of the study area, and the Louisiana portion of the study area are discussed. In such cases, socioeconomic data are provided separately for all Texas counties and for all Louisiana parishes. Finally, some communities within the study area are discussed in more detail than others simply because they are located closer to areas affected by the proposed project, or areas near to the detailed study area, which is the second geographic level of analysis (below).

### 3.14.1.2 Detailed Study Area

The detailed study area for this section is defined differently than for other sections of this FEIS. The detailed study area, for this section, includes only census tracts that are within (or at least partially overlap into) the “detailed study area” that is shown on Figure 3.14-1 (2000 census tracts). The detailed study area, as defined within this section only, includes areas within a 1-mile-wide corridor of the areas proposed for ship channel improvements. Many of the census tracts included in this section overlap partly into the detailed study area, but cover much larger areas outside of the detailed study area. Therefore, the census data (provided by census tract) for the detailed study area include much larger populations than those that physically live within the detailed study area (areas included in the census tract level analysis are shaded yellow). These areas include incorporated areas of Beaumont, Port Neches, Nederland, Bridge City, and Port Arthur and unincorporated areas within Jefferson, Hardin, and Orange counties, Texas, and

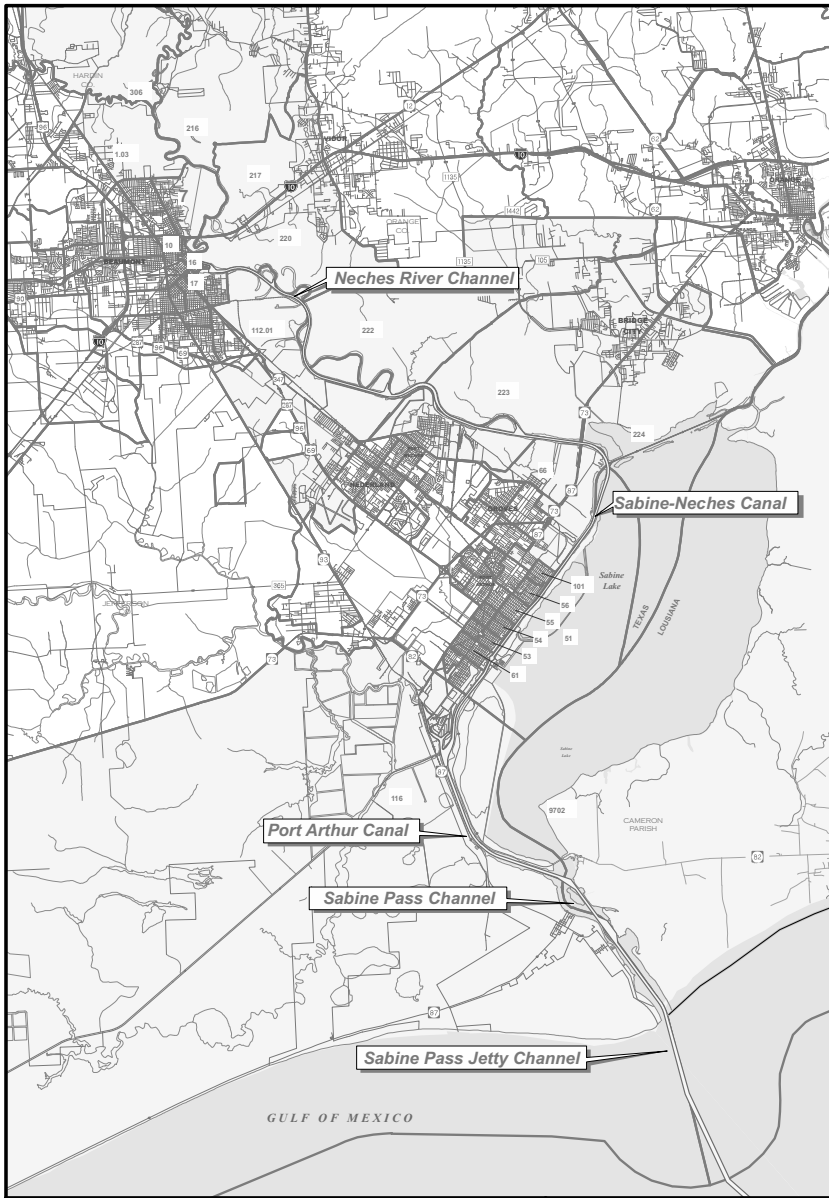


**Figure 3.14-1**

**2000 Census Tracts Sabine-Neches Waterway**

| | |
|---|---|
| Prepared for: USACE Galveston | |
| Job No: 100007609 | Scale: 1" = 16500' |
| Prepared by: 18895 | Date: 07/9/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Census_2000_11_17_v4.mxd

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Cameron Parish, Louisiana. Finally, the census tract figure breaks up the detailed study area into the following subcategories based on the names of different segments of the ship channel (from north to south): Neches Channel, Sabine-Neches Channel, Port Arthur Channel, Sabine Pass Channel, and the Sabine Pass Jetty Channel.

## 3.14.2 Population and Community Cohesion

### 3.14.2.1 Historic and Projected Population

Table 3.14-1 presents the current and historic population data for the study area. From 1980 to 1990, population growth within the study area was negative, with only a few communities exhibiting positive population growth during the 1980s. Negative population growth in the study area during the 1980s is largely attributable to high unemployment rates, and economic problems within the region due to the 1980s "oil bust," when manufacturing and construction industries within the study area (and other locations in Texas and Louisiana) suffered heavy economic losses and layoffs (Helen, 2002). During the 1980s the study area cities with the greatest population growth were Bridge City (6.5 percent increase) and Nederland (0.0 percent growth), while the greatest decreases in population were experienced in the City of Orange (at negative 12.9 percent) and Port Arthur (at negative 7.6 percent). Among study area counties and parishes, the greatest population growth during the 1980s occurred in Hardin County (at 1.5 percent growth) and Calcasieu Parish (at 0.5 percent growth), while the greatest decreases in population occurred in Jefferson County (at negative 4.6 percent) and in Orange County (at negative 4.0 percent). The population changes within the study area during the 1980s contrasted sharply with that of the State of Texas (at 19.4 percent), while it was fairly consistent with that of the State of Louisiana (at 0.3 percent) during this period. A possible reason for this trend is that the Texas economy, during the 1980s, was more diverse overall than the study area economy and that of the State of Louisiana, and therefore unemployment rates and economic losses were not as high, and out-migration of the population was not as prevalent.

Between 1990 and 2000 the study area population became positive again, with slow to moderate population growth (at 7.4 percent) occurring during this period. During the 1990s (especially during the late 1990s), the national economy had greatly improved, and within the study area less out-migration of population was occurring, as manufacturing and construction sectors were experiencing a partial recovery from the economic problems they had experienced during the 1980s. These sectors were retaining more of their employees, and the services sector was expanding, especially along the IH 10 corridor (Helen, 2002). During the 1990s the study area cities with the greatest population growth were Bridge City (6.0 percent increase) and Nederland (3.3 percent growth), while the greatest decreases in population were experienced in Orange (at negative 9.4 percent) and Port Arthur (at negative 0.9 percent). Among study area counties and parishes, the greatest population growth during the 1990s occurred in Hardin County (at 16.3 percent growth) and Calcasieu Parish (at 9.2 percent growth), while the slowest population growth occurred in Jefferson County (at 5.3 percent) and in Orange County (at 5.5 percent). The population changes within the study area during the 1990s contrasted sharply with that of the State of Texas (at 22.8 percent), while it was fairly consistent with that of the State of Louisiana (at 5.9 percent)

during this period. Much of this trend is attributable to the diversification of the study area economy relative to that of the states of Texas and Louisiana. The Texas economy was more diverse overall and was booming in the communications, high-tech, and services industries overall, and the population was expanding as a result. These trends were not occurring in the study area or the State of Louisiana to nearly the same degree.

Table 3.14-1
Study Area Population Trends, 1980–2000

| | Population | | | Percent Change | | |
|---|---|---|---|---|---|---|
| Place | 1980 | 1990 | 2000 | 1980–1990 | 1990–2000 | 1980–2000 |
| Beaumont | 118,102 | 114,323 | 113,866 | –3.2 | –0.4 | –3.6 |
| Bridge City | 7,667 | 8,164 | 8,651 | 6.5 | 6.0 | 12.8 |
| Lake Charles | 75,226 | 70,508 | 71,757 | –6.3 | 1.8 | –4.6 |
| Nederland | 16,855 | 16,858 | 17,422 | 0.0 | 3.3 | 3.4 |
| Orange | 23,628 | 20,571 | 18,643 | –12.9 | –9.4 | –21.1 |
| Port Arthur | 63,053 | 58,274 | 57,755 | –7.6 | –0.9 | –8.4 |
| Port Neches | 13,944 | 13,615 | 13,601 | –2.4 | –0.1 | –2.5 |
| Vidor | 12,043 | 11,385 | 11,660 | –5.5 | 2.4 | –3.2 |
| *Hardin County* | 40,721 | 41,320 | 48,073 | 1.5 | 16.3 | 18.1 |
| *Jefferson County* | 250,938 | 239,397 | 252,051 | –4.6 | 5.3 | 0.4 |
| *Orange County* | 83,838 | 80,509 | 84,966 | –4.0 | 5.5 | 1.3 |
| *Calcasieu Parish* | 167,223 | 168,134 | 183,577 | 0.5 | 9.2 | 9.8 |
| *Cameron Parish* | 9,336 | 9,260 | 9,991 | –0.8 | 7.9 | 7.0 |
| **Beaumont-Port Arthur MSA** | **375,497** | **361,218** | **385,090** | **–3.8** | **6.6** | **2.6** |
| **Lake Charles MSA** | **167,223** | **168,134** | **183,577** | **0.5** | **9.2** | **9.8** |
| **State of Louisiana** | **4,205,900** | **4,219,973** | **4,468,976** | **0.3** | **5.9** | **6.3** |
| **State of Texas** | **14,229,191** | **16,986,510** | **20,851,820** | **19.4** | **22.8** | **46.5** |
| **Project Study Area*** | **552,056** | **538,612** | **578,658** | **–2.4** | **7.4** | **4.8** |

Source: U.S. Census Bureau (1990, 2000a).

*The Project Study Area population is calculated from a combined total of the Beaumont-Port Arthur MSA, the Lake Charles MSA, and Cameron Parish.

Table 3.14-2 provides population projections from 2000 to 2050 for Hardin, Jefferson, and Orange counties, Texas, and Calcasieu and Cameron parishes, Louisiana, the State of Texas, and the State of Louisiana. Generally, population within the study area counties and parishes is expected to be slow to moderate through year 2050.[1] The greatest population growth rates within the study area during this period are anticipated in Hardin County (average decade growth rate of 8.1 percent). The slowest population growth rates during this period are anticipated in Cameron Parish (average decade growth rate of negative 16.3 percent) and in Orange County (average decade growth rate of 3.3 percent).

[1]Population projections for Calcasieu and Cameron parishes and the State of Louisiana for the years 2030 to 2050 were not available from the Louisiana State Data Center. Therefore, projections were made for these years based on average increases in population from the preceding 3 decades (for which projections were available). The average rate of growth that was used for these 3 decades for Calcasieu and Cameron parishes and the State of Louisiana were 5.7 percent, 1.3 percent, and 5.8 percent, respectively, for each decade from 2020 to 2050.

Table 3.14-2
Detailed Study Area Population Projections, 2000–2050

| Place | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | Percent Change | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2000–2010 | 2010–2020 | 2020–2030 | 2030–2040 | 2040–2050 |
| Hardin County | 48,073 | 54,504 | 59,115 | 61,211 | 63,381 | 65,627 | 13.4% | 8.5% | 3.5% | 3.5% | 3.5% |
| Jefferson County | 252,051 | 259,700 | 270,686 | 280,590 | 288,225 | 295,924 | 3.0% | 4.2% | 3.7% | 2.7% | 2.7% |
| Orange County | 84,966 | 90,503 | 94,274 | 95,818 | 96,473 | 97,843 | 6.5% | 4.2% | 1.6% | 0.7% | 1.4% |
| **State of Texas** | 20,851,790 | 24,915,388 | 29,117,537 | 33,052,506 | 36,893,267 | 41,071,409 | 19.5% | 16.9% | 13.5% | 11.6% | 11.3% |
| Calcasieu Parish | 183,577 | 85,400 | 183,740 | 197,420 | NA | NA | 1.0% | -0.9% | -2.4% | NA | NA |
| Cameron Parish | 9,991 | 7,230 | 6,660 | 5,760 | NA | NA | -27.6% | -7.9% | -13.5% | NA | NA |
| **State of Louisiana** | 4,424,550 | 4,683,030 | 4,991,410 | 5,360,774 | NA | NA | 5.8% | 6.6% | 7.4% | NA | NA |

Sources: TWDB (2007); Louisiana State Census Data Center (2007).

There are a few factors that are likely to contribute to the slow to moderate population growth that is projected for the project study area from 2000 to 2050 (see Table 3.14-2). The population projections are based on socioeconomic trends in the last 30 years or so, which are likely to continue in the future. Namely, the study area's economy has grown at a slow to moderate rate over the past 2 decades, since the "oil bust" of the 1980s. During the 1980s, the study area's population growth was negative, as the manufacturing sector lost about 17,000 jobs, and many residents left the area to find better opportunities elsewhere. During the 1990s, the economic situation improved somewhat, but not enough to fully recover from major job losses in the 1980s. Population growth during the 1990s was slow to moderate in all communities of the study area, largely as a response to these economic trends. Population growth has been slow even as many large cities in Texas had booming economies during the late 1990s. Job growth occurred in the services, wholesale and retail trade, government, and medical services industries within the study area during this period, but not enough to offset lagging job growth in the manufacturing industry. Housing units were added at a relatively steady rate, but the average household size got smaller during the decade, so that the new housing units were not an indicator of rapid population growth. Many manufacturing companies upgraded or expanded their facilities, but with these improvements came mechanization of jobs, and this led to little growth in new jobs. Therefore, the study area economy has seen very few economic indicators that the economy is going to grow at a rate that is any different than what has occurred in the recent past. Without such growth in new jobs, it is unlikely that the study area population is going to grow any faster than slow to moderate, as it has done in the recent past. Without any economic indicators showing otherwise, analysts with the TWDB, and locally based population analysts believe that population growth within the study area would continue to be slow to moderate from 2000 to 2050 (Helen, 2002). Table 3.14-3 provides population figures for 2000 for the detailed study area. The total detailed study area population was 82,401 in 2000.

#### 3.14.2.2 Demographics and Community Cohesion Factors

Being an intangible concept, the definition and, therefore, the measurement of community cohesion is not precise. There are certain factors, however, that can be measured and that can be interpreted to reflect community cohesion. The following community cohesion factors are presented within this section:

- Education and income
- Travel time to work
- Length of residence
- Degree of home ownership
- Age distribution

Table 3.14-3
Detailed Study Area Population, 2000

| Census Tracts | 2000 Population |
|---|---|
| **Hardin County, Texas** | |
| 306 | 3,116 |
| **Jefferson County, Texas** | |
| 1.03 | 3,084 |
| 7 | 3779 |
| 10 | 1,739 |
| 16 | 104 |
| 17 | 2,776 |
| 51 | 1,689 |
| 53 | 1,154 |
| 54 | 2,053 |
| 55 | 3,352 |
| 56 | 3,893 |
| 61 | 2,139 |
| 66 | 4,905 |
| 101 | 3,287 |
| 108 | 5,210 |
| 112.01 | 7,175 |
| 116 | 2,307 |
| **Orange County, Texas** | |
| 216 | 3,929 |
| 217 | 2,623 |
| 220 | 4,082 |
| 222 | 3,027 |
| 223 | 6,475 |
| 224 | 5,950 |
| **Cameron Parish, Louisiana** | |
| 9702 | 4,553 |
| **Total Detailed Study Area Population:** | 82,401 |

Source: U.S. Census Bureau (2000a).

**Education and Income**. Table 3.14-4 shows educational attainment levels for detailed study area census tracts (2000), and provides a comparison with state, county and parish figures. In terms of higher education (bachelor's degrees and graduate or professional degrees), the highest levels of educational attainment in the study area are found in Calcasieu Parish (at 16.9 percent) and the lowest levels of educational attainment are found in Cameron Parish (at 7.9 percent). In terms of high school education, the highest levels of educational attainment in the study area are found in Hardin County (at 79.3 percent), and the lowest level of educational attainment is found in Cameron Parish (at 68.1 percent). The average of the detailed study area census tracts' highest educational levels attained are as follows: high school graduate (80.6 percent), bachelor's degree (6.6 percent), and graduate or professional degree (2.3 percent). In terms of high school education, the detailed study area was consistent with study area

Table 3.14-4
Detailed Study Area Educational Attainment, 2000

| Study Area Census Tracts | Percent of Persons 25 Years and Older | | | | | |
|---|---|---|---|---|---|---|
| | High School Graduate | | Bachelor's Degree | | Graduate or Professional Degree | |
| **Hardin County** | | | | | | |
| 306 | 801 | 79.3% | 170 | 8.5% | 62 | 3.1% |
| **Jefferson County** | | | | | | |
| 1.03 | 547 | 73.8% | 51 | 3.5% | 38 | 2.6% |
| 7 | 689 | 64.4% | 82 | 3.9% | 18 | 0.9% |
| 10 | 336 | 51.6% | 26 | 2.3% | 16 | 0.4% |
| 16 | 22 | 88.2% | 21 | 27.6% | 10 | 3.2% |
| 17 | 719 | 66.0% | 49 | 2.6% | 3 | 1.6% |
| 51 | 390 | 71.9% | 70 | 5.9% | 25 | 2.1% |
| 53 | 223 | 57.8% | 35 | 4.9% | 0 | 0.0% |
| 54 | 485 | 62.4% | 21 | 1.7% | 24 | 2.0% |
| 55 | 587 | 62.7% | 128 | 6.7% | 54 | 2.8% |
| 56 | 575 | 56.7% | 96 | 4.8% | 19 | 0.9% |
| 61 | 568 | 57.8% | 34 | 2.3% | 0 | 0.0% |
| 66 | 934 | 65.3% | 102 | 4.1% | 22 | 0.9% |
| 101 | 597 | 67.7% | 105 | 6.0% | 39 | 2.2% |
| 108 | 1,236 | 84.6% | 413 | 12.5% | 102 | 3.1% |
| 112.01 | 1,566 | 84.3% | 528 | 11.4% | 292 | 6.3% |
| 116 | 627 | 76.7% | 160 | 10.6% | 32 | 2.1% |
| **Orange County** | | | | | | |
| 216 | 1,055 | 70.2% | 139 | 5.6% | 42 | 1.7% |
| 217 | 721 | 72.5% | 69 | 4.1% | 22 | 1.3% |
| 220 | 992 | 70.7% | 70 | 2.8% | 37 | 1.5% |
| 222 | 777 | 83.5% | 168 | 8.9% | 63 | 3.4% |
| 223 | 1,531 | 85.3% | 359 | 8.6% | 129 | 3.1% |
| 224 | 1,277 | 80.5% | 256 | 6.9% | 54 | 1.4% |
| **Cameron Parish** | | | | | | |
| 9702 | 1,138 | 62.4% | 140 | 4.8% | 65 | 2.2% |
| Detailed Study Area Total/Average | 18,393 | 80.6% | 3,292 | 6.6% | 1,168 | 2.3% |
| Hardin County, Texas | 12,380 | 79.5% | 2,972 | 9.7% | 1,027 | 3.3% |
| Jefferson County, Texas | 53,421 | 78.5% | 18,477 | 11.5% | 7,786 | 4.8% |
| Orange County, Texas | 21,012 | 79.0% | 4,450 | 8.2% | 1,506 | 2.8% |
| **Total Texas Study Area Counties** | 86,813 | 84.8% | 25,899 | 9.8% | 10,319 | 3.6% |
| Cameron Parish, Louisiana | 2,677 | 68.1% | 338 | 5.4% | 158 | 2.5% |
| Calcasieu Parish, Louisiana | 39,616 | 77.0% | 13,280 | 11.6% | 6,037 | 5.3% |
| **Total Louisiana Study Area Parishes** | 42,293 | 80.0% | 13,618 | 8.5% | 6,195 | 3.9% |
| **State of Louisiana** | 899,354 | 74.8% | 339,711 | 12.2% | 180,067 | 6.5% |
| **State of Texas** | 3,176,743 | 75.7% | 1,996,250 | 15.6% | 976,043 | 7.6% |

Source: U.S. Census Bureau (2000b).

county and parish attainment levels, and higher than the State of Louisiana and the State of Texas. In terms of higher education, the detailed study area was relatively low as compared with study area county and parish attainment levels, and very low when compared with the State of Texas and the State of Louisiana. Considering the Texas and Louisiana portions of the study area (the total/average for the counties/parishes for each respective state within the study area), the 2000 Census data show that the Louisiana portion of the study area (at 12.4 percent) has a slightly lower level of educational attainment in terms of higher education when compared with the Texas portion of the study area (at 13.4 percent). In terms of high school education, the levels of educational attainment for the Texas and Louisiana portions of the study area are 84.8 and 80.0 percent, respectively.

Table 3.14-5 provides the 1999 median family income for detailed study area census tracts and provides a comparison with county, parish, and state figures. The highest median family income within the study area is found in Hardin County (at $37,612), while the lowest median family income is found in Cameron Parish (at $34,232). All of the median family income figures for study area counties and parishes are higher than that of Louisiana (at $32,566), and lower than that of Texas (at $39,927). The detailed study area (average) median family income is $28,884, which is substantially lower than the State of Texas, and study area counties and parishes, and lower than the State of Louisiana. The detailed study area census tracts with the highest median family income were Orange County tract 223 (at $48,586) and tract 222 (at $46,474), while the lowest median family incomes were found in Jefferson County tracts 16 (at $11,833) and tract 53 (at $13,803). Within the Texas and Louisiana portions of the study area, the Texas portion had a higher median household income (at $36,635) than the Louisiana portion of the study area (at $34,802).

**Travel Time to Work**. Table 3.14-6 provides 2000 average travel time to work data for the detailed study area census tracts and provides a comparison with county, parish, and state figures. The longest average travel time to work is found in Hardin County (at 29.2 minutes), while the shortest average travel time to work is found in Jefferson County (at 19.9 minutes). The average travel time to work for the detailed study area is 21.5 minutes, which is relatively low when compared with the study area counties and parishes, and is lower than both Texas and Louisiana. The detailed study area census tracts with the shortest travel time to work were Jefferson County tracts 16 (at 12.1 minutes) and 53 (at 15.1 minutes). The longest travel times to work were found in Jefferson County tracts 10 (at 28.4 minutes) and 116 (at 27.4 minutes). Commute times within the Texas portion of the study area are only slightly longer (at 23.6 minutes) than in the Louisiana portion of the study area (at 22.7 minutes).

Generally speaking, the prevailing movement of commuters is from study area suburbs towards Beaumont and Port Arthur, and to industrial employment centers in Bridge City and Orange. Major employers draw the largest number of commuters, and these are concentrated primarily along the ship channels within the study area. One major commuter movement is from Hardin County, south along SH 96/69/287 towards Beaumont in the morning, and returning northward from Beaumont to Hardin County in the afternoon. Also, in the mornings many of these commuters continue to travel south along SH 96/69/287 towards the Port Arthur area and employment locations along the ship channel, and return

Table 3.14-5
Detailed Study Area Median Family Income, 1999

| Place/2000 Census Tract | Median Family Income $ (1999) |
|---|---|
| **Hardin County** | |
| 306 | 35,727 |
| **Jefferson County** | |
| 1.03 | 18,393 |
| 7 | 17,409 |
| 10 | 17,225 |
| 16 | 11,833 |
| 17 | 22,500 |
| 51 | 16,393 |
| 53 | 13,803 |
| 54 | 18,711 |
| 55 | 27,719 |
| 56 | 32,845 |
| 61 | 16,449 |
| 66 | 20,177 |
| 101 | 29,792 |
| 108 | 41,890 |
| 112.01 | 45,789 |
| 116 | 39,868 |
| **Orange County** | |
| 216 | 39,728 |
| 217 | 30,476 |
| 220 | 30,599 |
| 222 | 46,474 |
| 223 | 48,586 |
| 224 | 38,254 |
| **Cameron Parish** | |
| 9702 | 32,575 |
| Detailed Study Area Average | 28,884 |
| Hardin County, Texas | 37,612 |
| Jefferson County, Texas | 34,706 |
| Orange County, Texas | 37,586 |
| **Average of Texas Counties** | 36,635 |
| Cameron Parish, Louisiana | 34,232 |
| Calcasieu Parish, Louisiana | 35,372 |
| **Average of Louisiana Parishes** | 34,802 |
| **State of Louisiana** | 32,566 |
| **State of Texas** | 39,927 |

Source: U.S. Census Bureau (2000c).

Table 3.14-6
Detailed Study Area Travel Time to Work, 2000

| Place/Census Tracts | Aggregate Travel Time (minutes) | Total Workers (16+ years old) | Average Travel Time (minutes) |
|---|---|---|---|
| **Hardin County** | | | |
| 306 | 36,385 | 1,408 | 25.8 |
| **Jefferson County** | | | |
| 1.03 | 18,790 | 1,012 | 18.6 |
| 7 | 29,300 | 1,104 | 26.5 |
| 10 | 17,120 | 602 | 28.4 |
| 16 | 255 | 21 | 12.1 |
| 17 | 21,260 | 891 | 23.9 |
| 51 | 7,620 | 476 | 16.0 |
| 53 | 4,740 | 313 | 15.1 |
| 54 | 11,785 | 639 | 18.4 |
| 55 | 22,785 | 1,114 | 20.5 |
| 56 | 26,630 | 1,158 | 23.0 |
| 61 | 11,345 | 511 | 22.2 |
| 66 | 27,055 | 1,381 | 19.6 |
| 101 | 19,985 | 963 | 20.8 |
| 108 | 41,500 | 2,258 | 18.4 |
| 112.01 | 58,880 | 2,965 | 19.9 |
| 116 | 25,555 | 931 | 27.4 |
| **Orange County** | | | |
| 216 | 41,320 | 1,618 | 25.5 |
| 217 | 23,315 | 1,060 | 22.0 |
| 220 | 36,650 | 1,634 | 22.4 |
| 222 | 26,250 | 1,257 | 20.9 |
| 223 | 58,910 | 2,839 | 20.8 |
| 224 | 53,780 | 2,600 | 20.7 |
| **Cameron Parish** | | | |
| 9702 | 36,015 | 1,747 | 20.6 |
| Detailed Study Area Total/Average | 657,230 | 30,502 | 21.5 |
| Hardin County, Texas | 592,630 | 20,314 | 29.2 |
| Jefferson County, Texas | 1,943,425 | 97,437 | 19.9 |
| Orange County, Texas | 758,520 | 34,839 | 21.8 |
| **Average of Texas Counties** | 1,098,192 | 50,863 | 23.6 |
| Cameron Parish, Louisiana | 103,620 | 4,071 | 25.5 |
| Calcasieu Parish, Louisiana | 1,560,330 | 77,899 | 20.0 |
| **Average of Louisiana Parishes** | 831,975 | 40,985 | 22.7 |
| **State of Louisiana** | 45,993,645 | 1,831,057 | 25.1 |
| **State of Texas** | 226,011,890 | 9,157,875 | 24.7 |

Source: U.S. Census Bureau (2000d).

northward in the afternoons. Another major commuter route is from suburban areas north of Orange, along SH 87/62 towards Orange and industrial employment centers in Orange County, and returning northward in the afternoons. Another important employment corridor is along SH 73/87 from the Port Arthur area towards industrial employment centers in Orange County in the mornings and back towards Port Arthur in the afternoons (Helen, 2002).

**Length of Residency and Housing**. Table 3.14-7 provides length of residence data for the study area population and compares them with county, parish, and state data. The "length of residency" category shows the year that residents moved into their household unit (as reported in the 2000 census). The 2000 census data show that a majority of residents living within the detailed study area census tracts moved into their homes between 1995 and 1998 (at 23.3 percent of housing units) and between 1999 and March of 2000 (at 17.9 percent of housing units). This trend was also true for residents of Jefferson County, Orange County, Calcasieu Parish, the State of Texas, and the State of Louisiana, although to slightly varying degrees. Also, significant percentages of detailed study area residents reported moving into their homes between 1980 and 1989 (at 16.7 percent of housing units). This trend was also true for residents of Orange County and Cameron Parish, with percentages that were slightly greater than in the detailed study area. It is noteworthy that Cameron Parish had substantial numbers of residents who moved into their homes from 1969 and earlier (at 18.1 percent of housing units). Finally, there is some variation among detailed study area census tracts in terms of household residency. Specifically, the following detailed study area census tracts had greater than 50 percent of residents moving into their homes before 1990: Jefferson County tracts 7, 51, 53, 54, 55, and 61. In the Texas portion of the study area, a majority of residents moved into their housing units between 1995 and 1998 (at 25.4 percent of housing units) and between 1999 and March of 2000 (at 18.9 percent). In the Louisiana portion of the study area, also, a majority of residents moved into their housing units between 1995 and 1998 (at 27.4 percent) and between 1999 and March of 2000 (at 20.4 percent).

Table 3.14-8 provides a tally of owner-occupied versus renter-occupied housing units for the detailed study area census tracts compared with study area counties, parishes and states, as reported by the 2000 census. The greatest percentage of owner-occupied housing units is found in Cameron Parish (at 85.1 percent), and the lowest percentage of owner-occupied housing units is found in Jefferson County (at 66.0 percent). Conversely, the highest percentage of renter-occupied housing units is found in Jefferson County (at 34.0 percent), and the lowest percentage of renter-occupied housing units is found in Cameron Parish (at 14.9 percent). The detailed study area was 72.3 percent owner-occupied housing units, and 27.7 percent renter-occupied housing units, which is a relatively low level of owner-occupied housing units compared with study area counties and parishes, and also lower than both Texas and Louisiana. The highest percentage of owner-occupied housing units within the detailed study area census tracts, is found in Orange County tracts 222 (at 89.0 percent) and 216 (at 87.8 percent), and the lowest percentage of owner-occupied housing units is found in Jefferson County tracts 16 (at 1.6 percent) and 1.03 (at 42.0 percent). The Louisiana portion of the study area has a slightly higher percentage of owner-occupied housing units (at 72.2 percent) than the Texas portion of the study area (at 70.6 percent).

Table 3.14-7
Detailed Study Area Length of Household Residency, 2000

| | Number Occupied Housing Units | Year Householder Moved Into Residence | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1999 to March 2000 | % | 1995 to 1998 | % | 1990 to 1994 | % | 1980 to 1989 | % | 1970 to 1979 | % | 1969 or Earlier | % |
| Hardin County | | | | | | | | | | | | | |
| 306 | 1,009 | 187 | 18.5% | 279 | 27.7% | 213 | 21.1% | 260 | 25.8% | 127 | 12.6% | 80 | 7.9% |
| Jefferson County | | | | | | | | | | | | | |
| 1.03 | 1,058 | 266 | 25.1% | 210 | 19.8% | 191 | 18.1% | 50 | 4.7% | 179 | 16.9% | 162 | 15.3% |
| 7 | 1,445 | 302 | 20.9% | 221 | 15.3% | 192 | 13.3% | 160 | 11.1% | 248 | 17.2% | 322 | 22.3% |
| 10 | 619 | 145 | 23.4% | 139 | 22.5% | 63 | 10.2% | 110 | 17.8% | 43 | 6.9% | 119 | 19.2% |
| 16 | 69 | 12 | 17.4% | 9 | 13.0% | 36 | 52.2% | 0 | 0.0% | 0 | 0.0% | 12 | 17.4% |
| 17 | 997 | 173 | 17.4% | 212 | 21.3% | 123 | 12.3% | 138 | 13.8% | 132 | 13.2% | 219 | 22.0% |
| 51 | 763 | 102 | 13.4% | 120 | 15.7% | 142 | 18.6% | 74 | 9.7% | 79 | 10.4% | 246 | 32.2% |
| 53 | 437 | 68 | 15.6% | 33 | 7.6% | 14 | 3.2% | 100 | 22.9% | 88 | 20.1% | 134 | 30.7% |
| 54 | 717 | 117 | 16.3% | 91 | 12.7% | 119 | 16.6% | 137 | 19.1% | 134 | 18.7% | 119 | 16.6% |
| 55 | 1,070 | 130 | 12.1% | 257 | 24.0% | 144 | 13.5% | 266 | 24.9% | 195 | 18.2% | 78 | 7.3% |
| 56 | 1,172 | 179 | 15.3% | 310 | 26.5% | 168 | 14.3% | 290 | 24.7% | 118 | 10.1% | 107 | 9.1% |
| 61 | 990 | 105 | 10.6% | 110 | 11.1% | 96 | 9.7% | 166 | 16.8% | 73 | 7.4% | 350 | 35.4% |
| 66 | 1,752 | 418 | 23.9% | 440 | 25.1% | 245 | 14.0% | 189 | 10.8% | 154 | 8.8% | 306 | 17.5% |
| 101 | 1,021 | 158 | 15.5% | 310 | 30.4% | 182 | 17.8% | 143 | 14.0% | 82 | 8.0% | 146 | 14.3% |
| 108 | 2,010 | 356 | 17.7% | 393 | 19.6% | 372 | 18.5% | 292 | 14.5% | 221 | 11.0% | 376 | 18.7% |
| 112.01 | 2,401 | 385 | 16.0% | 611 | 25.4% | 452 | 18.8% | 437 | 18.2% | 142 | 5.9% | 374 | 15.6% |
| 116 | 848 | 137 | 16.2% | 181 | 21.3% | 136 | 16.0% | 155 | 18.3% | 47 | 5.5% | 192 | 22.6% |
| Orange County | | | | | | | | | | | | | |
| 216 | 1,413 | 260 | 18.4% | 370 | 26.2% | 234 | 16.6% | 216 | 15.3% | 190 | 13.4% | 143 | 10.1% |
| 217 | 988 | 194 | 19.6% | 319 | 32.3% | 97 | 9.8% | 137 | 13.9% | 122 | 12.3% | 119 | 12.0% |
| 220 | 1,539 | 256 | 16.6% | 469 | 30.5% | 228 | 14.8% | 231 | 15.0% | 183 | 11.9% | 172 | 11.2% |
| 222 | 1,021 | 146 | 14.3% | 281 | 27.5% | 131 | 12.8% | 246 | 24.1% | 155 | 15.2% | 62 | 6.1% |
| 223 | 2,331 | 476 | 20.4% | 458 | 19.6% | 326 | 14.0% | 468 | 20.1% | 338 | 14.5% | 265 | 11.4% |
| 224 | 2,238 | 463 | 20.7% | 617 | 27.6% | 324 | 14.5% | 394 | 17.6% | 208 | 9.3% | 232 | 10.4% |
| Cameron County | | | | | | | | | | | | | |
| 9702 | 1,654 | 258 | 15.6% | 462 | 27.9% | 236 | 14.3% | 292 | 17.7% | 204 | 12.3% | 202 | 12.2% |
| Detailed Study Area Total | 29,562 | 5,293 | 17.9% | 6,902 | 23.3% | 4,464 | 15.1% | 4,951 | 16.7% | 3,462 | 11.7% | 4,537 | 15.3% |
| Hardin County, Texas | 17,805 | 2,927 | 16.4% | 4,974 | 27.9% | 3,426 | 19.2% | 2,850 | 16.0% | 2,196 | 12.3% | 1,432 | 8.0% |
| Jefferson County, Texas | 92,880 | 18,360 | 19.8% | 23,162 | 24.9% | 14,190 | 15.3% | 13,995 | 15.1% | 10,000 | 10.8% | 13,173 | 14.2% |
| Orange County, Texas | 31,642 | 5,639 | 17.8% | 8,067 | 25.5% | 4,793 | 15.1% | 5,421 | 17.1% | 4,161 | 13.2% | 3,561 | 11.3% |
| **Total Texas Study Area Counties** | 142,327 | 26,926 | 18.9% | 36,203 | 25.4% | 22,409 | 15.7% | 22,266 | 15.6% | 16,357 | 11.5% | 18,166 | 12.8% |
| Cameron Parish, Louisiana | 3,592 | 540 | 15.0% | 837 | 23.3% | 526 | 14.6% | 634 | 17.7% | 406 | 11.3% | 649 | 18.1% |
| Calcasieu Parish, Louisiana | 68,613 | 14,157 | 20.6% | 18,950 | 27.6% | 9,694 | 14.1% | 9,538 | 13.9% | 7,769 | 11.3% | 8,505 | 12.4% |
| **Total Louisiana Study Area Parishes** | 72,205 | 14,697 | 20.4% | 19,787 | 27.4% | 10,220 | 14.2% | 10,172 | 14.1% | 8,175 | 11.3% | 9,154 | 12.7% |
| **State of Texas** | 7,393,354 | 1,842,731 | 24.9% | 2,233,669 | 30.2% | 1,126,526 | 15.2% | 1,030,476 | 13.9% | 630,749 | 8.5% | 529,203 | 7.2% |
| **State of Louisiana** | 1,656,053 | 309,663 | 18.7% | 446,127 | 26.9% | 258,185 | 15.6% | 253,627 | 15.3% | 194,288 | 11.7% | 194,163 | 11.7% |

Source: U.S. Census Bureau (2000e).

Table 3.14-8
Detailed Study Area Household Tenure, 2000

| Place/Detailed Study Area Census Tracts | Number of Occupied Household Units | Owner Occupied Units | Percent Owner Occupied Units | Renter Occupied Units | Percent Renter Occupied Units |
|---|---|---|---|---|---|
| **Hardin County** | | | | | |
| 306 | 1,146 | 997 | 87.0 | 149 | 13.0 |
| **Jefferson County** | | | | | |
| 1.03 | 1,087 | 457 | 42.0 | 630 | 58.0 |
| 7 | 1,445 | 778 | 53.8 | 667 | 46.2 |
| 10 | 610 | 263 | 43.1 | 347 | 56.9 |
| 16 | 64 | 1 | 1.6 | 63 | 98.4 |
| 17 | 1,019 | 653 | 64.1 | 366 | 35.9 |
| 51 | 753 | 530 | 70.4 | 223 | 29.6 |
| 53 | 445 | 294 | 66.1 | 151 | 33.9 |
| 54 | 709 | 465 | 65.6 | 244 | 34.4 |
| 55 | 1,070 | 756 | 70.7 | 314 | 29.3 |
| 56 | 1,172 | 871 | 74.3 | 301 | 25.7 |
| 61 | 886 | 585 | 66.0 | 301 | 34.0 |
| 66 | 1,762 | 820 | 46.5 | 942 | 53.5 |
| 101 | 1,021 | 752 | 73.7 | 269 | 26.3 |
| 108 | 2,010 | 1,425 | 70.9 | 585 | 29.1 |
| 112.01 | 2,401 | 2,000 | 83.3 | 401 | 16.7 |
| 116 | 848 | 721 | 85.0 | 127 | 15.0 |
| **Orange County** | | | | | |
| 216 | 1,413 | 1,241 | 87.8 | 172 | 12.2 |
| 217 | 988 | 761 | 77.0 | 227 | 23.0 |
| 220 | 1,539 | 1,109 | 72.1 | 430 | 27.9 |
| 222 | 1,021 | 909 | 89.0 | 112 | 11.0 |
| 223 | 2,331 | 1,931 | 82.8 | 400 | 17.2 |
| 224 | 2,238 | 1,707 | 76.3 | 531 | 23.7 |
| **Cameron Parish** | | | | | |
| 9702 | 1,654 | 1,392 | 84.2 | 262 | 15.8 |
| Detailed Study Area Total | 29,632 | 21,418 | 72.3 | 8,214 | 27.7 |
| Hardin County, Texas | 17,805 | 14,717 | 82.7 | 3,088 | 17.3 |
| Jefferson County, Texas | 92,880 | 61,274 | 66.0 | 31,606 | 34.0 |
| Orange County, Texas | 31,642 | 24,424 | 77.2 | 7,218 | 22.8 |
| **Total Texas Study Area Counties** | 142,327 | 100,415 | 70.6 | 41,912 | 29.4 |
| Cameron Parish, Louisiana | 3,592 | 3,056 | 85.1 | 536 | 14.9 |
| Calcasieu Parish, Louisiana | 68,613 | 49,106 | 71.6 | 19,507 | 28.4 |
| **Total Louisiana Study Area Parishes** | 72,205 | 52,162 | 72.2 | 20,043 | 27.8 |
| **State of Louisiana** | 1,656,053 | 1,125,135 | 67.9 | 530,918 | 32.1 |
| **State of Texas** | 7,393,354 | 4,716,959 | 63.8 | 2,676,395 | 36.2 |

Source: U.S. Census Bureau (2000e).

**Age Distribution**. Table 3.14-9 shows the age characteristics of the detailed study area census tracts and provides a comparison with county-, parish-, and state-level data. Within the detailed study area census tracts, the median age in 2000 was 35.3, which is consistent with county and parish figures but higher than the State of Louisiana (at 34.0) and the State of Texas (at 32.3). In general, a majority of the detailed study area population is within the 25 to 34 (at 12.4 percent), the 35 to 44 (at 16.2 percent), and the 45 to 54 (at 14.1 percent) age cohorts. In the states of Texas and Louisiana, these same age cohorts represent a majority of the population, but to a lesser extent than in the detailed study area population. In Texas, the 25 to 34 cohort represents 15.2 percent, the 35 to 44 cohort represents 15.9 percent, and the 45 to 54 cohort represents 12.5 percent. In Louisiana, the 25 to 34 cohort represents 13.5 percent, the 35 to 44 cohort represents 15.5 percent, and the 45 to 54 cohort represents 13.1 percent. The Texas portion of the detailed study area has a slightly higher median age (at 35.9) than the Louisiana portion of the study area (at 34.8). In the Texas portion of the study area, a majority of the population is within the 35 to 44 age cohort (at 15.8 percent) and within the 45 to 54 age cohort (at 13.2 percent). In the Louisiana portion of the study area, a majority of the population is within the 35 to 44 age cohort (at 15.8 percent) and within the 45 to 54 age cohort (at 13.2 percent).

One reason that the study area population (including study area counties and parishes and the detailed study area census tracts) has a higher median age, and a larger "baby boomer" population than the states of Louisiana and Texas, is that opportunities for higher education are not as readily available within the study area, as compared with cities offering higher education in Louisiana and Texas. As a result, many young adults move away from the study area, for higher education opportunities elsewhere in Texas, Louisiana, or other states. Also, the spike in the "baby boomer"–aged population may be a result of families of "baby boomer" age returning to the study area (returning to where they grew up) after living elsewhere to pursue higher education and/or careers (Helen, 2002).

#### 3.14.2.3 Demographics and Community Cohesion Factors Summary

Analysis of demographic and community cohesion factors within the study area and within the detailed study area suggests a moderate degree of community diversity. Study area counties and parishes exhibit low to moderate differences in levels of educational attainment. In terms of high school education, the detailed study area was consistent with study area counties and parishes. In terms of higher education, the detailed study area had achieved a relatively low level of educational attainment when compared with study area counties and parishes. There are some wide differences in levels of educational attainment among individual detailed study area census tracts. Study area median family income in 1999 by study area counties and parishes shows a fair amount of overall homogeneity. However, the detailed study area population had a substantially lower median family income than any of the study area counties and parishes. Also, median family incomes within the individual detailed study area census vary significantly, showing a high degree of community diversity. In terms of the median travel time to work, study area counties and parishes vary somewhat, varying from about 20 to 29 minutes. The detailed study area population has a relatively low average commute time when compared with the study area counties and parishes, and individual detailed study area census tracts show a relatively small degree of variation in commute times. In terms of length of household residency, the study area counties and parishes had a

Table 3.14-9
Detailed Study Area Age Characteristics, 2000

| Place/Detailed Study Area | Years of Age | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | under 5 | | 5 to 9 | | 10 to 14 | | 15 to 19 | | 20 to 24 | | 25 to 34 | | 35 to 44 | | 45 to 54 | | 55 to 59 | | 60 to 64 | | 65 to 74 | | 75 to 84 | | 85 and over | | Total | Median |
| Census Tracts | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % | Persons | Age |
| Hardin County | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 306 | 218 | 7.0% | 235 | 7.5% | 260 | 8.3% | 270 | 8.7% | 179 | 5.7% | 400 | 12.8% | 554 | 17.8% | 397 | 12.7% | 158 | 5.1% | 129 | 4.1% | 182 | 5.8% | 103 | 3.3% | 31 | 1.0% | 3,116 | 31.0 |
| Jefferson County | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.03 | 440 | 14.3% | 350 | 11.3% | 265 | 8.6% | 214 | 6.9% | 309 | 10.0% | 420 | 13.6% | 333 | 10.8% | 286 | 9.3% | 113 | 3.7% | 113 | 3.7% | 151 | 4.9% | 68 | 2.2% | 22 | 0.7% | 3,084 | 24.4 |
| 7 | 314 | 8.3% | 354 | 9.4% | 317 | 8.4% | 355 | 9.4% | 246 | 6.5% | 373 | 9.9% | 475 | 12.6% | 483 | 12.8% | 171 | 4.5% | 170 | 4.5% | 264 | 7.0% | 205 | 5.4% | 52 | 1.4% | 3,779 | 33.1 |
| 10 | 120 | 6.9% | 114 | 6.6% | 143 | 8.2% | 127 | 7.3% | 123 | 7.1% | 200 | 11.5% | 232 | 13.3% | 187 | 10.8% | 83 | 4.8% | 72 | 4.1% | 139 | 8.0% | 100 | 5.8% | 99 | 5.7% | 1,739 | 37.2 |
| 16 | 2 | 1.9% | 0 | 0.0% | 9 | 8.7% | 21 | 20.2% | 2 | 1.9% | 3 | 2.9% | 7 | 6.7% | 7 | 6.7% | 2 | 1.9% | 1 | 1.0% | 17 | 16.3% | 16 | 15.4% | 17 | 16.3% | 104 | 58.0 |
| 17 | 161 | 5.8% | 192 | 6.9% | 211 | 7.6% | 219 | 7.9% | 143 | 5.2% | 287 | 10.3% | 402 | 14.5% | 326 | 11.7% | 133 | 4.8% | 122 | 4.4% | 230 | 8.3% | 209 | 7.5% | 141 | 5.1% | 2,776 | 39.7 |
| 51 | 68 | 4.0% | 117 | 6.9% | 131 | 7.8% | 129 | 7.6% | 68 | 4.0% | 170 | 10.1% | 219 | 13.0% | 219 | 13.0% | 98 | 5.8% | 76 | 4.5% | 166 | 9.8% | 169 | 10.0% | 59 | 3.5% | 1,689 | 42.3 |
| 53 | 66 | 5.7% | 71 | 6.2% | 100 | 8.7% | 104 | 9.0% | 66 | 5.7% | 114 | 9.9% | 159 | 13.8% | 154 | 13.3% | 69 | 6.0% | 70 | 6.1% | 107 | 9.3% | 62 | 5.4% | 12 | 1.0% | 1,154 | 38.8 |
| 54 | 130 | 6.3% | 149 | 7.3% | 182 | 8.9% | 222 | 10.8% | 128 | 6.2% | 229 | 11.2% | 297 | 14.5% | 273 | 13.3% | 96 | 4.7% | 93 | 4.5% | 177 | 8.6% | 57 | 2.8% | 20 | 1.0% | 2,053 | 34.5 |
| 55 | 244 | 7.3% | 325 | 9.7% | 316 | 9.4% | 314 | 9.4% | 234 | 7.0% | 412 | 12.3% | 465 | 13.9% | 425 | 12.7% | 133 | 4.0% | 86 | 2.6% | 197 | 5.9% | 127 | 3.8% | 74 | 2.2% | 3,352 | 30.6 |
| 56 | 366 | 9.4% | 417 | 10.7% | 371 | 9.5% | 374 | 9.6% | 273 | 7.0% | 565 | 14.5% | 530 | 13.6% | 426 | 10.9% | 128 | 3.3% | 89 | 2.3% | 160 | 4.1% | 143 | 3.7% | 51 | 1.3% | 3,893 | 27.8 |
| 61 | 98 | 4.6% | 156 | 7.3% | 167 | 7.8% | 166 | 7.8% | 100 | 4.7% | 214 | 10.0% | 326 | 15.2% | 251 | 11.7% | 84 | 3.9% | 108 | 5.0% | 260 | 12.2% | 176 | 8.2% | 33 | 1.5% | 2,139 | 40.3 |
| 66 | 625 | 12.7% | 533 | 10.9% | 464 | 9.5% | 424 | 8.6% | 378 | 7.7% | 583 | 11.9% | 615 | 12.5% | 469 | 9.6% | 146 | 3.0% | 125 | 2.5% | 314 | 6.4% | 180 | 3.7% | 49 | 1.0% | 4,905 | 25.4 |
| 101 | 344 | 10.5% | 365 | 11.1% | 292 | 8.9% | 286 | 8.7% | 217 | 6.6% | 454 | 13.8% | 491 | 14.9% | 331 | 10.1% | 110 | 3.3% | 88 | 2.7% | 118 | 3.6% | 146 | 4.4% | 45 | 1.4% | 3,287 | 27.8 |
| 108 | 366 | 7.0% | 403 | 7.7% | 390 | 7.5% | 388 | 7.4% | 339 | 6.5% | 705 | 13.5% | 861 | 16.5% | 658 | 12.6% | 205 | 3.9% | 199 | 3.8% | 378 | 7.3% | 260 | 5.0% | 58 | 1.1% | 5,210 | 35.2 |
| 112.01 | 393 | 5.5% | 425 | 5.9% | 496 | 6.9% | 643 | 9.0% | 543 | 7.6% | 953 | 13.3% | 1,326 | 18.5% | 933 | 13.0% | 342 | 4.8% | 300 | 4.2% | 502 | 7.0% | 254 | 3.5% | 65 | 0.9% | 7,175 | 36.1 |
| 116 | 138 | 6.0% | 146 | 6.3% | 194 | 8.4% | 218 | 9.4% | 117 | 5.1% | 275 | 11.9% | 387 | 16.8% | 315 | 13.7% | 124 | 5.4% | 114 | 4.9% | 188 | 8.1% | 84 | 3.6% | 7 | 0.3% | 2,307 | 37.3 |
| Orange County | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 216 | 281 | 7.2% | 274 | 7.0% | 344 | 8.8% | 324 | 8.2% | 221 | 5.6% | 541 | 13.8% | 635 | 16.2% | 529 | 13.5% | 215 | 5.5% | 195 | 5.0% | 221 | 5.6% | 123 | 3.1% | 26 | 0.7% | 3,929 | 34.7 |
| 217 | 189 | 7.2% | 204 | 7.8% | 190 | 7.2% | 203 | 7.7% | 161 | 6.1% | 341 | 13.0% | 395 | 15.1% | 364 | 13.9% | 99 | 3.8% | 118 | 4.5% | 211 | 8.0% | 108 | 4.1% | 40 | 1.5% | 2,623 | 35.6 |
| 220 | 320 | 7.8% | 313 | 7.7% | 332 | 8.1% | 308 | 7.5% | 321 | 7.9% | 566 | 13.9% | 592 | 14.5% | 506 | 12.4% | 180 | 4.4% | 165 | 4.0% | 295 | 7.2% | 150 | 3.7% | 34 | 0.8% | 4,082 | 32.8 |
| 222 | 176 | 5.8% | 235 | 7.8% | 317 | 10.5% | 289 | 9.5% | 168 | 5.6% | 295 | 9.7% | 585 | 19.3% | 465 | 15.4% | 116 | 3.8% | 109 | 3.6% | 187 | 6.2% | 68 | 2.2% | 17 | 0.6% | 3,027 | 35.7 |
| 223 | 371 | 5.7% | 457 | 7.1% | 537 | 8.3% | 557 | 8.6% | 382 | 5.9% | 713 | 11.0% | 1,074 | 16.6% | 961 | 14.8% | 353 | 5.5% | 280 | 4.3% | 519 | 8.0% | 231 | 3.6% | 40 | 0.6% | 6,475 | 37.1 |
| 224 | 419 | 7.0% | 462 | 7.8% | 455 | 7.6% | 499 | 8.4% | 363 | 6.1% | 772 | 13.0% | 934 | 15.7% | 844 | 14.2% | 297 | 5.0% | 208 | 3.5% | 424 | 7.1% | 218 | 3.7% | 55 | 0.9% | 5,950 | 35.1 |
| Cameron Parish | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9702 | 322 | 7.1% | 323 | 7.1% | 370 | 8.1% | 360 | 7.9% | 320 | 7.0% | 544 | 11.9% | 755 | 16.6% | 624 | 13.7% | 248 | 5.4% | 214 | 4.7% | 303 | 6.7% | 131 | 2.9% | 39 | 0.9% | 4,553 | 35.5 |
| Detailed Study Area Total/Average | 6,171 | 7.5% | 6,620 | 8.0% | 6,853 | 8.3% | 7,014 | 8.5% | 5,401 | 6.6% | 10,129 | 12.3% | 12,649 | 15.4% | 10,433 | 12.7% | 3,703 | 4.5% | 3,244 | 3.9% | 5,710 | 6.9% | 3,388 | 4.1% | 1,086 | 1.3% | 82,401 | 35.3 |
| Hardin County | 3,337 | 6.9% | 3,615 | 7.5% | 3,865 | 8.0% | 3,949 | 8.2% | 2,698 | 5.6% | 5,930 | 12.3% | 7,656 | 15.9% | 6,606 | 13.7% | 2,566 | 5.3% | 1,987 | 4.1% | 3,356 | 7.0% | 1,910 | 4.0% | 598 | 1.2% | 48,073 | 36.0 |
| Jefferson County | 16,925 | 6.7% | 18,187 | 7.2% | 18,476 | 7.3% | 19,336 | 7.7% | 17,666 | 7.0% | 34,164 | 13.6% | 39,779 | 15.8% | 32,624 | 12.9% | 11,053 | 4.4% | 9,572 | 3.8% | 17,933 | 7.1% | 12,253 | 4.9% | 4,083 | 1.6% | 252,051 | 35.5 |
| Orange County | 5,712 | 6.7% | 6,461 | 7.6% | 6,683 | 7.9% | 6,767 | 8.0% | 4,983 | 5.9% | 10,515 | 12.4% | 13,351 | 15.7% | 11,610 | 13.7% | 4,350 | 5.1% | 3,758 | 4.4% | 6,243 | 7.3% | 3,529 | 4.2% | 1,004 | 1.2% | 84,966 | 36.1 |
| **Total Texas Study Area Counties** | 25,974 | 6.7% | 28,263 | 7.3% | 29,024 | 7.5% | 30,052 | 7.8% | 25,347 | 6.6% | 50,609 | 13.1% | 60,786 | 15.8% | 50,840 | 13.2% | 17,969 | 4.7% | 15,317 | 4.0% | 27,532 | 7.1% | 17,692 | 4.6% | 5,685 | 1.5% | 385,090 | 35.9 |
| Cameron Parish | 667 | 6.7% | 757 | 7.6% | 871 | 8.7% | 821 | 8.2% | 663 | 6.6% | 1,218 | 12.2% | 1,744 | 17.5% | 1,257 | 12.6% | 490 | 4.9% | 445 | 4.5% | 660 | 6.6% | 293 | 2.9% | 105 | 1.1% | 9,991 | 35.0 |
| Calcasieu Parish | 13,253 | 7.2% | 13,792 | 7.5% | 14,036 | 7.6% | 15,147 | 8.3% | 12,925 | 7.0% | 23,793 | 13.0% | 28,912 | 15.7% | 24,220 | 13.2% | 8,492 | 4.6% | 7,248 | 3.9% | 12,399 | 6.8% | 7,152 | 3.9% | 2,208 | 1.2% | 183,577 | 34.5 |
| **Total Louisiana Study Area Parishes** | 13,920 | 7.2% | 14,549 | 7.5% | 14,907 | 7.7% | 15,968 | 8.2% | 13,588 | 7.0% | 25,011 | 12.9% | 30,656 | 15.8% | 25,477 | 13.2% | 8,982 | 4.6% | 7,693 | 4.0% | 13,059 | 6.7% | 7,445 | 3.8% | 2,313 | 1.2% | 193,568 | 34.8 |
| **State of Louisiana** | 317,392 | 7.1% | 336,780 | 7.5% | 347,912 | 7.8% | 365,945 | 8.2% | 325,571 | 7.3% | 601,162 | 13.5% | 691,966 | 15.5% | 586,271 | 13.1% | 208,761 | 4.7% | 170,287 | 3.8% | 282,925 | 6.3% | 175,328 | 3.9% | 58,676 | 1.3% | 4,468,976 | 34.0 |
| **State of Texas** | 1,624,628 | 7.8% | 1,654,184 | 1.8% | 1,631,192 | 7.8% | 1,636,232 | 7.8% | 1,539,404 | 7.4% | 3,162,083 | 15.2% | 3,322,238 | 15.9% | 2,611,137 | 12.5% | 896,521 | 4.3% | 701,669 | 3.4% | 1,142,608 | 5.5% | 691,984 | 3.3% | 237,940 | 1.1% | 20,851,820 | 32.3 |

Source: U.S. Census Bureau (2000f).

majority of residents moving into their housing units relatively recently (since 1995). The only exception was Cameron Parish, where a large proportion of residents had moved into their housing units prior to 1970, although this has changed due to the devastating effects of Hurricane Rita on the parish. The detailed study area also had a majority of the households moving into their housing units since 1995, but there is a high degree of variability within individual census tracts related to the year that households moved into their housing units. The study area counties and parishes have a low degree of variation related to the percentage of housing units that are owner-occupied, with all counties and parishes having between 70 and 83 percent owner-occupied housing units. The detailed study area census tracts had a proportion of owner-occupied housing units that was lower than that of the study area counties and parishes. There was a high degree of variability in individual detailed study area census tracts in terms of the percentage of owner-occupied housing units, varying from 1.6 to 89 percent. In terms of median age, there was very little variation among study area counties and parishes, with the median age varying from 34.5 to 36.1. The average detailed study area median age was consistent with the study area counties and parishes. However, there was a moderate to high degree of variability among individual detailed study area census tracts in terms of median age, varying from 24.4 to 58.0. In general, the population living within the study area and the detailed study area demonstrated a moderate level of community diversity judging from the community cohesion factors evaluated in this section.

#### 3.14.2.4 Environmental Justice

In compliance with Executive Order (EO) 12898 – Federal Action to Address EJ in minority populations and low-income populations, an analysis has been performed to determine whether the proposed project would have a disproportionately adverse impact on minority or low-income population groups within the detailed study area. The EO requires that minority and low-income populations do not receive disproportionately high and adverse human health or environmental impacts and requires that representatives of minority or low-income populations, who could be affected by the project, be involved in the community participation and public involvement process.

##### *3.14.2.4.1 EJ Index Methodology*

Three levels of analysis are provided to help determine whether there is potential for disproportionately high and adverse effects accruing to the population living within the detailed study area. These analyses were patterned after the EPA Region 6 model called the EJ Index, which depicts a survey of ethnicity and income within the study area (EPA, 2003). The raw data used to recreate the analysis are based on 2000 U.S. Census Bureau census tract–level data for ethnicity and tract-level data for income data (U.S. Census Bureau, 2000a, 2000b).

The EPA EJ Index model is a modification of the Region's Human Health Risk Index Formula. The model uses GIS and census data to delineate the demographics within census tracts. The EJ Index model calculates the degree of vulnerability for the area based on population density and two socioeconomic criteria: a community's percentage minority population and percentage of economically stressed households. This information is then compared with the calculated State index and a ranking criterion is

established. There are three ranking variables that comprise the EJ Index: population density, minority status, and economic status.

A score is assigned to each detailed study area tract that represents the population density. The criterion used to determine the population density score (from 0 to 4) is based on the number of persons per square mile. If a tract has no persons living within it, it is given a ranking score of 0, a population of 1 to 200 is ranked as 1, a population of greater than 200 but less than 1,000 is ranked as 2, a population of greater than 1,000 but less than 5,000 is ranked as 3, and a population of greater than 5,000 is ranked as 4.

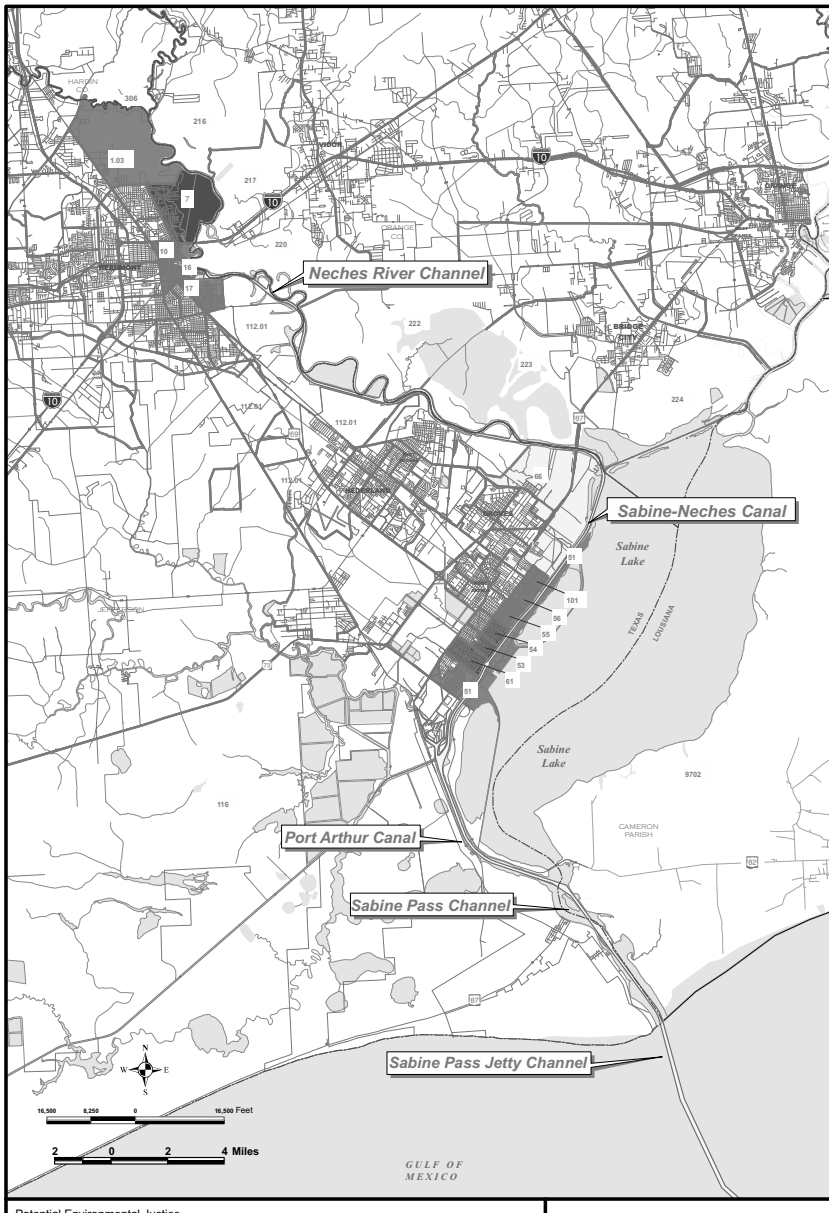
A score is also assigned to each detailed study area tract that represents the percentage of minority population and the percentage of economically stressed persons. To establish the rankings for both the minority population and the percentage of economically stressed persons, each tract is assigned a score that represents how that tract compares to the state's percentage (SP). Therefore, a score of 1 indicates that the tract's average is less than or equal to the SP, a score of 2 indicates that the tract is greater than the SP, but less than or equal to 1.33 times the SP, a score of 3 indicates that the tract is greater than 1.33 times the SP, but less than or equal to 1.66 times the SP, a score of 4 indicates that the tract is greater than 1.66 times the SP, but less than or equal to 1.99 times the SP, and a score of 5 indicates that the tract is equal to or greater than twice the SP. The EJ Index score is established by multiplying the population density score with the minority status score and the economically stressed score.

#### *3.14.2.4.2 Minority Status Degree of Vulnerability*

The Minority Status Degree of Vulnerability figure (Figure 3.14-2a) portrays the degree of vulnerability for minority status by detailed study area census tract. The percentages of minority populations that are living within census tracts that overlap into the detailed study area (entirely or partially) are compared with the respective SP of minority population. Tracts that are located within the State of Texas were compared with Texas's percentage of 47.5 percent, and tracts that are located within the State of Louisiana were compared with Louisiana's percentage of 37.4 percent. Minority status is defined to include all non-white as well as Hispanic-origin households. A ranking score (as described in the EJ Index Methodology) is assigned to each tract.

#### *3.14.2.4.3 Economic Status Degree of Vulnerability*

The Economic Status Degree of Vulnerability figure (Figure 3.14-2b) shows the percentage of economically stressed persons (or economically vulnerable) based on household income (the risk group is defined by the EPA – Region 6 as households with incomes less than $15,000 per year). The percentage of economically stressed persons who are living within the detailed study area census tracts that overlap into the detailed study area (entirely or partially) are compared with the respective SP of economically stressed households. Census tracts that are located within the State of Texas were compared with Texas's percentage of 15 percent, and tracts that are located within the State of Louisiana were compared with Louisiana's percentage of 19 percent. A ranking score (as described in the EJ Index Methodology) is assigned to each tract.




| Potential Environmental Justice Index for the Detailed Study Area Census Tracts | |
|---|---|
| Persons Per Sq. Mile<br>Population Ranking | 1377<br>3 |
| Percent Minority<br>Minority Status | 48.8%<br>3 |
| Percent Economically Stressed<br>Economic Status | 20.6%<br>3 |
| Environmental Justice Index | 27 |

Percent Minority by Census Tract

- Less than the State Percentage (SP)
- > the SP but <=1.33 times the SP
- > 1.33 times the SP but <= 1.66 times the SP
- > 1.66 times the SP but <= 1.99 times the SP
- >= 2 times the SP

Census Tract Boundary

Project Area, Proposed Channel

Source: US Census Bureau, 2009g (Summary File 3 [SF3] Data)

**Figure 3.14-2a**

**Detailed Study Area Minority Status 2000**

| | |
|---|---|
| Prepared for: USACE Galveston | |
| Job No.: 100007609 | Scale: 1" = 16500' |
| Prepared by: 18895/ 20192 | Date: 09/10/2009 |

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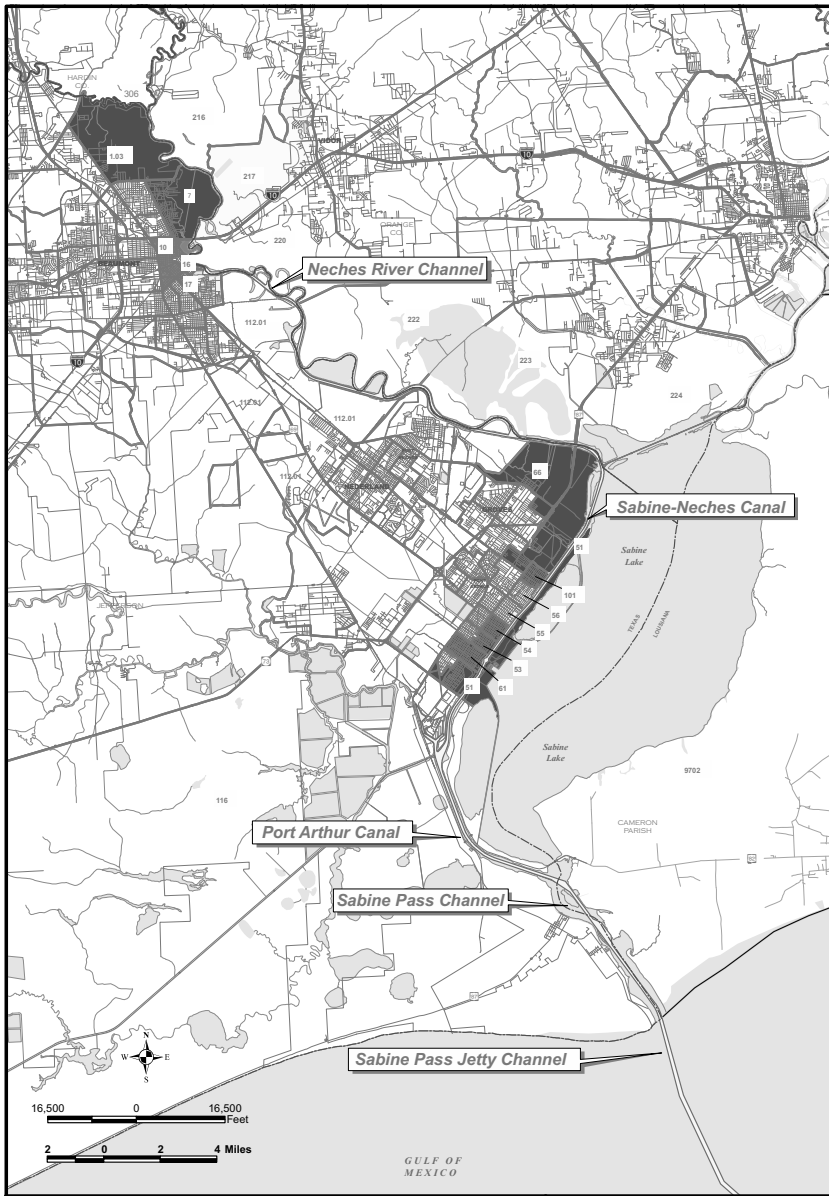


Potential Environmental Justice
Index for the Detailed Study Area Census Tracts

| | |
|---|---|
| Persons Per Sq. Mile<br>Population Ranking | 1377<br>3 |
| Percent Minority<br>Minority Status | 48.8%<br>3 |
| Percent Economically Stressed<br>Economic Status | 20.6%<br>3 |
| Environmental Justice Index | 27 |

Percent Economically Stressed by Census Tract

- Less than the State Percentage (SP)
- > the SP but <=1.33 times the SP
- > 1.33 times the SP but <= 1.66 times the SP
- > 1.66 times the SP but <= 1.99 times the SP
- >= 2 times the SP

Census Tract Boundary

Project Area, Proposed Channel

Source: US Census Bureau, 2009g (Summary File 3 [SF3] Data)

**Figure 3.14-2b**

**Detailed Study Area Economic Status 2000**

| | |
|---|---|
| Prepared for: USACE Galveston | |
| Job No.: 100007609 | Scale: 1" = 16500' |
| Prepared by: 18895/20192 | Date: 09/10/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/Census_2000_economic_status_vr5.mxd

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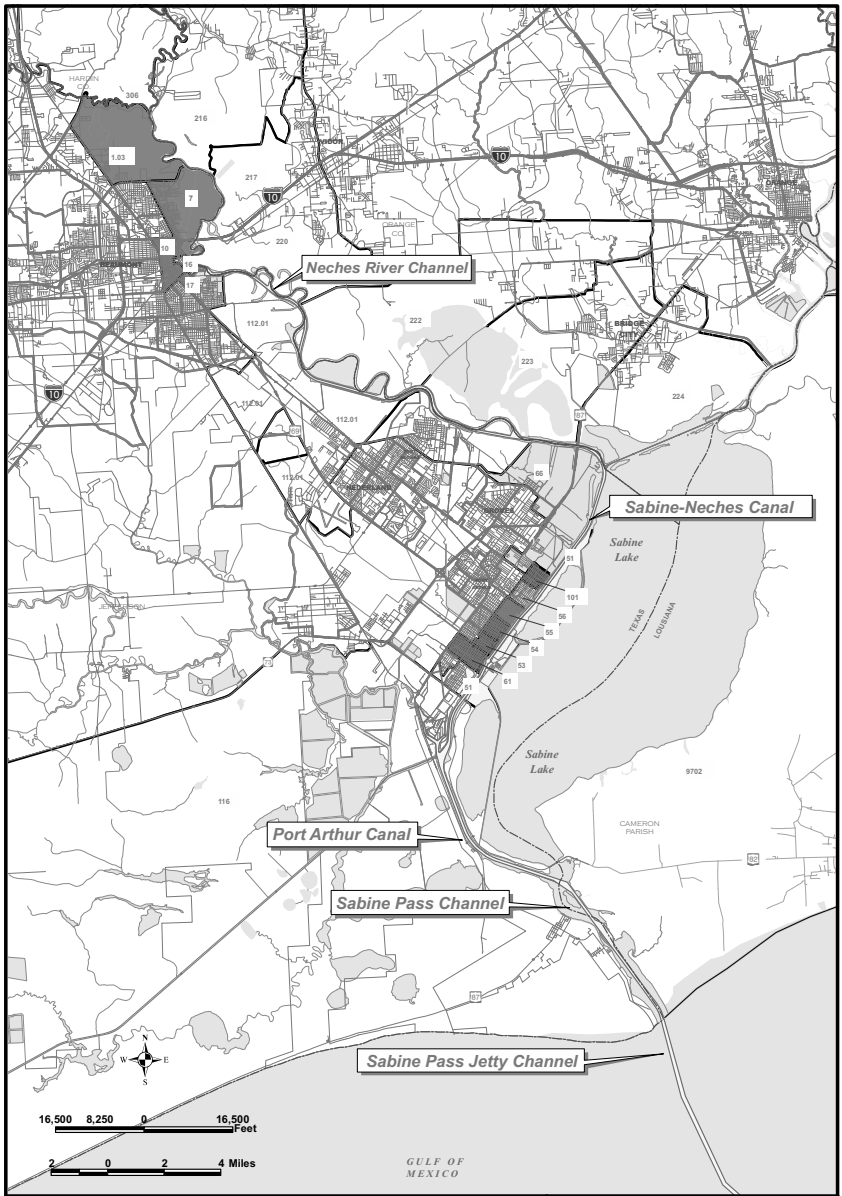


| Potential Environmental Justice Index for the Detailed Study Area Census Tracts | |
|---|---|
| Persons Per Sq. Mile<br>Population Ranking | 1377<br>3 |
| Percent Minority<br>Minority Status | 48.8%<br>3 |
| Percent Economically Stressed<br>Economic Status | 20.6%<br>3 |
| Environmental Justice Index | 27 |

Criteria Ranked by Census Tract

- 1 to 12
- 13 to 25
- 26 to 37
- 38 to 50
- 51 to 100

Census Tract Boundary

Project Area, Proposed Channel

Source: US Census Bureau, 2009g (Summary File 3 [SF3] Data

**Figure 3.14-2c**
**Detailed Study Area**
**Environmental Justice Index**

Prepared for: USACE Galveston

| Job No.: 100007609 | Scale: 1" = 16500' |
|---|---|
| Prepared by: 18895/20192 | Date: 09/10/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/Census_2000_envir_justice_layout_vr5.mxd

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#### *3.14.2.4.4 Potential Environmental Justice Index*

The Potential Environmental Justice Index figure (Figure 3.14-2c) shows a composite index incorporating population density, income, and ethnicity factors. Because the EJ Index is derived in part by the population of the project area, there is no county or state EJ Index number for comparison purposes.

#### *3.14.2.4.5 Environmental Justice Index Analysis*

The Minority Status Degree of Vulnerability figure (Figure 3.14-2a) shows that the detailed study area's population density (on average) is ranked as a 3, and the average percentage of ethnic minorities is 48.8 percent, which is substantially greater than all counties and parishes of the study area, greater than the State of Louisiana, and slightly greater than the State of Texas. The overall minority status for the detailed study area is ranked 3.

The Economic Status Degree of Vulnerability figure (Figure 3.14-2b) shows that the detailed study area census tracts have an average of 20.6 percent of the population that is economically stressed, which is slightly greater than in all study area counties and parishes, and the states of Texas and Louisiana. The overall economically stressed status is ranked 3.

The Potential Environmental Justice Index figure (Figure 3.14-2c) shows that the overall EJ Index for the detailed study area is 27. In addition to the EJ Index methodology, an analysis of the census tracts was also performed. The census tract data were used in this study to determine the potential for disproportionate effects to low-income and/or minority populations within the detailed study area and are presented in Table 3.14-10. The information is based on 2000 U.S. Census Bureau state, county, and census tract–level data for ethnicity and income (see Figure 3.14-1). All study area census tracts that overlap into the detailed study area (entirely or partially) were used in this analysis.

#### *3.14.2.4.6 Census Tract Analysis*

Within the detailed study area census tracts, the average percentage of African Americans is 26.7 percent, which is lower than the percentage of African Americans in Jefferson County (33.4 percent) and the State of Louisiana (32.2 percent), but is higher than the percentage of African Americans in Orange County (8.6 percent), Hardin County (6.9 percent), Cameron Parish (3.5 percent), Calcasieu Parish (23.5 percent), and the State of Texas (11.3 percent). Individual detailed study area census tracts with unusually high percentages of African Americans include the following: Jefferson County tracts 1.03, 7, 17, 51, 53, 54, 55, 61, and 66. The average percentage of Hispanics within the detailed study area is 9.6 percent, which is lower than Jefferson County (10.6 percent) and the State of Texas (32.0 percent), but is higher than the percentage of Hispanics in Orange County (3.5 percent), Hardin County (2.4 percent), Cameron Parish (2.1 percent), Calcasieu Parish (1.7 percent), and the State of Louisiana (2.4 percent). Individual detailed study area census tracts with unusually high percentages of Hispanics include the following: Jefferson County tracts 10, 56, and 101. The average percentage of "Other Race" population within the detailed study area is 4.1 percent, which is lower than the percentage of "other races" in Jefferson County (4.1 percent), the State of Louisiana (2.9 percent), and the State of Texas (4.3 percent), but is higher than

Table 3.14-10
Detailed Study Area Ethnic Distribution and Poverty Status, 2000

| Place/Detailed Study Area Census Tracts | Population | Number White | Percent White | Number African American | Percent African American | Number Hispanic Origin | Percent Hispanic | Number Other | Percent Other | Number Below Poverty | Percent Below Poverty |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hardin County | | | | | | | | | | | |
| 306 | 3,116 | 2,965 | 95.2% | 5 | 0.2% | 61 | 2.0% | 85 | 2.7% | 216 | 6.9% |
| Jefferson County | | | | | | | | | | | |
| 1.03 | 3,065 | 360 | 11.7% | 2,605 | 85.0% | 65 | 2.1% | 35 | 1.1% | 1,257 | 41.0% |
| 7 | 3,779 | 104 | 2.8% | 3,451 | 91.3% | 172 | 4.6% | 52 | 1.4% | 1,321 | 35.0% |
| 10 | 1,783 | 366 | 20.5% | 711 | 39.9% | 665 | 37.3% | 41 | 2.3% | 443 | 24.8% |
| 16 | 105 | 76 | 72.4% | 22 | 21.0% | 0 | 0.0% | 7 | 6.7% | 0 | 0.0% |
| 17 | 2,735 | 319 | 11.7% | 2,385 | 87.2% | 31 | 1.1% | 0 | 0.0% | 675 | 24.7% |
| 51 | 1,842 | 119 | 6.5% | 1,723 | 93.5% | 0 | 0.0% | 0 | 0.0% | 711 | 38.6% |
| 53 | 1,074 | 47 | 4.4% | 934 | 87.0% | 62 | 5.8% | 31 | 2.9% | 481 | 44.8% |
| 54 | 2,133 | 63 | 3.0% | 1,455 | 68.2% | 386 | 18.1% | 229 | 10.7% | 691 | 32.4% |
| 55 | 3,352 | 478 | 14.3% | 1,710 | 51.0% | 534 | 15.9% | 630 | 18.8% | 768 | 22.9% |
| 56 | 3,893 | 585 | 15.0% | 1,133 | 29.1% | 1,613 | 41.4% | 562 | 14.4% | 608 | 15.6% |
| 61 | 2,100 | 12 | 0.6% | 1,960 | 93.3% | 116 | 5.5% | 12 | 0.6% | 783 | 37.3% |
| 66 | 4,752 | 1,444 | 30.4% | 2,102 | 44.2% | 753 | 15.8% | 453 | 9.5% | 1,843 | 38.8% |
| 101 | 3,287 | 668 | 20.3% | 896 | 27.3% | 1,490 | 45.3% | 233 | 7.1% | 994 | 30.2% |
| 108 | 5,210 | 4,760 | 91.4% | 13 | 0.2% | 377 | 7.2% | 60 | 1.2% | 351 | 6.7% |
| 112.01 | 7,193 | 6,151 | 85.5% | 603 | 8.4% | 299 | 4.2% | 140 | 1.9% | 411 | 5.7% |
| 116 | 2,307 | 2,040 | 88.4% | 59 | 2.6% | 158 | 6.8% | 50 | 2.2% | 195 | 8.5% |
| Orange County | | | | | | | | | | | |
| 216 | 3,929 | 3,767 | 95.9% | 0 | 0.0% | 78 | 2.0% | 84 | 2.1% | 471 | 12.0% |
| 217 | 2,623 | 2,473 | 94.3% | 0 | 0.0% | 113 | 4.3% | 37 | 1.4% | 493 | 18.8% |
| 220 | 4,082 | 3,798 | 93.0% | 12 | 0.3% | 178 | 4.4% | 94 | 2.3% | 555 | 13.6% |
| 222 | 3,027 | 2,853 | 94.3% | 0 | 0.0% | 84 | 2.8% | 90 | 3.0% | 159 | 5.3% |
| 223 | 6,475 | 6,031 | 93.1% | 6 | 0.1% | 275 | 4.2% | 163 | 2.5% | 569 | 8.8% |
| 224 | 5,950 | 5,508 | 92.6% | 7 | 0.1% | 245 | 4.1% | 190 | 3.2% | 639 | 10.7% |
| Cameron Parish | | | | | | | | | | | |
| 9702 | 4,553 | 4,079 | 89.6% | 229 | 5.0% | 136 | 3.0% | 109 | 2.4% | 600 | 13.2% |
| Detailed Study Area Total | 82,365 | 49,066 | 59.6% | 22,021 | 26.7% | 7,891 | 9.6% | 3,387 | 4.1% | 15,234 | 18.5% |
| Hardin County | 48,073 | 42,714 | 88.9% | 3,322 | 6.9% | 1,176 | 2.4% | 861 | 1.8% | 5,314 | 11.1% |
| Jefferson County | 252,051 | 130,655 | 51.8% | 84,290 | 33.4% | 26,664 | 10.6% | 10,442 | 4.1% | 41,142 | 16.3% |
| Orange County | 84,966 | 72,921 | 85.8% | 7,275 | 8.6% | 2,978 | 3.5% | 1,792 | 2.1% | 11,518 | 13.6% |
| **Total Texas Study Area Counties** | 385,090 | 246,290 | 64.0% | 94,887 | 24.6% | 30,818 | 8.0% | 13,095 | 3.4% | 57,974 | 15.1% |
| Cameron Parish, Louisiana | 9,991 | 9,266 | 92.7% | 354 | 3.5% | 207 | 2.1% | 164 | 1.6% | 1,220 | 12.2% |
| Calcasieu Parish, Louisiana | 183,577 | 133,607 | 72.8% | 43,197 | 23.5% | 3,166 | 1.7% | 3,607 | 2.0% | 27,582 | 15.0% |
| **Total Louisiana Study Area Parishes** | 193,568 | 142,873 | 73.8% | 43,551 | 22.5% | 3,373 | 1.7% | 3,771 | 1.9% | 28,802 | 14.9% |
| **State of Louisiana** | 4,468,974 | 2,794,348 | 62.5% | 1,437,100 | 32.2% | 107,854 | 2.4% | 129,672 | 2.9% | 851,113 | 19.0% |
| **State of Texas** | 20,851,820 | 10,927,538 | 52.4% | 2,349,641 | 11.3% | 6,670,122 | 32.0% | 904,519 | 4.3% | 3,117,609 | 15.0% |

Source: U.S. Census Bureau (2000a, 2000g).

the percentage of "Other Race" population in Orange County (2.1 percent), Hardin County (1.8 percent), Cameron Parish (1.6 percent), and Calcasieu Parish (2.0 percent). Individual detailed study area census tracts with unusually high percentages of "Other Race" persons include the following: Jefferson County tracts 54, 55, and 56.

The average percentage of persons living below the poverty level within the detailed study area is 18.5 percent, which is lower than the percentage of people living below the poverty level in the State of Louisiana (19.0 percent), but is higher than the percentage of people living below the poverty level in Jefferson County (16.3 percentage), Orange County (13.6 percent), Hardin County (11.1 percent), Cameron Parish (12.2 percent), Calcasieu Parish (15.0 percent), and the State of Texas (15.0 percent). Individual detailed study area census tracts with unusually high percentages of poverty status persons include the following: Jefferson County tracts 1.03, 7, 51, 53, 54, 61, 66, and 101.

#### *3.14.2.4.7 Results*

The results of the census tract analysis suggests that within the detailed study area census tracts, the potential for disproportionately high effects to ethnic minority populations is high, and the potential for disproportionately high effects to poverty status persons is moderate. The detailed study area exhibits a disproportionately high percentage of African Americans relative to other portions of the study area and the State of Texas. In addition, there are several detailed study area census tracts with exceptionally high percentages of African Americans. Also, the detailed study area has a moderately high percentage of Hispanics when compared with most counties and parishes within the study area and also the State of Louisiana. There are three detailed study area census tracts with unusually high percentages of Hispanics. Also, the detailed study area has an overall "Other Race" population that is slightly higher than four of the five study area counties and parishes. There are three detailed study area census tracts with unusually high percentages of "Other Race" population. The population living within the detailed study area census tracts has a moderately high percentage of poverty status when compared with most counties and parishes within the study area and the State of Texas. There are numerous census tracts within the detailed study area that have unusually high percentage of poverty status persons.

### 3.14.2.5 Port-Related Population

In subsection 3.14.3.3, the number of direct port-related employees for the Port of Beaumont, the Port of Port Arthur, and the Port of Orange is estimated at 41, 16, and 8, respectively, or a total of 65 direct employees for the three ports (Floyd, 2009; Myers, 2009). Applying a multiplier of 2.65 for the average household size within the study area, an estimate of the direct port-related population in the area is 172 persons. This represents only a very small fraction of the total population within the five-county study area.

Also, in subsection 3.14.3.3, it is estimated that total port-related employment in the port, manufacturing, and industrial industries is currently around 21,000. To estimate the population that is related to these industries, a multiplier of 2.65 was again applied to yield a port-related population of approximately

55,650 people. Since the study area consisted of 578,658 persons in 2000, this port/manufacturing/ industrial population represents approximately 9.6 percent of the current study area population. This is an estimate of the population that has at least one family member that works in any of these industries that are either directly or indirectly linked to waterborne commerce. However, this estimate likely undercounts the population within the study area that is employed by companies that are suppliers to port, manufacturing, and industrial employers. Within the study area, outside vendors provide a wide diversity of expendables and services to these industries (Davis, 1996). Given that these estimates likely undercount the degree to which the local population depends on port, manufacturing, and industrial employment for its livelihood, it seems apparent that the a substantial portion of the population does depend on the these industries, probably at least 25 percent of the population. However, this dependency on port-related industry employment is less than it was before the 1980s "oil bust," as the study area economy has made adjustments since the 1980s (Helen, 2002). Now the study area population relies to a greater extent on industries such as services, Federal, State, and local government, retail and wholesale trade, medical services, education, and Federal and State jails for its livelihood.

## 3.14.3 Economics

### 3.14.3.1 Historical Perspective

The SNWW forms a Y-shaped set of interlocking river channels and canals extending from the Gulf to Port Arthur, Beaumont, and Orange, Texas. Extensive construction to improve the waterways began with river and harbor acts of 1875, 1882, and 1896, when the mouth of the channel was deepened and jetties were built to prevent silting. Some improvements in the Sabine and Neches rivers were authorized in 1878, and the Port Arthur Canal and Dock Company began building a more suitable channel to Port Arthur in 1895. The Port Arthur Canal opened in 1899. The discovery of the Spindletop oil field in 1901 increased demand for deepwater navigation along the lower Sabine and Neches rivers. In response, Congress provided authorization and money in 1905 to complete the GIWW from New Orleans to Galveston Bay. This channel was dredged to a depth of 9 feet and a width of 100 feet and provided a direct connection with the Port Arthur Canal. By 1916 Congress approved the extension of the Port Arthur Canal, and a 25-foot-deep channel was completed to Beaumont in 1916 (known as the Neches Channel). Additional dredging and improvements extended the waterway to Orange (known as the Sabine Channel). By 1972, the SNWW was 40 feet deep and 400 feet wide (University of Texas, 2001).

A series of jetties, canals, rivers, and turning basins now compose the waterway. At the mouth of the channel is Sabine Pass, with jetties extending 3 miles into the Gulf. Twenty-four miles north, up the SNWW, is Port Arthur. The SNWW then splits. To the west, the Port of Beaumont is 19 miles up the Neches River from Port Arthur. To the east, the Port of Orange is 15 miles above the confluence of the Sabine and Neches rivers, via the Sabine Channel. The SNWW, the Neches Channel, the Sabine Channel, and the GIWW have all been tremendously important to development within the study area. The system supported more than 45,000,000 tons of cargo annually by the late 1930s, and over 40,000 vessels used the waterway by 1943. In 1979 well over 75,000,000 tons passed through the Sabine Pass jetties, making the Sabine-Neches shipping district the second largest in the State of Texas, behind that of Galveston-

Houston-Texas City (University of Texas, 2001). In 2007, the SNWW ranked 4th in the Nation in total tonnage, importing 141 million short tons. Individually, the Port of Beaumont ranked 5th nationally for domestic and total tonnage, and the Port of Port Arthur ranked 28th in the Nation (IWR-WCUS, 2007).

#### 3.14.3.2 Employment

Table 3.14-11 provides employment by major industry sector and total employment for the study area for three Texas counties, two Louisiana parishes, the State of Texas, and the State of Louisiana. In Texas, a study of the fourth-quarter data for 2006 and 2008 show that total employment in Hardin County decreased from 12,616 to 12,527 (–0.7 percent), Jefferson County increased from 123,417 to 127,523 (3.3 percent), and Orange County increased from 22,493 to 23,275 (3.5 percent). Total employment in the State of Texas increased from 10,104,642 to 10,512,878 (4.0 percent) during this same period (Texas Workforce Commission [TWC], 2009).

In Louisiana, a study of the fourth-quarter employment data for 2006 and 2008 show that total employment in Calcasieu Parish increased from 85,506 to 87,877 (2.8 percent), and Cameron Parish increased from 2,501 to 3,046 (21.8 percent). Total employment in the State of Louisiana increased from 1,843,179 to 1,903,858 (3.3 percent) during this same period (Louisiana Department of Labor [LDOL], 2005, 2009).

In Texas, fourth-quarter TWC employment data for 2008 show that the leading economic sectors in Hardin County were government (20.1 percent), retail trade (15.5 percent), and construction (11.5 percent). For Jefferson County, leading sectors are construction (14.4 percent), government (14.1 percent), and manufacturing (12.2 percent). For Orange County, the leading sectors were manufacturing (23.7 percent), government (19.1 percent), and retail trade (13.3 percent). State of Texas leader sectors were government (16.9 percent), retail (11.5 percent), and manufacturing (8.7 percent) (TWC, 2009).

In Louisiana, data for 2008 show that the leading economic sectors in Calcasieu Parish were construction (12.9 percent) and retail trade (12.4 percent); leading sectors in Cameron Parish are transportation and warehousing (14.8 percent) and construction (13.2 percent); for the State of Louisiana, retail trade (12.0 percent) and manufacturing (8.0 percent) (LDOL, 2009).

Table 3.14-12 provides unemployment data for the study area including three Texas counties, two Louisiana parishes, the State of Texas, and the State of Louisiana. In Texas, a study of TWC unemployment data in 1998, 2001, 2003, 2006, and 2008 indicates that the highest unemployment rates were as follows: Hardin County (7.8 percent in 2003), Jefferson County (8.6 percent in 2003), Orange County (9.8 percent in 2001), and the State of Texas (6.7 percent in 2003). The lowest unemployment rates for these areas are as follows: Hardin County (5.3 percent in 2006), Jefferson County (6.1 percent in 2006), Orange County (5.9 percent in 2006), and the State of Texas (4.8 percent in 1998).

Table 3.14-11
Study Area Major Employment Sectors

| Employment Sector | 4th Quarter Employment 2006 | 4th Quarter Employment 2008 | Percent Total Employment 2006 | Percent Total Employment 2008 | Percent Change 2006–2008 |
|---|---|---|---|---|---|
| **Hardin County** | | | | | |
| Agriculture, Forestry, Fishing, and Hunting | 81 | 100 | 0.6 | 0.8 | 24.7 |
| Mining | 476 | 396 | 3.8 | 3.2 | –16.8 |
| Utilities | 34 | 33 | 0.3 | 0.3 | –2.9 |
| Construction | 1,867 | 1,443 | 14.8 | 11.5 | –22.7 |
| Manufacturing | 1,016 | 795 | 8.1 | 6.3 | –21.8 |
| Wholesale Trade | 315 | 402 | 2.5 | 3.2 | 27.6 |
| Retail Trade | 1,920 | 1,947 | 15.2 | 15.5 | 1.4 |
| Transportation and Warehousing | 147 | 168 | 1.2 | 1.3 | 14.3 |
| Information | 62 | 76 | 0.5 | 0.6 | 22.6 |
| Finance and Insurance | 206 | 189 | 1.6 | 1.5 | –8.3 |
| Real Estate and Rental Leasing | 110 | 102 | 0.9 | 0.8 | –7.3 |
| Professional and Technical Services | 179 | 210 | 1.4 | 1.7 | 17.3 |
| Federal/State/Local Government | 2,548 | 2,518 | 20.2 | 20.1 | –1.2 |
| Total Employment* | 12,616 | 12,527 | 100.0 | 100.0 | –0.7 |
| **Jefferson County** | | | | | |
| Agriculture, Forestry, Fishing, and Hunting | 158 | 143 | 0.1 | 0.1 | –9.5 |
| Mining | 625 | 638 | 0.5 | 0.5 | 2.1 |
| Utilities | 1,213 | 1,259 | 1.0 | 1.0 | 3.8 |
| Construction | 12,178 | 18,385 | 9.9 | 14.4 | 51.0 |
| Manufacturing | 15,550 | 15,508 | 12.6 | 12.2 | –0.3 |
| Wholesale Trade | 3,872 | 4,316 | 3.1 | 3.4 | 11.5 |
| Retail Trade | 15,766 | 15,474 | 12.8 | 12.1 | 1.9 |
| Transportation and Warehousing | 5,945 | 4,598 | 4.8 | 3.6 | –22.7 |
| Information | 2,421 | 1,792 | 2.0 | 1.4 | –26.0 |
| Finance and Insurance | 2,688 | 2,601 | 2.2 | 2.0 | –3.2 |
| Real Estate and Rental Leasing | 1,905 | 1,719 | 1.5 | 1.3 | –9.8 |
| Professional and Technical Services | 6,505 | 6,453 | 5.3 | 5.1 | –0.8 |
| Federal/State/Local Government | 19,014 | 17,959 | 15.4 | 14.1 | –5.5 |
| Total Employment* | 123,417 | 127,523 | 100.0 | 100.0 | 3.3 |
| **Orange County** | | | | | |
| Agriculture, Forestry, Fishing, and Hunting | 15 | 30 | 0.1 | 0.1 | 1.0 |
| Mining | 259 | 394 | 1.2 | 1.7 | 52.1 |
| Utilities | 318 | 332 | 1.4 | 1.4 | 4.4 |
| Construction | 1,451 | 1,954 | 6.5 | 8.4 | 34.7 |

Table 3.14-11, cont'd

| Employment Sector | 4th Quarter Employment | | Percent Total Employment | | Percent Change |
|---|---|---|---|---|---|
| | 2006 | 2008 | 2006 | 2008 | 2006–2008 |
| Manufacturing | 5,082 | 5,512 | 22.6 | 23.7 | 8.5 |
| Wholesale Trade | 485 | 556 | 2.2 | 2.4 | 14.6 |
| Retail Trade | 3,174 | 3,093 | 14.1 | 13.3 | –2.6 |
| Transportation and Warehousing | 745 | 747 | 3.3 | 3.2 | 0.3 |
| Information | 147 | 147 | 0.7 | 0.6 | 0.0 |
| Finance and Insurance | 780 | 853 | 3.5 | 3.7 | 9.4 |
| Real Estate and Rental Leasing | 180 | 208 | 0.8 | 0.9 | 15.6 |
| Professional and Technical Services | 657 | 403 | 2.9 | 1.7 | –38.7 |
| Federal/State/Local Government | 4,547 | 4,448 | 20.2 | 19.1 | –2.2 |
| Total Employment* | 22,493 | 23,275 | 100.0 | 100.0 | 3.5 |
| **State of Texas** | | | | | |
| Agriculture, Forestry, Fishing, and Hunting | 63,518 | 61,649 | 0.6 | 0.6 | –2.9 |
| Mining | 194,188 | 236,690 | 1.9 | 2.3 | 21.9 |
| Utilities | 74,240 | 79,307 | 0.7 | 0.8 | 6.8 |
| Construction | 652,822 | 703,026 | 6.5 | 6.7 | 7.7 |
| Manufacturing | 943,090 | 918,704 | 9.3 | 8.7 | –2.6 |
| Wholesale Trade | 507,253 | 527,792 | 5.0 | 5.0 | 4.0 |
| Retail Trade | 1,174,230 | 1,204,234 | 11.6 | 11.5 | 2.6 |
| Transportation and Warehousing | 441,559 | 452,243 | 4.4 | 4.3 | 2.4 |
| Information | 231,216 | 220,795 | 2.3 | 2.1 | –4.5 |
| Finance and Insurance | 449,394 | 454,303 | 4.4 | 4.3 | 1.1 |
| Real Estate and Rental Leasing | 182,938 | 186,166 | 1.8 | 1.8 | 1.8 |
| Professional and Technical Services | 543,372 | 593,833 | 5.4 | 5.6 | 9.3 |
| Federal/State/Local Government | 1,717,411 | 1,780,480 | 17.0 | 16.9 | 3.7 |
| Total Employment* | 10,104,642 | 10,512,878 | 100.0 | 100.0 | 4.0 |
| **Calcasieu Parish** | | | | | |
| Agriculture, Forestry, Fishing, and Hunting | 183 | 247 | 0.2 | 0.3 | 35.0 |
| Mining | 1,016 | 1,191 | 1.2 | 1.4 | 17.2 |
| Utilities | 572 | 587 | 1 | 1 | 3 |
| Construction | 10,005 | 11,337 | 11.7 | 12.9 | 13.3 |
| Manufacturing | 8,683 | 8,849 | 10.2 | 10.1 | 1.9 |
| Wholesale Trade | 2,586 | 2,553 | 3.0 | 2.9 | –1.3 |
| Retail Trade | 10,945 | 10,861 | 12.8 | 12.4 | –0.8 |
| Transportation and Warehousing | 3,411 | 3,492 | 4.0 | 4.0 | 2.4 |
| Information | 1,169 | 1,243 | 1 | 1 | 6 |
| Finance and Insurance | 1,881 | 1,877 | 2 | 2 | –0.2 |

Table 3.14-11, cont'd

| Employment Sector | 4th Quarter Employment 2006 | 4th Quarter Employment 2008 | Percent Total Employment 2006 | Percent Total Employment 2008 | Percent Change 2006–2008 |
|---|---|---|---|---|---|
| Real Estate and Rental Leasing | 1,160 | 1,153 | 1.4 | 1.3 | –0.6 |
| Professional and Technical Services | 3,605 | 3,599 | 4.2 | 4.1 | –0.2 |
| Federal/State/Local Government | NA | NA | NA | NA | NA |
| Total Employment* | 85,506 | 87,877 | 100.0 | 100.0 | 2.8 |
| **Cameron Parish** | | | | | |
| Agriculture, Forestry, Fishing, and Hunting | 11 | 15 | 0.4 | 0.5 | 36.4 |
| Mining | 176 | 211 | 7.0 | 6.9 | 19.9 |
| Utilities | NA | NA | NA | NA | NA |
| Construction | 302 | 402 | 12.1 | 13.2 | 33.1 |
| Manufacturing | 235 | 302 | 9.7 | 9.9 | 28.5 |
| Wholesale Trade | 246 | 295 | 9.8 | 9.7 | 19.9 |
| Retail Trade | 115 | 89 | 4.6 | 2.9 | –22.6 |
| Transportation and Warehousing | 480 | 450 | 19.2 | 14.8 | –6.3 |
| Information | NA | NA | NA | NA | NA |
| Finance and Insurance | NA | NA | NA | NA | NA |
| Real Estate and Rental Leasing | 68 | 103 | 2.7 | 3.4 | 51.5 |
| Professional and Technical Services | 55 | 47 | 2.2 | 1.5 | 14.5 |
| Federal/State/Local Government | NA | NA | NA | NA | NA |
| Total Employment* | 2,501 | 3,046 | 100.0 | 100.0 | 21.8 |
| **State of Louisiana** | | | | | |
| Agriculture, Forestry, Fishing, and Hunting | 11,349 | 10,137 | 0.6 | 0.5 | –10.7 |
| Mining | 47,606 | 53,154 | 2.6 | 2.8 | 11.7 |
| Utilities | 14,203 | 14,529 | 0.8 | 0.8 | 2.3 |
| Construction | 140,896 | 147,318 | 7.6 | 7.7 | 4.6 |
| Manufacturing | 155,394 | 151,603 | 8.4 | 8.0 | –2.4 |
| Wholesale Trade | 73,709 | 75,233 | 4.0 | 4.0 | 2.1 |
| Retail Trade | 227,399 | 228,731 | 12.3 | 12.0 | 0.6 |
| Transportation and Warehousing | 79,770 | 81,311 | 4.3 | 4.3 | 1.9 |
| Information | 29,066 | 30,074 | 1.6 | 1.8 | 3.5 |
| Finance and Insurance | 58,886 | 58,608 | 3.2 | 3.1 | –0.5 |
| Real Estate and Rental Leasing | 34,968 | 33,804 | 1.9 | 1.8 | –3.3 |
| Professional and Technical Services | 80,358 | 86,570 | 4.4 | 4.5 | 7.7 |
| Federal/State/Local Government | NA | NA | NA | NA | NA |
| Total Employment* | 1,843,779 | 1,903,858 | 100.0 | 100.0 | 3.3 |

Source: TWC (2009); Louisiana Workforce Commission (2007, 2009).

*Total employment includes all industry sectors, including sectors not listed.

Table 3.14-12
Study Area Unemployment, 1998 to 2008

| | % Annual Average Unemployment Rate | | | | |
|---|---|---|---|---|---|
| | 1998 | 2001 | 2003 | 2006 | 2008 |
| Hardin County | 6.1 | 6.8 | 7.8 | 5.3 | 5.5 |
| Jefferson County | 6.8 | 7.9 | 8.6 | 6.1 | 6.8 |
| Orange County | 8.6 | 9.8 | 9.4 | 5.9 | 6.6 |
| Calcasieu Parish | 5.5 | 6.1 | 6.6 | 3.3 | 4.8 |
| Cameron Parish | 4.4 | 5.9 | 6.4 | 2.9 | 4.7 |
| **State of Louisiana** | 5.7 | 6.0 | 6.6 | 4.3 | 4.6 |
| **State of Texas** | 4.8 | 5.1 | 6.7 | 4.9 | 4.9 |

Source: TWC (2009); Louisiana Workforce Commission (2007, 2009).

In Louisiana, LDOL data in 1998, 2001, 2003, 2006, and 2008 indicate that the highest unemployment rates were as follows: Calcasieu Parish (6.6 percent in 2003), Cameron Parish (6.4 percent in 2003), and the State of Louisiana (6.6 percent in 2003). The lowest unemployment rates were as follows: Cameron Parish (2.9 percent in 2006), Calcasieu Parish (3.3 percent in 2006), and the State of Louisiana (4.3 percent in 2006).

Table 3.14-13 provides a list of the top 20 major employers within the study area. The top employers are concentrated in the public education, health care, petrochemical, manufacturing, gambling, shipbuilding, Federal prisons, and other port-related industries. Together these top 20 (overall) employers provide over 41,000 jobs within the study area economy. Based on a labor force around 300,000 for the five-county/parish study area, this represents approximately 13.7 percent of employment within the five-county/parish study area. Among the top 20 employers, 8 of them are port-related employers (includes manufacturing employment), and these employers encompass 15,735 workers.

#### 3.14.3.3 Port-Related Employment and Operations

Direct employment with the three study area ports, the Port of Beaumont, the Port of Port Arthur, and the Port of Orange, make up a very small fraction of the overall employment that is indirectly tied to port activities. Discussions with area port staff indicated that permanent full-time staff at the ports is as follows: Port of Beaumont (41 employees), the Port of Port Arthur (16 employees), and the Port of Orange (8 employees). Each of these ports also contracts with varying numbers of longshoreman to handle loading and unloading of cargo from ships when they are at port. Information on the average number of longshoremen was not readily available except in the case of the Port of Port Arthur where it was estimated that in an average month there are approximately 6,350 labor hours of employment, which is equivalent to approximately 40 full-time employees for that month, assuming a 40-hour-per-week schedule. Based on the yearly tonnage of cargo, it may be assumed that both the Port of Beaumont and the Port of Orange would have more longshoremen than the Port of Port Arthur (Bouillon, 2002; Davis, 2002; Floyd, 2009; Myers, 2009; Richard, 2002).

Table 3.14-13
Top 20 Employers, Study Area, 2008

| Employers | Number of Employees |
|---|---|
| Calcasieu Parish School System | 4,850 |
| Beaumont Independent School District (ISD) | 2,896 |
| Exxon-Mobile Corporation | 2,500 |
| Christus St. Elizabeth Hospital | 2,300 |
| Turner Industries, LTD. | 2,250 |
| E.I. Dupont De Nemours | 2,000 |
| Dupont Sabine River Works | 2,000 |
| Memorial Hermann Baptist Beaumont Hospital | 1,614 |
| Bayer Corporation | 1,600 |
| Harrah's Lake Charles | 1,600 |
| Northrop Grumman Corporation | 1,500 |
| West Teleservices Corporation | 1,464 |
| PPG Industries | 1,296 |
| Citgo Petroleum Corporation | 1,275 |
| Lamar University | 1,252 |
| City of Beaumont | 1,217 |
| Isle of Capri Casino | 1,171 |
| Christus St. Patrick Hospital | 1,085 |
| Lake Charles Memorial Hospital | 1,039 |

Source: Beaumont Independent School District (2008); Calcasieu Parish School Board (2008); Nederland Economic Development Corporation (2008); Southwest Louisiana - The Chamber (2008).

Conservative estimates of all port, manufacturing, and industrial-related employment, based on information from the U.S. Bureau of Labor Statistics indicates approximately 21,000 jobs in the study area in 2009 (TWC, 2009). It is likely, however, that an even greater number of port-related jobs exist within the area economy, as numerous small supplier companies provide goods and services to larger port, manufacturing, and industrial-related employers (Davis, 1996).

There are a few factors that have had effects on employment within port, manufacturing and industrial-related industries within the study area. One major factor that has led to relatively high unemployment levels within the study area has been a downturn in oil-related industries since the 1980s “oil bust.” During the 1980s, the study area experienced relatively high unemployment rates, as oil refineries and other manufacturing plants laid off as many as 17,000 workers. Since, the 1980s the manufacturing and other port-related industries have been slow to add large increases in the workforce, so unemployment rates did not fully recover even during the national economic boom of the 1990s. The particular “industrial mix” of the study area, which is heavily concentrated in manufacturing, port-related, construction, transportation, and public utilities, is also susceptible to employment volatility due to heavy reliance on contract labor. As new contracts are awarded, employees are contracted to accomplish the work, and when the project is completed, these companies would lay off their workforce until the next

contract is awarded unless current contracts can allow them to maintain staffing levels. In terms of competition for workers, the port-related, manufacturing, and industrial-related employers of the study area do not have to compete much with other industries in order to retain their workers. This is because overall these employers pay substantially higher wages than other industries that are important to the area, such as the services, retail and wholesale trade, and government services. Another factor affecting employment among manufacturing and port-related employers is an increased reliance on mechanized means of production. In many cases, large investments have been made to increase the size, capacity, and output of manufacturing plants and other port-related industries, but these expansions have led to relatively small increases in the number of employees (Crawley and Sanchez, 1999; Helen, 2002).

Table 3.14-14 provides a list of the top 10 industrial, manufacturing, and port-related employers in the study area. Collectively, these top 10 employers provide over 17,000 jobs to the area. Based on a labor force around 300,000 for the five-county/parish study area, this represents approximately 5.7 percent of employment within the five-county/parish study area.

Table 3.14-14
Top 20 Industrial, Manufacturing and Port-Related Employers – Study Area

| Employers | Number of Employees |
|---|---|
| Exxon-Mobile Corporation | 2,500 |
| Turner Industries, LTD. | 2,250 |
| Dupont Sabine River Works | 2,000 |
| E.I. Dupont De Nemours | 2,000 |
| Master-Halo, Inc. | 2,000 |
| Bayer Corporation | 1,600 |
| Northrop Grumman Corporation | 1,500 |
| Motiva Corporation | 1,300 |
| PPG Industries | 1,296 |
| Citgo Petroleum Corporation | 1,275 |

Source: Beaumont Chamber of Commerce (2005); Greater Orange Chamber of Commerce (2002); Nederland Economic Development Corporation (2008); Southwest Louisiana - The Chamber (2008).

Table 3.14-15 provides a list of the top 10 export commodities and import commodities at the Port of Beaumont, the Port of Orange, the Port of Port Arthur, and the Port of Sabine Pass. In terms of waterborne export commodities, 4 of the 10 top commodities being shipped are petroleum-based products, most of which are manufactured at plants located within the study area. The greatest export is petroleum coke at 3,777 short tons in 2003. In terms of waterborne import commodities, by far the single greatest waterborne commodity being received at these four study area ports (in terms of tonnage) is crude petroleum, at 69,260 short tons in 2003, or 91 percent of all inbound freight traffic tonnage. Examination of the top 10 import and export commodities provides a better understanding of the nature of the port-related economy within the study area. Because the single most important commodity (in terms of tonnage and value) being moved through the four ports is imported foreign crude petroleum, the price

of oil on the foreign market has very large implications in terms of economic success for study area manufacturing plants, and most other port-related businesses. If the price for a barrel of oil is either too low or too high, the entire manufacturing, and port-related sector of the study area economy as well as overall-employment levels, and economic activity within the study area can be adversely affected. Other important nonpetroleum based commodities (both imports and exports) include wheat, sand and gravel, waste and scrap materials, and iron and steel products.

Table 3.14-15
Top 10 Waterborne Export and Import Commodities – Ports of Beaumont, Port Arthur, Orange, and Sabine Pass, 2003

| | Short Tons |
|---|---|
| **Top 10 Export Commodities*** | |
| Petroleum Coke | 3,777 |
| Gasoline | 1,571 |
| Wheat | 1,209 |
| Other Hydrocarbons | 496 |
| Distillate Fuel Oil | 401 |
| Metallic Salts | 379 |
| Plastic Fertilizer | 293 |
| Paper and Paperboard | 148 |
| Plastics | 91 |
| Organic comp. NEC | 88 |
| **Top 10 Import Commodities*** | |
| Crude Petroleum | 69,260 |
| Naphtha & Solvents | 1,532 |
| Distillate Fuel Oil | 1,325 |
| Lube Oil & Greases | 1,301 |
| Iron and Steel Primary Forms | 744 |
| Petroleum Coke | 674 |
| Gasoline | 521 |
| Limestone | 314 |
| Ammonia | 172 |
| Pulp and Wastepaper | 160 |

Source: USACE (2003b).

*The number of short tons for each commodity represents a total of all Foreign, Canadian, Domestic-Coastwise, and Internal (inbound or outbound) tonnage for each commodity that is either an export or an import to the four study area ports.

#### 3.14.3.4 Commercial Fishing

Commercial fishing within the Sabine Lake system is a relatively small contributor to the study area economy compared with other industry sectors. Table 3.14-16 compares the commercial fishing landings of the Sabine Lake system to all Texas bay systems in 2004. The total wholesale value for all finfish and shellfish landings in the Sabine Lake system in 2004 was $623,160. It is noteworthy, however, that 2004 was not a particularly good year for commercial fishing in the Sabine Lake system. During the 1990s, 1992 had the greatest total value for all finfish and shellfish landings at $6.0 million.

Table 3.14-16
Trends in Commercial Fishery Landings – Sabine Lake System
Compared with All Texas Bay Systems, 1999

| | Sabine Lake System | | | All Texas Bay Systems | |
|---|---|---|---|---|---|
| | Weight (lbs) of Fish Landed | Wholesale ($) Value of Fish Landed | % of Total (lbs) From All Texas Bay System Landings | Weight (lbs) of Fish Landed | Wholesale ($) Value of Fish Landed |
| Black drum | 0 | 0 | 0 | 1,717,000 | 1,444,000 |
| Flounder | 0 | 0 | 0 | 151,000 | 325,000 |
| Sheepshead | 0 | 0 | 0 | 68,000 | 28,000 |
| Mullet | 535 | 668 | 0.7 | 76,000 | 143,000 |
| Other finfish | 7,312 | 38,793 | 66.5 | 11,000 | 9,000 |
| Total finfish | 7,847 | 39,461 | 0.1 | 5,620,000 | 10,585,000 |
| Shrimp, bait | 0 | 0 | 0 | 1,330,000 | 3,666,000 |
| Shrimp, commercial | 344 | 355 | <0.1 | 31,150,000 | 96,055,000 |
| Total shrimp | 344 | 355 | <0.1 | 32,480,000 | 99,721,000 |
| Blue crab | 707,086 | 439,036 | 17.8 | 3,967,000 | 2,668,000 |
| Eastern oyster | 0 | 0 | 0 | 5,569,000 | 14,954,000 |
| Squid | 0 | 0 | 0 | 42,000 | 40,000 |
| Total shellfish | 707,430 | 439,371 | 7.4 | 9,578,000 | 17,662,000 |
| Total finfish and shellfish | 715,277 | 478,832 | 1.5 | 47,715,000 | 128,168,000 |

Source: TPWD (2005d).

The 2002 and 2003 Gulf annual commercial fishery statistics for Louisiana and Texas (NMFS, 2005) were reviewed. The commercial catch and the value of that catch for Louisiana were 1.3 billion pounds ($307 million) and 1.2 billion pounds ($294 million) for 2002 and 2003, respectively. The Texas catch was 93 million pounds ($173 million) and 96 million pounds ($168 million) for the same time periods. Menhaden were the dominant poundage in Louisiana, while shrimp accounted for most of the weight in Texas. Shrimp, in terms of value, were most dominant in both states. Commercial finfish catches in the Gulf result from beach seines (under certain circumstances), longlines, and incidental catch in shrimp trawls. The blue crab fishery is located in the bays as well as the Gulf. From 1982 to 1986, an annual average of 7.1 million pounds of blue crabs was landed in Texas at an annual average value of $2.8 million. More species-specific commercial catch information is located in Appendix B ODMDS, subsection 3.5.1.1.

### 3.14.3.5 Recreation

#### *3.14.3.5.1 Recreational Fishing*

Among sport-related activities, recreational fishing continues to be a major outdoor recreational activity. In 2006, 3.0 million people aged 16 and older fished in Texas. Between 2001 and 2006, the number of anglers increased by 25 percent, and fishing expenditures increased by 66 percent. Saltwater fishing increased by 33 percent, and freshwater fishing increased by 1 percent (USFWS, 2002e, 2006).

Sabine Lake, numerous wetlands, and the Gulf are sources of recreational fishing within the study area. The large variety of fresh and saltwater species in the area make fishing the most popular recreational activity within the marsh environment within the region. Recreational fishing in this area is a yearround activity that varies with the breeding cycle, water levels, fishing pressure, and aquatic-life productivity. Largemouth bass in inland waters and speckled trout in the Gulf and Sabine Lake are favorites among anglers in the area. Many local freshwater and saltwater anglers join fishing clubs, and enter contests for prize money. The estuarine-marsh-swamp environment provides the necessary nursery ground for an abundant seafood supply. More than 90 percent of the Gulf's finfish spend part of their lifecycle within the coastal zone. Although most species are commercially exploited, recreational anglers contributed more than $420 million to the local economy (within southeastern Texas and southwestern Louisiana) in 2006, with more than half a million people involved in this leisure time activity (USFWS, 2003).

Also, crawfish are an important source of recreational fishing within freshwater wetlands and creeks within the study area (as well as throughout Louisiana). These crustaceans are collected from natural water areas and cultivated in ponds. In Louisiana and the Louisiana portion of the study area, the crawfish is more than a source of recreational fishing or even a food supply, but rather part of the local culture. Found in almost every ditch and harvested from large ponds, crawfish are utilized as food, bait, income, recreation, weed control, and as a literary topic (Davis, 1996).

#### *3.14.3.5.2 Wildlife-Associated Recreation*

Outdoor recreation is a booming business throughout the United States, and Texas and Louisiana offer many outdoor recreational activities. According to the USFWS 2006 National Survey of Fishing, Hunting, and Wildlife Associated Recreation, 29 percent of the total population of Louisiana and 26 percent of the total population of Texas was involved in wildlife-related recreation (USFWS, 2006).

Among the 1.2 million people who participated in wildlife-related recreation in the State of Louisiana in 2006, 91 percent were involved in sporting wildlife recreation (fishing, hunting, or both) and 60 percent were involved in wildlife-watching (feeding, photographing, and observing). Among the 6.0 million people who participated in wildlife-associated recreation in the State of Texas in 2006, 68 percent were involved in sporting wildlife recreation and 70 percent were involve in wildlife-watching (USFWS, 2006).

One of the benefits of outdoor recreation is the economic impact it has on a state and its regions. In Louisiana, over $2.0 billion was spent on wildlife-associated activities (sporting yielded over $1.7 billion and wildlife-watching yielded over $312 million), and in Texas, almost $2.3 billion was spent on wildlife-associated activities (sporting yielded almost $1.3 billion and wildlife-watching yielded almost $2.9 billion) (USFWS, 2006).

The Big Thicket National Preserve covers 106,684 acres of wetland, riparian and upland forest habitat within portions of Hardin and Orange counties, Texas, in the vicinity of the study area. It has been referred to as an "American Ark" because of the tremendous amount of biological diversity that occurs there. Recreational activities include auto touring, backpacking, biking, birdwatching, boating, camping,

fishing, hiking, horseback riding, hunting, interpretive programs, kayaking, nature walks, stargazing, swimming, and wildlife viewing. As a major recreational attraction of the area, the Big Thicket received 106,237 visitors in fiscal year 2004. The annual budget has decreased from $2,266,000 in fiscal year 2002, to $2,251,000 in fiscal year 2004 (USFWS, 2003). As with most attractions, money spent in the Big Thicket area would move into local economies. Many visitors to the Big Thicket National Preserve come as weekend visitors from the Houston metro area, and most visitors to the preserve spend money within the BPA MSA and the Lake Charles MSA (within the study area) on hotels, restaurants, entertainment, groceries, supplies, and sporting equipment. The popularity of outdoor recreation and "eco-tourism" within the study area is expected to increase over time, and with the increase in visitors to the area, there would be an increase in visitor spending within the local economy (Helen, 2002).

#### *3.14.3.5.3 Hunting*

The economic impact of hunting in Texas resulted in $2.2 billion spent in Texas in 2006. Trip-related expenses totaled $874 million, including $338 million on food and lodging, $336 million on transportation, and $785 million for equipment rental. Hunting within the Louisiana portion of the study area is equally popular, with numerous seasonally occupied camps located primarily on private land, and leased to club members who often travel from metropolitan areas of Louisiana and Texas to waterfowl and deer hunting, among other game. Spending on hotels, restaurants, groceries, entertainment, supplies, and sporting goods by these hunting recreationists is a boon to both the economies of the BPA MSA and the Lake Charles MSA and is expected to increase over time as an important economic contributor (Helen, 2002).

In 2001, 6 percent of the U.S. population aged 16 and older were involved in hunting activities. An average of 18 days was spent by each hunter on their sport. The USFWS reports that the number of hunters has dropped by 7 percent between 1991 and 2001. The drop occurred primarily in small game and other animal hunting. Big game and migratory bird hunting numbers remained constant. Hunting-related expenditures also dropped by 12 percent. Neither the drop in hunters nor the drop in their expenditures is considered statistically significant (USFWS, 2002e).

#### *3.14.3.5.4 Wildlife Watching*

In 2006, 24 percent of the U.S. population aged 16 and older were involved in wildlife-watching activities. Between 2001 and 2006, people involved in wildlife-watching activities decreased by 7 percent. The USFWS differentiates between wildlife-watchers who participate around their homes and those who take trips to view wildlife. In spite of the decrease in the population of wildlife-watchers, their total expenditures have increased over the last 5 years by 16 percent, primarily due to equipment expenditures (USFWS, 2002e, 2006).

In 2006, expenditures related to wildlife-watching in the State of Louisiana were almost $312 million, and in the State of Texas were almost $2.9 billion. Expenditure totals include food and lodging, transportation, equipment, magazine subscriptions, membership dues, and contributions (USFWS, 2002e).

Wildlife-watching, particularly birding, is an extremely popular activity within the study area and in the nearby vicinity. The Great Texas Coastal Birding Trail (GTCBT) is a series of trails that links 308 bird-watching sites and many communities within 43 Texas counties on or near the Gulf Coast. The GTCBT offers boardwalks, parking pullouts, kiosks, and observation platforms for the comfort of wildlife-watchers. Participation in the GTCBT has grown by 33 percent overall between 2001 and 2002. Participation by youth teams has grown from one team to 97 teams in the 7 years of its existence (Scroggs, 2002; USFWS, 2002e).

There are several sections of the GTCBT that are located in or near the project study area. They are: Claiborne West Park, Lower Neches WMA and Bailey's Fish Camp, Big Thicket National Preserve, Gore Store Road and Turkey Creek, Roy E. Larson Sandyland Sanctuary, Village Creek State Park, Tyrrell Park and Cattail Marsh, Tony Houseman State Park and WMA, Pleasure Island, J.D. Murphree WMA, Taylor Bayou, Sabine Pass, Sabine Pass Battleground State Historic Park and Texas Point, Texas Point NWR, Sabine Woods, Sea Rim State Park, and McFaddin NWR.

#### 3.14.3.6 Tax Base

In Texas the state sales tax is 6.25 percent, with local sales/use tax not to exceed 8.25 percent (Texas Comptroller of Public Accounts, 2009). In Louisiana the aggregate rate of state sales tax is 4.00 percent, which consists of 3.97 percent Louisiana sales tax and 0.03 percent Louisiana Tourism Promotion District sales tax (Louisiana Association of Tax Administration, 2008). Within the general vicinity of the study area, local sales/use taxes are as shown in Table 3.14-17.

Table 3.14-17
Sales and Use Taxes by Study Area Jurisdictions, 2004*

| Taxing Jurisdiction | City Rate (%) | County/Parish Rate (%) | Total Rate (includes State sales/use tax %) |
|---|---|---|---|
| City of Beaumont | 1.25 | 0.50 | 8.25 |
| City of Port Arthur | 1.25 | 0.50 | 8.25 |
| City of Port Neches | 1.25 | 0.50 | 8.25 |
| City of Groves | 1.25 | 0.50 | 8.25 |
| City of Nederland | 1.25 | 0.50 | 8.25 |
| City of Bridge City | 1.25 | 0.50 | 8.25 |
| City of Orange | 1.25 | 0.50 | 8.25 |
| City of West Orange | 1.25 | 0.50 | 8.25 |
| City of Vidor | 1.25 | 0.50 | 8.25 |
| City of Lake Charles | 2.25 | 2.25 | 8.75 |

Source: Texas Comptroller of Public Accounts (2005a, 2005b); Louisiana Department of Revenue (2005); Louisiana Economic Development (2005).

*2002 for Louisiana.

In Texas property is appraised, property tax is collected by local (county) tax offices or appraisal districts, and these funds are used to fund many local needs including public schools, city streets, county roads,

police, and fire protection (Texas Comptroller of Public Accounts, 2009). In Louisiana property is appraised, property tax is collected by local (parish) tax offices or Police Juries, and these funds are used for local schools and services. Table 3.14-18 provides a summary of property tax jurisdictions and tax rates for jurisdictions that affect large portions of the population living in the vicinity of the study area.

### 3.14.4 Land Use

The study area is approximately 1,900 square miles in area, and includes portions of Jefferson, Hardin and Orange counties, Texas, and Calcasieu and Cameron parishes, Louisiana. The study area includes nine municipalities: Beaumont, Port Neches, Nederland, Groves, Port Arthur, Bridge City, Vidor, Orange, and West Orange. Land uses for portions of the study area that are relatively close to the detailed study area are shown on figures 3.14-3a (Beaumont, Vidor, and vicinity), 3.14-3b (Nederland, Groves, Port Neches, Port Arthur and vicinity), and 3.14-3c (Sabine Pass and vicinity).[2]

The most currently available coverages were obtained from a variety of public agencies and private entities, and were integrated into a GIS using ArcView 3.2 and ArcView GIS. A land use/land cover coverage for the study area in 1990 was obtained from the USGS. This coverage was developed by the USGS through interpretation of satellite imagery (USGS, 1990). This land use/land cover coverage uses the Anderson system of classification, which categorizes land uses into 19 categories. Also, 1999 TxDOT county roads coverage (TxDOT, 1999a) and a 1999 parks coverage (derived from the TxDOT urban data) were obtained from Texas Natural Resource Inventory System (TxDOT, 1999b). Additional state parks and wildlife management areas (GLO, 1997) and wildlife refuge coverages (USFWS, 2001) for Texas were obtained from the GLO and USFWS. In addition, 1999 road and park coverages were obtained from the Louisiana Oil Spill Coordinator's Office for Cameron and Calcasieu parishes. A combination of these coverages was used as a working base map for aerial interpretation.

Within the study area, new urban development had occurred since 1990, so the land use/land cover coverage did not adequately capture areas of development since 1990. In order to address this issue, land use interpretation was conducted from working maps to identify and categorize land uses from areas that had been developed since 1990. Land use observations taken from a windshield survey of the study area, on October 2 and 3, 2001, were used to verify interpretation from the land use working maps. These new land use polygons were digitized and combined with the existing USGS land use/land cover coverage. In addition, the Anderson system of classification categories were aggregated for display in order to focus on urban land uses rather than vegetation types.

The study area includes all of Sabine Lake and portions of the Sabine and Neches rivers (flowing into Sabine Lake). The land use figures show the detailed study area that consists of the proposed areas for channel deepening within a 1-mile corridor and includes portions of land adjacent to the channel. The

[2]Land use maps were developed for portions of the study area that are relatively close to the detailed study area, because these are the areas where potential effects (either beneficial or adverse) from project implementation may accrue to the local population.

Table 3.14-18
Property Tax Role for Study Area Jurisdictions

| Tax Jurisdictions | Tax Rate per $100 of Appraised Valuation | Tax Jurisdictions | Tax Rate per $100 of Appraised Valuation |
|---|---|---|---|
| **Jefferson County, Texas** | | Orange County Lateral Roads | 0.00649 |
| Jefferson County | 0.365 | Orange County Navigation and Port District | 0.0125 |
| Hamshire Fannett ISD | 1.325 | Orange County Drainage District | 0.12111 |
| Beaumont ISD | 1.1925 | Bridge City ISD | 1.66320 |
| Nederland ISD | 1.12 | Little Cypress-Mauriceville CISD | 1.6 |
| Port Arthur ISD | 1.3111 | Orangefield ISD | 1.585 |
| Port Neches-Groves ISD | 1.284 | Vidor ISD | 1.64250 |
| Sabine Pass ISD | 1.134808 | West Orange Cove CISD | 1.57357 |
| City of Beaumont | 0.6400 | City of Bridge City | 0.58850 |
| City of Groves | 0.624207 | City of Orange | 0.846 |
| City of Nederland | 0.578 | City of Port Arthur | 0.775 |
| City of Port Arthur | 0.76 | City of Pinehurst | 0.42 |
| Port of Sabine Pass | 0.194148 | City of Rose City | 0.17318 |
| Drainage District #3 | 0.304615 | City of Vidor | 0.561 |
| Drainage District #6 | 0.195587 | City of West Orange | 0.42939 |
| Drainage District #7 | 0.13965 | Orange Co. Water Control and Improvement District | 0.36412 |
| Navigation District | 0.022418 | Orange Co. Emergency Services District #1 (Vidor) | 0.1 |
| Water District #10 | 0.244705 | Orange Co. Emergency Services District #2 (Bridge City) | 0.1 |
| Emergency Services District #1 | 0.026726 | Orange Co. Fire District #3 (Little Cypress) | 0.03 |
| Emergency Services District #2 | 0.049721 | Orange Co. Fire District #4 (McLewis-Mrcville) | 0.03 |
| **Hardin County, Texas** | | **Calcasieu Parish, Louisiana** | |
| Hardin-Jefferson ISD | 1.485 | City of Lake Charles | 2.25 |
| West Hardin ISD | 1.69 | Calcasieu Parish Police Jury | 2.25 |
| Kountze ISD | 1.5 | Calcasieu Parish School Board | 2.00 |
| Lumberton ISD | 1.456 | City of Iowa | 2.50 |
| Silsbee ISD | 1.62 | City of Vinton | 2.50 |
| Lumberton MUD | 0.18428 | City of Westlake | 2.50 |
| City of Silsbee | 0.37 | **Cameron Parish, Louisiana** | |
| City of Kountze | 0.45 | Parishwide | 0.00372 |
| City of Sour Lake | 0.45 | Parishwide Road | 0.00661 |
| City of Rose Hill | 0.057742 | Courthouse | 0.00264 |
| Silsbee Fire #2 | 0.03 | Library | 0.006 |
| Batson Fire #4 | 0.03 | Mosquito | 0.00563 |
| Saratoga EMSD #3 | 0.07 | Consolidated Garbage #1 | 0.00786 |
| Kountze EMSD #1 | 0.05 | Law Enforcement | 0.01141 |
| Lumberton EMSD #2 | 0.08 | Law Enforcement Special | 0.01 |
| Sour Lake EMSD #5 | 0.048949 | Assessment District | 0.00271 |
| **Orange County, Texas** | | Combined School District | 0.05072 |
| Orange County | 0.53913 | | |

Source: Hardin County Tax Appraisal District (2008); Jefferson County Tax Appraisal District (2008); Orange County Tax Appraisal District (2008); Calcasieu Parish School System Sales and Use Tax Department (2008).

ISD = Independent School District; CISD = Consolidated Independent School District; MUD = Municipal Utility District; EMSD = Emergency Services District.

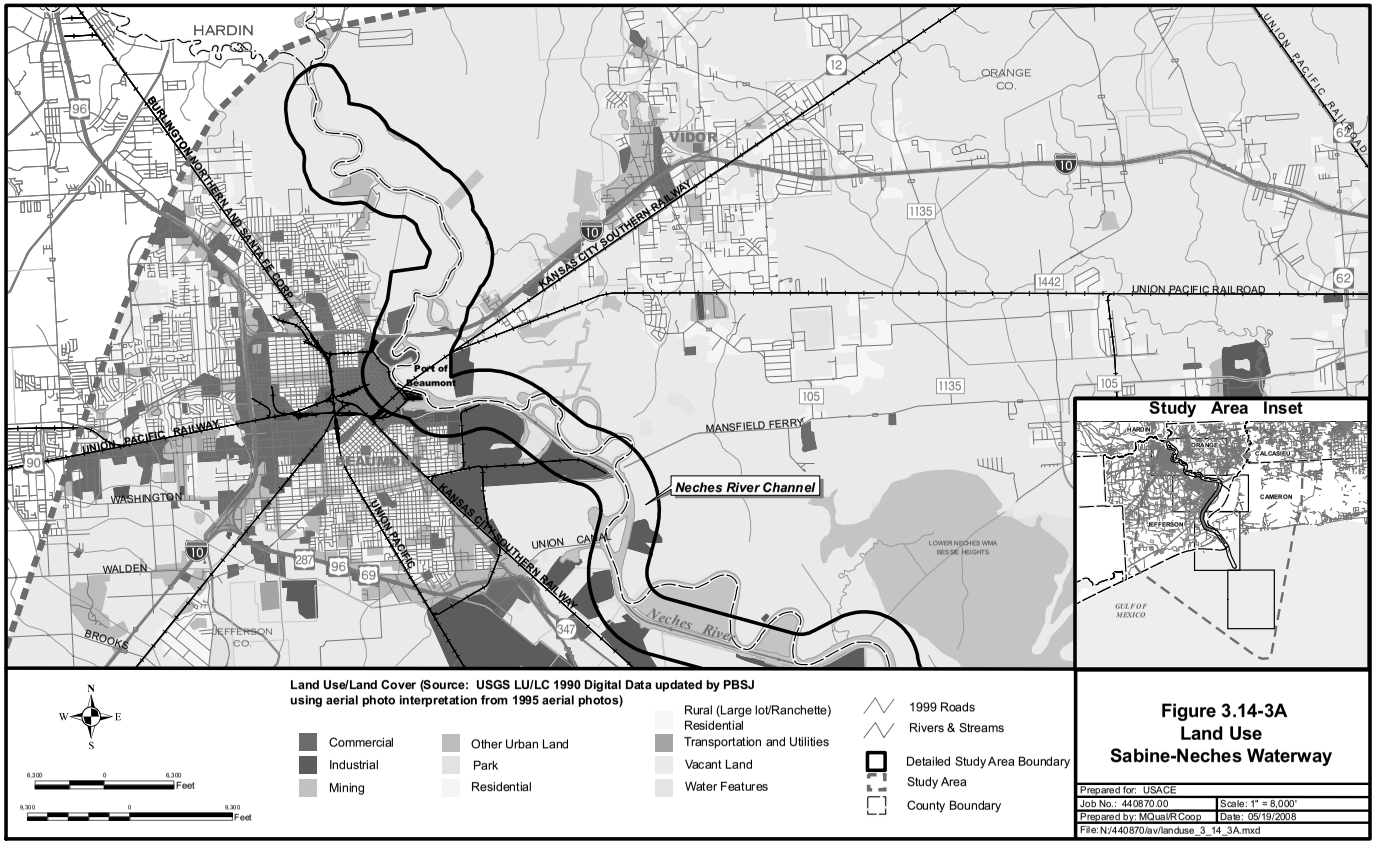


**Figure 3.14-3A**
**Land Use**
**Sabine-Neches Waterway**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 440870.00 | Scale: 1" = 8,000' |
| Prepared by: MQual/R.Coop | Date: 05/19/2008 |
| File:N:/440870/av/landuse_3_14_3A.mxd | |

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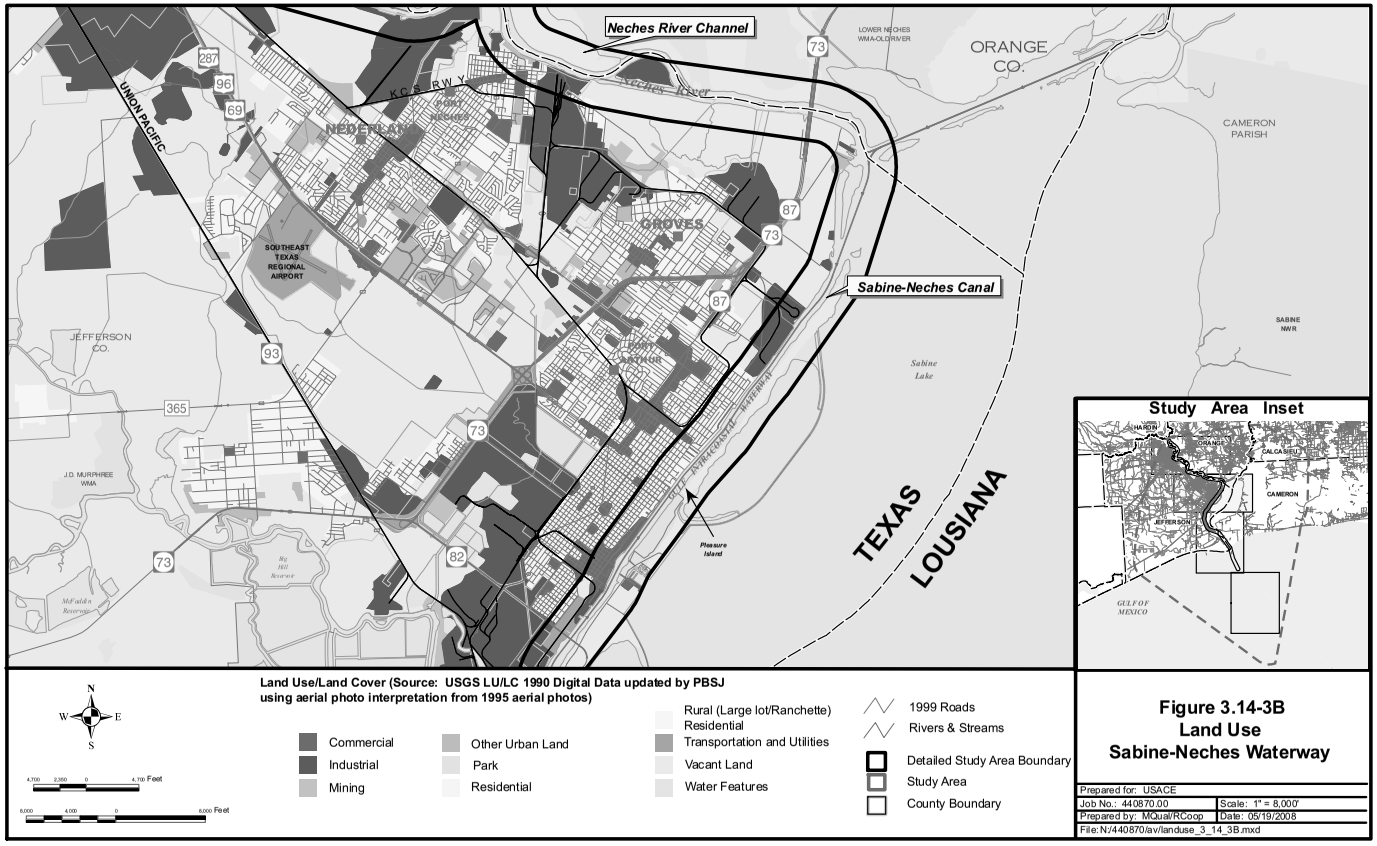


**Figure 3.14-3B**
**Land Use**
**Sabine-Neches Waterway**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 440870.00 | Scale: 1" = 8,000' |
| Prepared by: MQual/RCoop | Date: 05/19/2008 |
| File:N:/440870/av/landuse_3_14_3B.mxd | |

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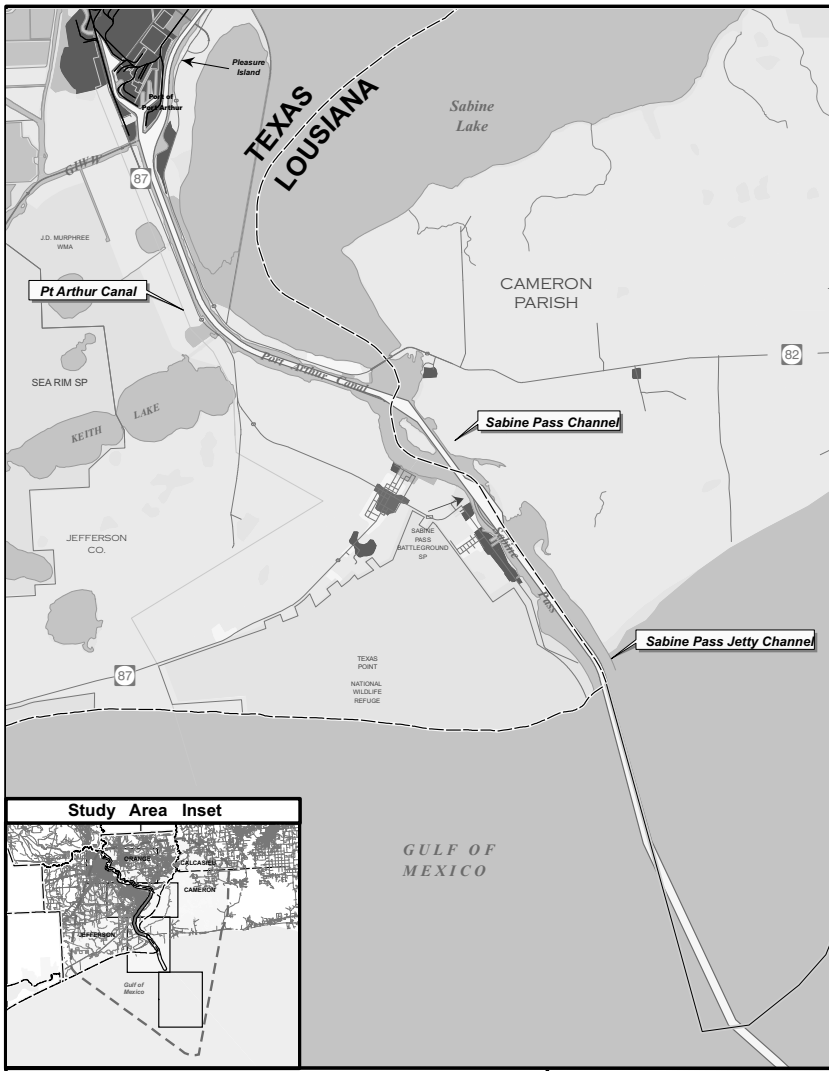


**Land Use/Land Cover (Source: USGS LU/LC 1990 Digital Data updated by PBSJ using aerial photo interpretation from 1995 aerial photos)**

- Commercial
- Industrial
- Mining
- Other Urban Land
- Park
- Residential
- Rural (Large lot/Ranchette) Residential
- Transportation and Utilities
- Vacant Land
- Water Features
- 1999 Roads
- Rivers & Streams
- Project Area, Proposed Channel
- County Boundary

N W E S

8,000 4,000 0 8,000 Feet

1 0.5 0 1 Miles

**Figure 3.14-3C**
**Land Use**
**Sabine-Neches Waterway**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 8,000' |
| Prepared by: 18895 | Date:07/09/2009 |
| File:N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/landuse_3_14_3C.mxd | |

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detailed study area is divided into the following subcategories: the Neches Channel, the Sabine-Neches Channel, the Port Arthur Channel, the Sabine Pass Channel, and the Sabine Pass Jetty Channel. Cities that are located adjacent to the detailed study area include Beaumont, Port Neches, Nederland, Groves, Bridge City, and Port Arthur.

As shown on Figure 3.14-3a, the City of Beaumont is located along the IH 10 corridor and along the western banks of the Neches Channel. Beaumont's downtown central business district (CBD) is located immediately west of the Neches Channel, and includes a variety of land uses including restaurants, retail shops, civic buildings, museums, hotels, and apartment buildings. The Beaumont CBD area includes the Art Museum of Southeast Texas, the Texas Energy Museum, the Jefferson County Courthouse, the Beaumont Civic Center, the Edison Plaza Museum, the Riverfront Park, the Fire Museum of Texas, and various other City of Beaumont and Jefferson County facilities. The Port of Beaumont is located on the southeast side of the CBD (at the intersection of Main Street and Blanchette Street) adjacent to the Neches Channel. Industrial sites in the Beaumont area are located adjacent to the Port of Beaumont along the Neches Channel, and to the southeast of the Beaumont city limits. Industrial uses in this area include Trinity Industries, ExxonMobile, Mobile Chemical, and North Star Steel.

Located east of Beaumont and along IH 10 is the City of Vidor. Vidor is a relatively small town with commercial uses located mainly along the IH 10 corridor. Residential neighborhoods of Vidor extend both north and south of the IH 10 corridor.

The City of Nederland is located southeast of Beaumont along the US Highway 287 corridor. This city is mostly residential in character with some commercial areas and parks. Industrial uses are located adjacent to Nederland to the north.

The City of Groves is located north of Port Arthur along SH 73. This relatively small city is mostly residential in nature and is bordered by heavy industrial uses to the northwest, north, northeast, and east.

Located along the southwest side of the Neches Channel is the City of Port Neches. This city includes older residential neighborhoods (located mostly near the Port Neches CBD), new subdivisions (mostly located on the southwest side of the city and near SH 347), commercial development along state highways and arterial roadways, and some civic buildings located mostly in the CBD. Industrial uses are located west and east of the city limits and along the Neches Channel. Notable industrial uses located to the west of Port Neches include Huntsman, Ameripol Synpol/Huntsman, Motiva Enterprises, and Air Liquide. Adjacent to the Neches River on the north side (north of Port Neches), land uses are mostly vacant land, with the exception of the Entergy – Sabine Plant.

North of the Sabine Pass area, the SNWW divides Pleasure Island and Sabine Lake from land areas west of the channel. Pleasure Island is a long narrow island that extends from the Sabine Pass area northward to the vicinity of the confluence of the Sabine and Neches rivers. The southern half of Pleasure Island consists primarily of vacant land. The northern half of Pleasure Island has some development in areas directly across from downtown Port Arthur. These developed areas consist of the Port Arthur Marina and

Yacht Club, the Pleasure Island Golf Course, Logans Park, City Hall Park, residential areas, and buildings and facilities operated by the USCG, the U.S. Army Reserve, the USACE, and Lamar University. SH 82 (T.B. Ellison Parkway) provides north-south access along Pleasure Island.

West of Pleasure Island and the Sabine-Neches Ship Channel is the City of Port Arthur. This area is characterized by heavy industry south, southwest, and north of the city. Land uses in the City of Port Arthur include commercial development mostly along state highways and arterial roadways, and residential neighborhoods, offices, and parks are interspersed throughout the city on collector and residential streets. Housing stock varies widely in terms of date of construction, size, and degree of maintenance. Civic buildings are located mostly in Port Arthur's CBD, which is located near the Sabine-Neches Ship Channel. Also located in the Port Arthur CBD is Lamar University – Port Arthur, and the Port of Port Arthur.

Notable industrial uses located east, southeast, and south of Port Arthur include Motiva Enterprises LLC, Huntsman, Ethyl Additives, Equilon, Premcor, Chevron, and the Texaco Terminal. Notable industrial uses that are located north of Port Arthur include Atofina, Horizon, Pabtex, R&R Marine Maintenance, and a variety of other industrial companies located either along SH 87/73 or adjacent to the SNWW.

Sabine Pass forms the southern entrance of the Sabine-Neches Ship Channel from the Gulf into the study area. In this area, on the Texas side (on the west side) of the Sabine Pass, is the Texas Point NWR and the Sabine Pass Battleground State Historical Park. Farther west along the Gulf coastline is Sea Rim State Park and the McFaddin Marsh NWR. This area is characterized by (mostly) undeveloped marshland and beaches, with numerous small lakes and wetland areas. The eastern side of Sabine Pass (the Louisiana side) consists almost entirely of undeveloped marshland and beaches. SH 82 parallels the Gulf coastline and connects with Johnson's Bayou, Holly Beach, Cameron, and the Calcasieu Lake area to the east.

In Louisiana, east of Sabine Lake, land is mostly vacant and consists primarily of wetland areas. The Sabine NWR makes up much of the land area in this portion of Cameron Parish. Very few roads or other urbanized land uses are located in this area.

#### 3.14.4.1 Transportation

##### *3.14.4.1.1 Roadways*

Surface transportation in the vicinity of the study area is provided by a network of primary, secondary, and local roads. IH 10 is the primary artery of the BPA MSA. US 69, 90, and 287 and SH 347 also facilitate travel throughout the study area. As a result of the area's heavy dependence on industrial manufacturing, rail and sea transportation are vital within the area.

Transportation in Cameron Parish is served by two major state highways. The major north-south routes through the parish follow SH 27, which connects with IH 10 in Calcasieu Parish (16 miles north of the Cameron Parish border). The major east-west route through the parish is SH 82, which follows the Gulf Coast. Traffic on SH 27 and SH 82 must use the Cameron Ferry to cross the Calcasieu River Ship

Channel. Intercity bus service is provided only in Lake Charles and in Sulphur (Cameron Parish Police Jury, 2002). In Cameron Parish, IH 10 provides for east-west travel through the parish. SH 171 provides for travel to points north of Lake Charles.

#### *3.14.4.1.2 Airports*

There are no public general or commercial aviation airports in Cameron Parish. There are several private companies that have landing strips and offer helicopter services (primarily to the offshore oil and gas industry).

The Southeast Texas Regional Airport is located 10 miles south of Beaumont on US 69. This airport is served by Continental Express providing direct service to Houston and Dallas-Fort Worth. The Orange County Airport, located 3 miles southwest of Orange, serves general aviation needs for the study area. The Beaumont Municipal Airport serves the City of Beaumont and is located on US 90, 6 miles west of the city.

Due to the increasing concern about aircraft-wildlife strikes, the FAA has implemented standards, practices, and recommendations for holders of Airport Operating Certificates issued under Title 14, CFR Part 139, Certification of Airports, Subpart D (Part 139), to comply with the wildlife hazard management requirements of Part 139. Airports that have received Federal grant-in-aid assistance must use these standards.

When considering proposed dredged spoil, BU features, and mitigation areas, developers must take into account whether the proposed action will increase wildlife hazards. The FAA recommends minimum separation criteria for land use practices that attract hazardous wildlife to the vicinity of airports. These criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport's approach or departure airspace or air operations area (AOA).

These separation criteria include:

- Perimeter A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest AOA (does not include any of the three airports within the study area);
- Perimeter B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest AOA (includes the three airports within the study area); and
- Perimeter C: 5-mile range to protect approach, departure, and circling airspace (includes the three airports within the study area).

Airports within the study area that must comply with these standards include the Orange County and Southeast Texas Regional airports and the Beaumont Municipal Airport, which is located just outside the study area (Figure 3.14-4a). Figures 3.14-4b–c show the perimeters around the AOA of 5,000 feet, 10,000 feet, and 5 miles surrounding these airports. Although the Beaumont Municipal Airport itself is not located within the study area, the 5-mile perimeter does fall within the study area (Figure 3.14-4d).

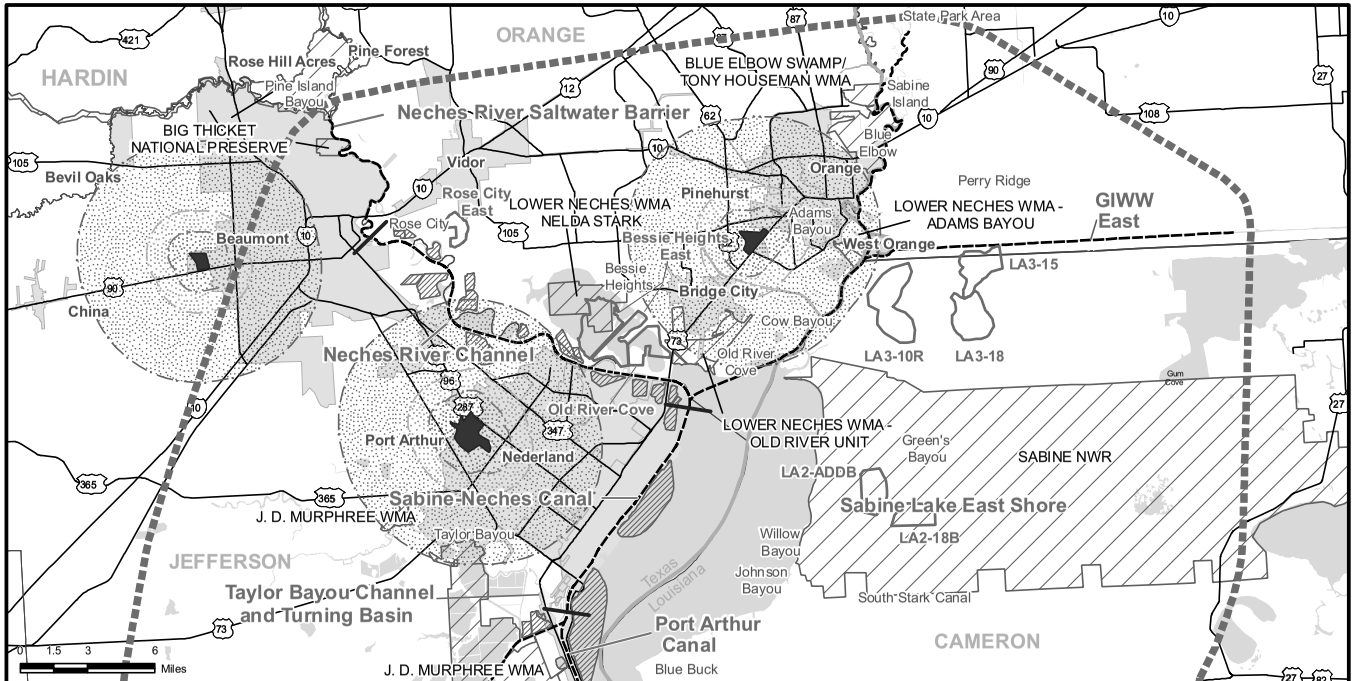


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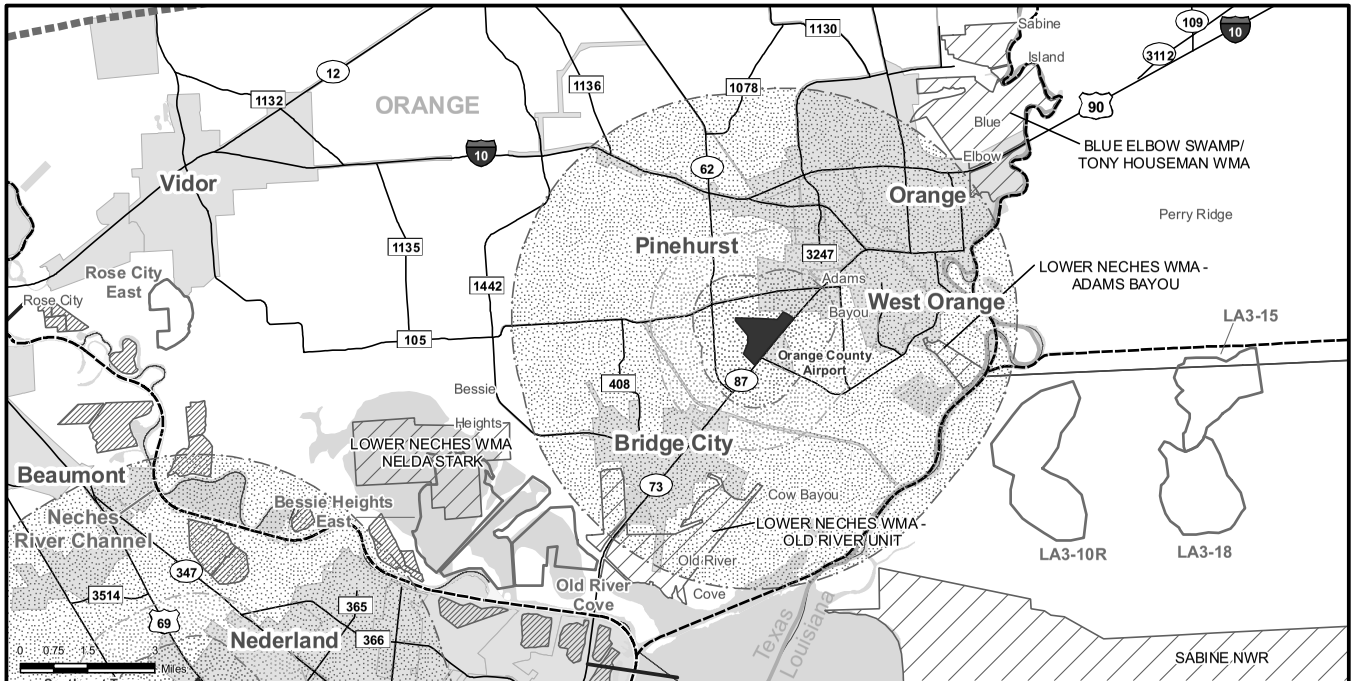
**Figure 3.14-4a**
**Sabine-Neches Waterway Airport Locations FAA AOA**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1 inch = 6 miles |
| Prepared by: RF | Date: 1 April 2010 |

File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Fig_airport_AOA_vr3.mxd




## Legend

- Project Area, Dredged Channel
- State Parks, National Wildlife Refuges, and Wildlife Management Areas
- Project Area, Dredged Material Placement Areas
- Project Area, BU Features
- State Boundaries
- Channel Centerlines
- County Boundaries
- Study Area
- Channel Reach Limits
- Airport
- Perimeter: 5,000 ft; 10,000 ft; 5 mi

N

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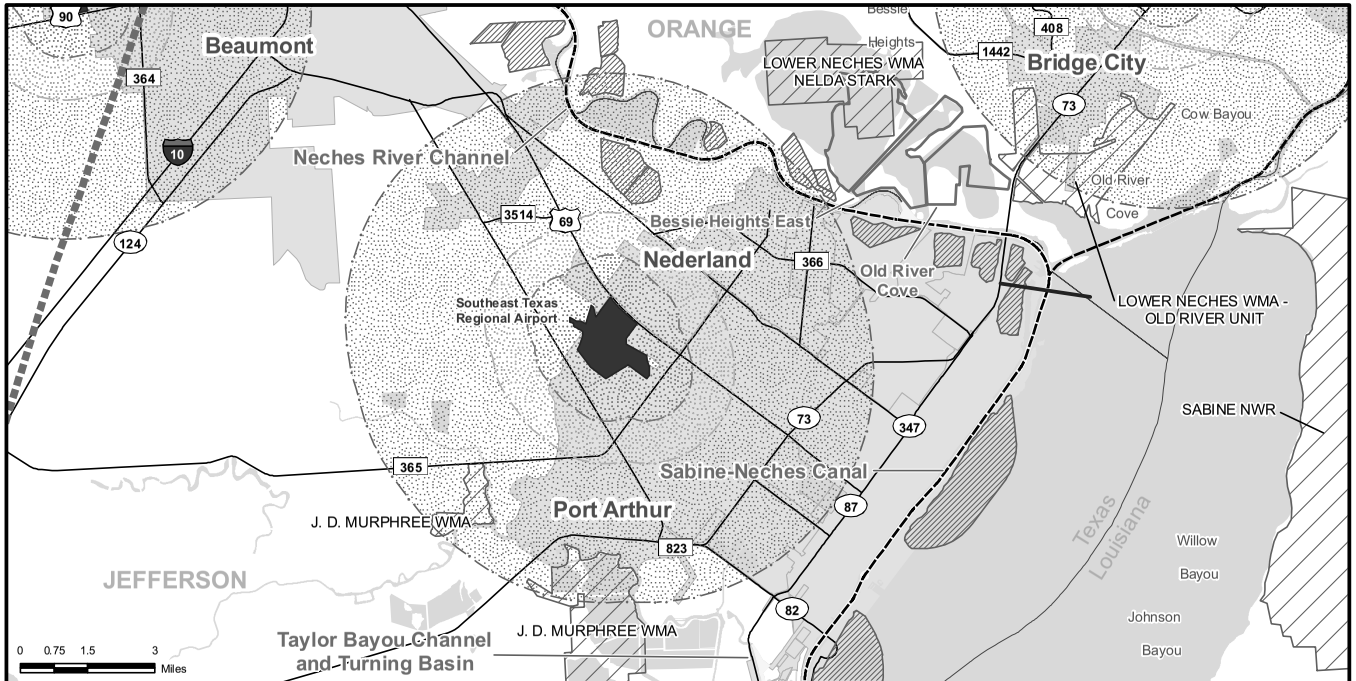
**Figure 3.14-4b**

**Sabine Neches Waterway**
**Orange County Airport**
**FAA AOA**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1 inch = 3 miles |
| Prepared by: RF | Date: 1 April 2010 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Fig_airport_AOA_OrangeCountyArpt_v3.mxd




**Legend**

- Project Area, Dredged Channel
- State Parks, National Wildlife Refuges, and Wildlife Management Areas
- Project Area, Dredged Material Placement Areas
- Project Area, BU Features/ Mitigation Areas
- State Boundaries
- Channel Centerlines
- County Boundaries
- Study Area
- Channel Reach Limits
- Airport
- Perimeter: 5,000 ft, 10,000 ft, 5 mi

N

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**Figure 3.14-4c**

**Sabine Neches Waterway**
**Southeast Texas Regional Airport**
**FAA AOA**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1 inch = 3 miles |
| Prepared by: RF | Date: 1 April 2010 |

File:N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Fig_airport_AOA_SoutheastTxRegional_vr3.mxd

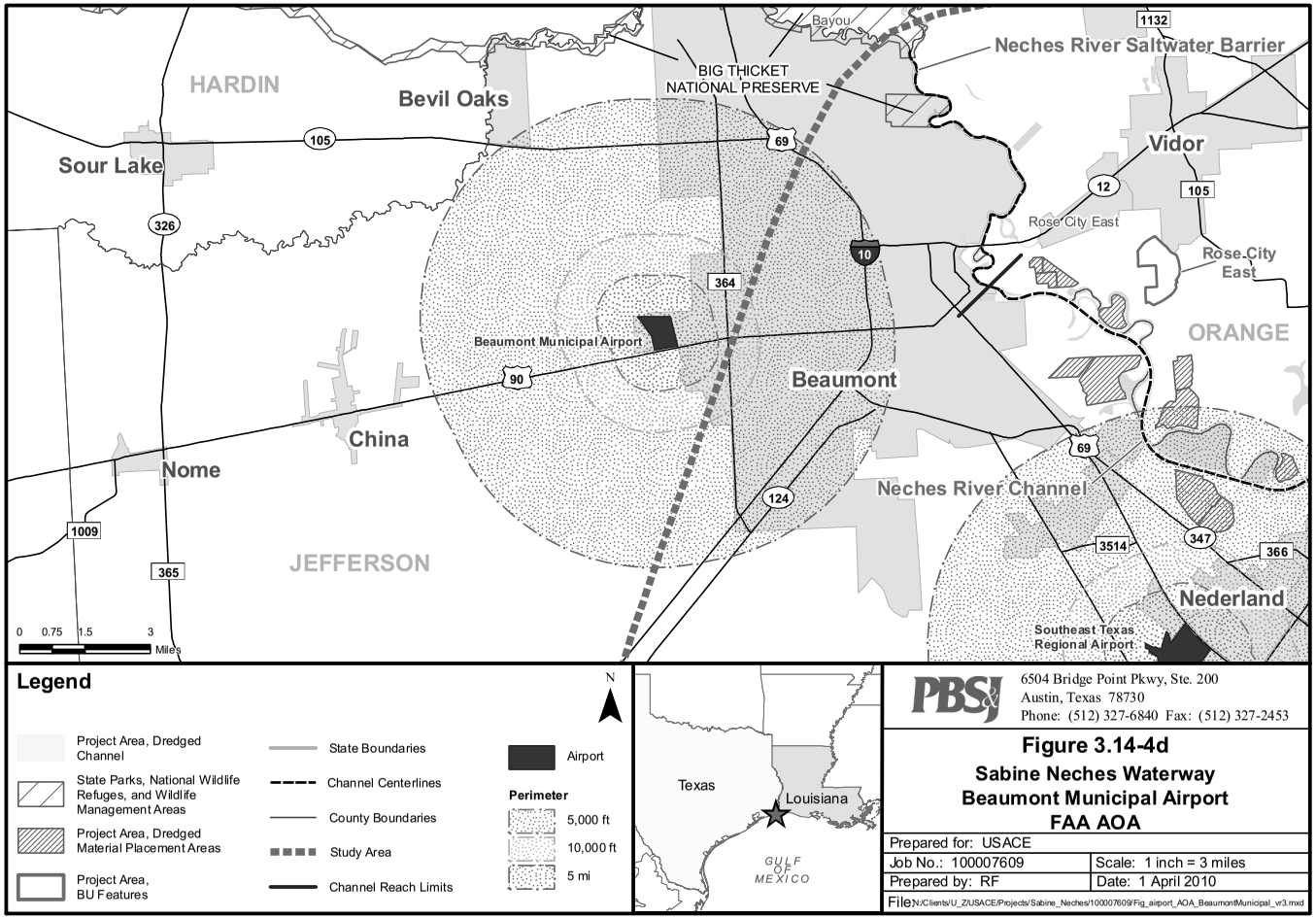


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**Figure 3.14-4d**
**Sabine Neches Waterway**
**Beaumont Municipal Airport**
**FAA AOA**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1 inch = 3 miles |
| Prepared by: RF | Date: 1 April 2010 |
| File: N:\Clients\U_Z\USACE\Projects\Sabine_Neches\100007609\Fig_airport_AOA_Beaumont\Municipal_vr3.mxd | |

#### *3.14.4.1.3 Railways*

There is no rail service to Cameron Parish. Connections to three major freight rail systems (the Kansas City Southern Railway, the Union Pacific System, and the Southern Pacific Transportation Company) can be obtained in the nearby Lake Charles/Westlake/Sulphur metropolitan area of Calcasieu Parish. Amtrack Intercity Rail Passenger service is also available in Lake Charles.

Several rail carriers provide transportation within the study area, and form an important link to the Port of Beaumont, the Port of Port Arthur, and the Port of Orange. The four major rail carriers are Burlington Northern Santa Fe, Union Pacific, Kansas City Southern Railroad, and Tex Mex Rail Road. The Sabine River and Northern is a short-line railroad running through the area. Beaumont has 13 motor freight carrier terminals and 53 general freight carriers that serve the MSA's transportation needs (Texas A&M University, 2000).

### 3.14.4.2 Community Services

#### *3.14.4.2.1 Fire, Police, and Emergency Medical Service*

Fire protection within the vicinity of the study area is handled by a combination of municipal and volunteer fire departments (VFD). Fire departments serving the study area include the Beaumont Fire Department, Nederland Fire-Rescue Department (includes the Nederland VFD), Port Arthur Fire Department, and the City of Groves Fire Department.

In Beaumont, fire protection is provided by the City of Beaumont Fire Department, which covers approximately 85 square miles and serves approximately 113,400 people. There are 229 paid personnel serving the city. This fire department responds to fire, medical, hazardous material, high-rise rescue, and dive rescue emergencies. The department includes 10 fire engines, 2 aerial pumpers, 2 aerial trucks, and 3 rescue trucks (City of Beaumont, 2009).

Fire protection within the city limits of Nederland is handled by the Nederland Fire-Rescue Department, which includes the Nederland VFD. Together, the Nederland Fire-Rescue Department and the Nederland VFD serve an area of approximately 4.5 square miles and approximately 17,400 residents who live within the City of Nederland and its Extraterritorial Jurisdiction (ETJ). There are 17 volunteer firefighters, and 6 of these personnel form a 6-person specialized rescue team. This fire department has the following equipment: three pumpers/engines, one 75-foot aerial truck, and one rescue truck. These fire departments respond to both fire and medical emergencies (City of Nederland, 2009).

In Port Arthur, fire protection is provided by the City of Port Arthur Fire Department, which covers an area of approximately 142 square miles serving approximately 57,800 people. There are 105 firefighters and 7 fire stations serving the residents and industrial areas of the city. This fire department responds to fire, medical, and hazardous materials emergencies. The services of this fire department are broken into the departments of Administration, Suppression, Training, Prevention, Communications, and Maintenance. This fire department includes the following equipment: seven fire engines, one snorkel, one

dive and high-angle rescue van, one hazardous materials truck, and several rescue boats (City of Port Arthur Fire Department, 2009).

Fire protection within the city limits of Groves is provided by the City of Groves Fire Department, which covers approximately 4 square miles and serves approximately 15,733 residents living within the city limits and its ETJ. The fire department responds to fire, medical, and hazardous materials emergencies. There are 14 paid firefighters and 25 volunteers operating from one fire station that is centrally located. This fire department includes the following equipment: three pumpers, one utility van, one utility pickup truck, one Chief's car, and one Assistant Fire Marshall's car (City of Groves, 2009).

The Insurance Services Office (ISO) ranks in accordance with the *Fire Suppression Rating Schedule* manual. The rankings are determined through the examination of three primary factors: the city's alerting system (i.e., 911 service and fire alarm systems) (10 percent); the fire department itself (50 percent); and the existing water system (40 percent). In Texas, the *Fire Suppression Rating Schedule* has been modified to include the following fire prevention activities: fire prevention code information, fire investigation, public fire safety education, construction code enforcement, attendance in Texas A&M's Fireman Training School, the number of certified volunteer firefighters available, and membership in the State Fire Marshall's Association or Texas Commission on Fire Protection. On the *Fire Suppression Rating Schedule* scale of 1 to 10 (1 being best), the ISO gives the City of Nederland Fire-Rescue Department a rating of 5, the City of Port Arthur Fire Department a rating of 3, and the City of Groves Fire Department a rating of 4 (Bradley, 2002).

#### *3.14.4.2.2 Public Services and Utilities*

Within the study area, a variety of entities provides electric utility, natural gas, water, wastewater, and solid waste disposal services. These services are summarized in Table 3.14-19.

#### *3.14.4.2.3 Regional Water Planning*

The TWDB has provided information pertaining to water supply, demand, and management direction for 16 Regional Water Planning Areas in Texas in the 2007 State Water Plan, Water for Texas – 2007, which was adopted by the Board on November 14, 2006. This State Water Plan document provides baseline information and planning policy related to the East Texas Region (Region I), which includes 20 counties of East Texas, including three counties (Hardin, Jefferson, and Orange) within the proposed project study area (TWDB, 2007).

The East Texas Region Planning Group identified water supply needs for 92 out of 165 water user groups in the region. The total needs by 2060 are about 1,261,320 acre-feet per year. There are 47 urban and rural municipalities and 18 irrigation and livestock user groups with needs in 2060. Estimated capital costs of recommended water management strategies for meeting needs over the 50-year planning horizon are about $613 million (TWDB, 2007).

Table 3.14-19
Public Service and Utility Providers within the Study Area

| | Electric Utility Service | Natural Gas Service | Water | Waste Water | Solid Waste Disposal Service |
|---|---|---|---|---|---|
| City of Beaumont | Entergy | Reliant Entex | City of Beaumont | City of Beaumont | City of Beaumont |
| City of Nederland | Entergy | Reliant Entex | City of Nederland | City of Nederland | City of Nederland |
| City of Port Neches | Entergy | Southern Union Gas | City of Port Neches | City of Port Neches | City of Port Neches |
| City of Groves | Entergy | Southern Union Gas | City of Groves | City of Groves | City of Groves |
| City of Port Arthur | Entergy | Southern Union Gas | City of Port Arthur | City of Port Arthur | City of Port Arthur |
| Unincorporated areas of Jefferson County | Entergy | Southern Union Gas and Reliant Gas | | | |
| Unincorporated areas of Hardin County | | | | | |
| City of Vidor | | | | | |
| City of Bridge City | Entergy | Reliant and Entergy Entex | City of Bridge City | City of Bridge City | City of Bridge City |
| City of Orange | | | City of Orange | City of Orange | City of Orange |
| City of West Orange | | | | | |
| Unincorporated areas of Orange County | Entergy and Gulf States Utilities | Entex and United Texas Transmission | | | |
| Unincorporated areas of Calcasieu Parish | Entergy | Reliant Entex | Publicly provided by multiple water districts | Mechanical Sewer and Septic Systems | Waste Management Inc. |
| Unincorporated areas of Cameron Parish | | | | | |

Sources: Entergy Louisiana (2002); City of Beaumont (2002); City of Bridge City (2002); City of Nederland (2005); City of Port Neches (2002); Bellard (2002); Cendercast (2002); Greater Orange Area Chamber of Commerce (2002).

The largest water user in the East Texas Region is steam electric, which accounts for 51 percent of the total demand of about 1.75 million acre-feet per year in 2060. Increases in steam-electric power generation, mining, and irrigation demands are also expected. Municipal water use for the region is projected to increase between 2010 and 2060, from about 151,000 acre-feet per year to 188,000 acre-feet per year. Five counties (including two study area counties), Angelina, Jefferson, Nacogdoches, Orange, and Smith, account for most of the total municipal use for the region in 2060. The cities (includes three study area cities) of Lufkin, Beaumont, Port Arthur, Nacogdoches, Orange, and Tyler are included in these counties. These cities would rely on increased groundwater and surface water production to meet

their needs. The only unmet needs in 2060 are 3-acre-feet per year for mining and 17 acre-feet per year for municipal uses (TWDB, 2007).

#### 3.14.4.3 Aesthetics

The term aesthetics deals with the subjective perception of natural beauty in a landscape by attempting to define and measure an area's scenic qualities. Consideration of the visual environment includes a determination of aesthetic values (where the major potential effect of a project on the resource is considered visual) and recreational values (where the location of a proposed project could potentially affect the scenic enjoyment of the area). Aesthetic values considered in this study, which combine to give an area its aesthetic identity, include:

- topographical variation (hills, valleys, etc.)
- prominence of water in the landscape (rivers, lakes, etc.)
- vegetation variety (woodlands, meadows, etc.)
- diversity of scenic elements
- degree of human development or alteration
- overall uniqueness of the scenic environment compared with the larger region

The study area consists of a variety of terrain characterized by varying levels of aesthetic quality. The topography of the area is mostly flat to gently rolling, with very few outstanding elevational changes. Natural water features within the study area include the following: Sabine Lake, the Neches River (upstream of the Neches Channel), the Sabine River (upstream from the Sabine Channel), Black Marsh Lake, Black Bayou, Cow Bayou, Old River Bayou, numerous relatively small lakes, and many wetland areas. Also, the Gulf forms the southern border of the study area. Water features that are heavily used for waterborne commerce show a high a degree of human development and alteration and include the following: the Neches Channel, the Sabine Channel, the Sabine-Neches Channel, the Port Arthur Channel, the Sabine Pass Channel, the Sabine Pass Jetty Channel, and the GIWW. Also some areas of Sabine Lake (especially on the Texas side of the lake) show a moderate degree of human development and alteration.

In general, in areas that are not urbanized, the study area exhibits a variety of vegetation types. Generalized vegetation within the study area is shown on Figure 3.9-1 and discussed in more detail in Section 3.9. Wetland areas are found surrounding Sabine Lake, along the Gulf Coast on both the Texas and Louisiana side, throughout most of the Louisiana portion of the study area and within the floodplain areas of the Sabine and Neches rivers/channels. Agricultural lands are found mostly in the western, northern, and northeastern portions of the study area. Forested or woodland upland areas are found primarily in the northern portion of the study area between the Sabine and Neches rivers.

However, the study area has also seen widespread human development, which can, depending on the type and scale, detract or add to the overall aesthetic quality (see figures 3.14-3a–c). Urban development

within the study area is concentrated in and around the following municipalities: Beaumont, Nederland, Port Neches, Groves, Port Arthur, Vidor, Bridge City, West Orange, and Orange. Land uses within the urbanized areas include a variety of residential neighborhoods, commercial or CBD districts, transportation systems (highways and railways), civic uses, parks, schools, port facilities, and heavy industry areas. The single largest detraction from the aesthetics of the study area is undoubtedly the heavy industry areas. There are large areas of heavy industry located near to the detailed study area (along the SNWW) southeast of Beaumont and in areas near Port Neches, Groves, and Port Arthur.

Generally speaking, the study area is not particularly distinguished in aesthetic quality from other adjacent areas within the region, although some areas within the region lack the vast waterbodies of the study area. The landscape exhibits a generally moderate to high level of impact from human development and alteration. No designated scenic views or scenic roadways were identified from the literature review or from field reconnaissance of the study area.

# 4.0 ENVIRONMENTAL CONSEQUENCES

This chapter is divided into 16 sections. Section 4.1 describes how the HS and WVA models were used to evaluate project impacts. Section 4.2 discusses risk and uncertainty in the application of these models. This is followed by separate sections that discuss project impacts to each category of physical, natural, cultural, and socioeconomic resources in the SNWW study. The chapter ends with a discussion of cumulative impacts in Section 4.16.

Environmental consequences analysis of the Preferred Alternative includes the assumption that the eight Neches River Turning and Anchorage Basins (Alternative G, Table 2.3-1) are a component of the SNWW CIP.

## 4.1 MODELING FUTURE WITHOUT AND WITH-PROJECT CONDITIONS

The evaluation of ecological impacts to the extensive wetland habitats in the study area was performed primarily with WVA models. These models provide quantitative estimates of changes to the quality and quantity of fish and wildlife habitat in the SNWW's wetland communities. The WVA is primarily driven by salinity predictions from the HS model. Both FWOP and FWP effects must be determined using the WVA models and the differences between the two calculated in order to determine the effects of the proposed project.

The HS model is described in detail in a separate report (Brown and Stokes, 2009). In brief, the HS model is a 3-dimensional TABS-MDS code that propagates flow and salinity throughout the model domain in response to many factors (e.g., tides, Gulf boundary conditions, winds, freshwater inflows). A 3-dimensional simulation was employed in the navigation channels and Sabine Lake, and 2-dimensional simulation (vertically integrated) was used in the shallow tributaries.

As described in Brown and Stokes (2009), the HS model was calibrated and verified using field observations collected by the ERDC during a long-term data collection effort at 16 stations in the study area from May 16, 2001, through January 10, 2002 (Fagerburg, 2003). The model tidal elevations, discharge measurements, current velocities, and salinities were compared to field data obtained during the period, and figures showing these comparisons can be reviewed in Brown and Stokes (2009). In general, the model performed reasonably well. The tidal elevations were comparable to field data near the coast with the level of agreement reduced somewhat in the upper reaches. Discharge and current velocity observations were also similar to model output at most but not all stations. The salinity comparisons were also reasonably close. It was noted that while salinity stratification was qualitatively correct, the model was somewhat more diffusive than observed and the amount of upstream salinity transport may at times be underestimated. However, a sensitivity analysis was conducted to investigate how well the model behaves under conditions when the flow is not changing rapidly. Since flow changes associated with the project would not be rapid, the behavior of the model under these conditions provides a better reflection of the gradual changes expected with the project. The model was found to behave better at most gages

under these conditions. Overall, the model provides a very detailed representation of the system and appears to be a suitable tool for evaluating project effects.

With the model developed and performance demonstrated against field data, the next step was using the model to quantify changes in the FWP and FWOP conditions. Two key components of this future evaluation are freshwater inflows and relative sea level change. After these components are described, the FWOP and FWP conditions are presented.

### 4.1.1 Freshwater Inflows

Freshwater inflow for the SNWW HS model's future conditions were developed using model outputs from Run 8 of the TCEQ Water Availability Models (WAM) for the lower Sabine and Neches rivers. For existing conditions, "Run 8 uses modified diversion amounts (maximum use for the last 10 years), year 2000 area-capacity parameters for major reservoirs, and assumed return flows. It also includes term water rights and provides the most realistic assessment of current streamflow conditions" (TWDB, 2007). The TWDB projected flows for the year 2060 by modifying Run 8 "to include projected increased demand from existing water rights, expected change to return flows, projected new strategies to come online before 2060, and estimated year 2060 storage capacities for major reservoirs" (TWDB, 2007).

The 2060 WAM runs were selected for use in the SNWW HS modeling because they were developed by the State's lead water planning agency, and they include future water supply strategies approved by the 2007 Texas State Water Plan (TWDB, 2007). The SNWW study area is included in Regional Plan I for the East Texas Region. The Region I water plan takes into consideration existing flows that are dedicated to the State of Louisiana as prescribed by the Sabine River Compact. All existing and proposed future strategies for meeting Texas's demand must be met by the Texas firm-yield share (750,000 acre-feet) of the total Sabine River flow, as appropriated under the use provision of Certificate of Adjudication No. 05-4658 (March 5, 1958). The 2060 WAM model does not attempt to predict future demand in the Louisiana portion of the Sabine Basin. This should not significantly affect future projections because the Louisiana portion of the basin is comprised primarily of undeveloped, coastal wetlands.

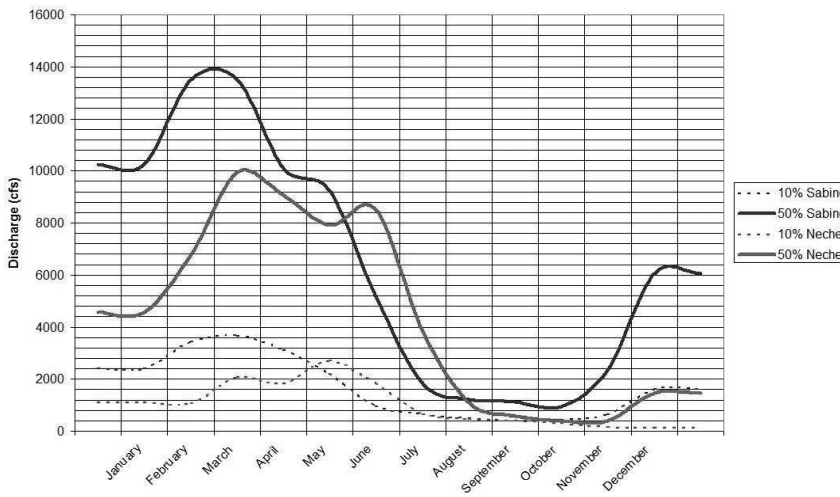
By 2060, Region I's population is projected to grow 36 percent, and water demands are projected to increase by 41 percent. The greatest increase (48 percent) is expected in the demand for water for manufacturing. Municipal demand is expected to grow 24 percent. The existing water supply is projected to decrease slightly by 2060, due primarily to reservoir sedimentation and a small decline in groundwater supply. Although the region as a whole appears to have enough supply to meet demands through 2060, the total water supply is not readily available to all users.

The regional plan recommends the following strategies to provide the additional water supply projected to be needed by 2060: (1) the construction of Lake Columbia reservoir in the Neches River watershed; (2) cooperation with Region C, which includes the Dallas-Fort Worth metropolitan area, in the use of surface water from Toledo Bend Reservoir and proposed Lake Fastrill; (3) expanded groundwater use by smaller communities; and (4) municipal conservation throughout the region.

The WAM outputs were developed using current patterns of precipitation and evaporation. The USACE did not modify the models to use projected precipitation or evaporation for SNWW future conditions because the Texas State Climatologist has recently concluded that it is impossible to predict with confidence what precipitation trends would be in Texas over the next half century (Nielsen-Gammon, 2009). Unlike precipitation, there is more consensus for a predicted temperature increase in Texas of close to 4°F by 2060. No attempt was made to change future temperatures in the model because resulting changes in evapotranspiration would be so small as to negligibly change modeling results.

Two freshwater inflow conditions, median and low, were developed for project evaluation. For both flow conditions, the ERDC provided salinities for all model stations and nodes for WVA modeling. Figure 4.1-1 illustrates the inflow values employed for the two major inflow sources for both the 10th percentile, low flow (dotted lines), and 50th percentile, median flow (solid lines), obtained from the WAM monthly output files.

Figure 4.1-1. SNWW Low and Median Inflow Hydrographs




These inflows were used for all impact analyses. The low inflow runs were conducted for 5 months, June through October, with June and July used for model spin-up. The spin-up months allow the model to reach a dynamic equilibrium for salinity and are not used in the analysis. The model output for the 3-month period from August through October was used for the low-flow sensitivity analysis. The median-flow simulation covered 6 months, April through September, with only 1 month, March, used for spin-up. The shorter spin-up period for the median flow was because the higher flow resulted in lower water residence times in the system. The median-flow output was used for all impact analyses.

Additional boundary conditions include flows in and out of the GIWW on the east and west boundaries of the study area, direct precipitation inputs, and the Gulf boundary condition salinity. Details are provided in Brown and Stokes (2009).

### 4.1.2 Relative Sea Level Rise

While the future rate of RSLR at the Sabine-Neches Estuary is very uncertain, it must be considered in project planning. Current USACE guidance (ER 1105-2-100; April 2000) stipulates that NRC (1987) should be used to determine the potential impacts of sea level rise on plan formulation and engineering structures. RSLR consists of two components: global (eustatic) sea level rise and local subsidence. The uncertainty inherent in the rates of eustatic sea level rise is evident in the variability of the different modeled rates given for the NRC (1987) projections and the Intergovernmental Panel on Climate Change (IPCC, 2007). A similar degree of uncertainty exists with the rate of local subsidence.

A detailed review of both eustatic and local subsidence rates was performed by the ERDC (Brown and Stokes, 2009). This review found the eustatic rate estimates range from 1.8 mm/year to 6.45 mm/year for the next 50 years. This study employs an estimate for eustatic rise (4.5 mm/year) that is in the middle of the range projected by NRC (1987) and in the high middle range of that predicted by IPCC (2007). In coastal Louisiana, estimates of the local subsidence component of RSLR were found to range from 0.4 to 0.6 mm/year based on basal peat measurements (Törnqvist et al., 2006), 2 to 5 mm/year as averaged from 48 years of tide gage data (Morton et al., 2006), and to 10 to 15 mm/year as measured from settling rates of established benchmarks (Shinkle and Dokka, 2004). The ERDC's review concluded that the lower rates were the most technically valid. These lower rates represent long-term trends in the subsidence rate, and seem to be the closest approximation of consensus concerning the local subsidence rate that is currently available.

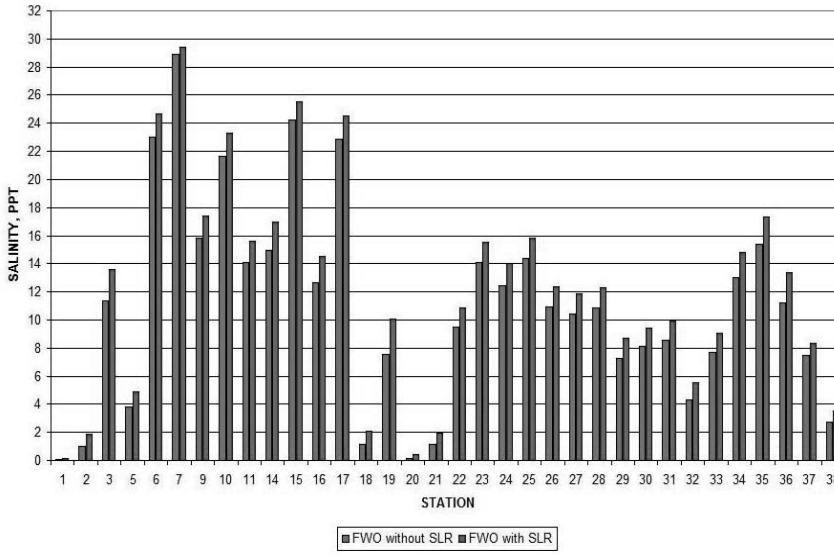
Adding these to the NRC II projections for eustatic sea level rise yields a value for the RSLR in the SNWW study area over 50 years of 4.9 to 5.1 mm/year. The average of these, 5.0 mm/year is used for modeling purposes.

Therefore, the "most likely" value of RSLR to be used for the SNWW deepening study's 50-year period of analysis is 250 mm (0.82 foot). Adjusting this to account for the period of analysis beginning in 2019 and ending in 2069 (the new period of analysis for the SNWW reformulation), the "most likely" amount of RSLR by the year 2069 is 335 mm (1.1 feet).

Figure 4.1-2 illustrates the effect of RSLR on predicted FWOP salinity in the system with the low (10th percentile) flows. The two simulations illustrate the salinity difference between the FWOP salinities without RSLR and the FWOP salinities with RSLR. Both simulations use the same inflows (WAMs 2060 inflows). At most stations, the RSLR is predicted to cause average salinity to increase about 1 ppt.

Incorporating RSLR in the HS model raises water elevation uniformly by 1.1 feet, which in turn allows greater salt transport through the system. At Bessie Heights, the salinity increase with the low-flow inputs is 2.0 to 2.5 ppt. At the median inflows, the salinity increase from RSLR is 1.0 to 1.5 ppt.

Figure 4.1-2. Mean Salinity Values, Low-Flow Conditions




### 4.1.3 Application of HS Model to Predict Project Effects

Having established the HS model's performance against field data and future conditions expected for freshwater inflows and RSLR, the next step is to use the model to predict changes in water elevations and salinity associated with project alternatives (the FWP condition). All simulations were performed using the low and median freshwater inflows and the 1.1 feet RSLR increase. Three types of project alternatives are considered: the 48-foot depth, other depth alternatives, and the effect of salinity mitigation measures.

#### 4.1.3.1 Water Surface Elevations – 48 Foot Channel

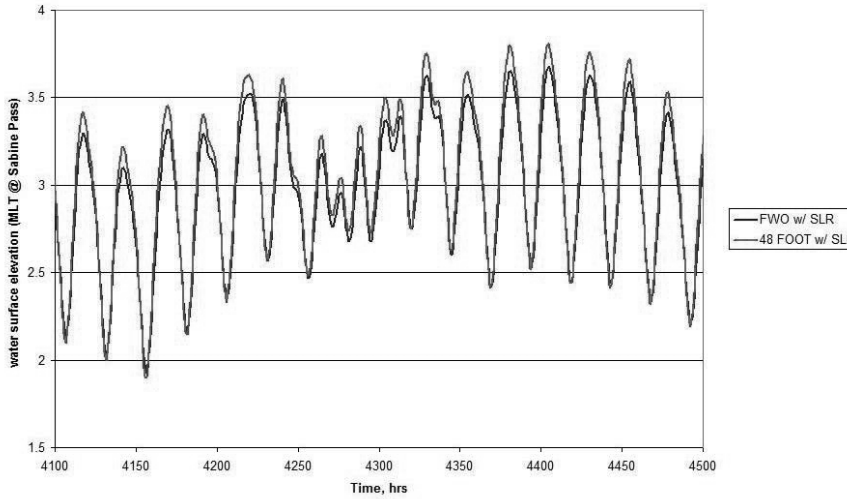
Water surface elevation over the study area was largely unaffected by the deeper navigation channel. An exception to the general result is the upper end of the Neches River near the saltwater barrier. Figure 4.1-3 provides a sample of the tides with and without the 48-foot channel at this location. The average high-water elevation appears to increase by 0.067 foot.

#### 4.1.3.2 Salinity Changes – 48-Foot Channel

The effect of the 48-foot navigation channel is to increase salinity over most of the study area. The increase is greater for the median flows than for the low flows, reflecting a greater salinity gradient at high inflows, which allows a greater effect from the density current. Tables 4.1-1 and 4.1-2 provide a statistical analysis of salinity differences at 17 stations throughout the system for the low- and median-

flow conditions. The tables provide the average differences between FWP and FWOP for surface, mid-depth, and bottom depths at each station.

Figure 4.1-3. Time Series of Tide at Neches River Salt Water Barrier – Low-Flow Case




The model salinity results are used for WVA modeling. The WVA requires input of "mean salinity" during the growing season and "mean high salinity" for impacts to fresh and intermediate habitats. The term "mean high salinity" is defined as the average of the highest 33 percent of consecutive salinity readings during a specified period of record. These two outputs of the HS model: mean and highest 33 percent, are the primary inputs to the WVA modeling.

#### 4.1.3.3 Salinity Changes – Other Channel Depths

A model run with a 45-foot channel indicated that the salinity differences from the FWOP were similar to those with a 48-foot channel but lower in magnitude. To address salinity changes at other channel depths besides 48 and 45 foot, a quadratic equation was developed at each station based on model results at 0-, 5-, and 8-foot channel depth increase. This allowed the salinity change for each channel depth alternative to be predicted without having to model each deepening scenario independently.

Table 4.1-1
Statistical Analysis of Salinity Differences – Low Flow

| | Average Differences | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station Number | 1 | 2 | 3 | 5 | 6 | 7 | 9 | 10 | 11 | 14 | 15 | 16 | 17 |
| Surface Salinity | 0.14 | 0.68 | 0.41 | 0.89 | 0.08 | –0.31 | 1.03 | –0.10 | 1.01 | 0.96 | –0.05 | 1.01 | 0.02 |
| Mid-depth Salinity | 0.14 | 0.83 | 0.69 | 0.68 | 0.06 | –0.25 | 1.03 | –0.11 | 0.99 | 0.96 | –0.04 | | 0.01 |
| Bottom Salinity | 0.14 | 0.85 | 0.55 | 0.58 | 0.00 | –0.21 | 1.03 | –0.12 | 0.99 | 0.97 | –0.05 | | 0.00 |

| | Standard Deviation of the Differences | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station Number | 1 | 2 | 3 | 5 | 6 | 7 | 9 | 10 | 11 | 14 | 15 | 16 | 17 |
| Surface Salinity | 0.15 | 0.20 | 0.36 | 0.49 | 0.45 | 0.32 | 0.17 | 0.55 | 0.18 | 0.13 | 0.40 | 0.20 | 0.23 |
| Mid-depth Salinity | 0.15 | 0.18 | 0.20 | 0.32 | 0.47 | 0.27 | 0.17 | 0.55 | 0.15 | 0.13 | 0.40 | | 0.23 |
| Bottom Salinity | 0.15 | 0.23 | 0.25 | 0.35 | 0.47 | 0.26 | 0.17 | 0.55 | 0.15 | 0.14 | 0.41 | | 0.23 |

Note: Statistics calculated after the spin-up period (hr 5088-7296)

Table 4.1-2
Statistical Analysis of Salinity Differences – Median Flow

| | Average Differences | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station Number | 1 | 2 | 3 | 5 | 6 | 7 | 9 | 10 | 11 | 14 | 15 | 16 | 1.62 |
| Surface Salinity | 0.00 | 0.13 | 0.79 | 0.23 | 1.60 | 0.11 | 1.37 | 1.18 | 1.09 | 1.61 | 1.41 | 1.38 | 1.60 |
| Mid-depth Salinity | 0.00 | 0.16 | 1.18 | 0.22 | 1.78 | 0.25 | 1.37 | 1.16 | 1.11 | 1.62 | 1.42 | | 1.58 |
| Bottom Salinity | 0.00 | 0.26 | 1.18 | 0.21 | 1.70 | 0.29 | 1.38 | 1.12 | 1.11 | 1.62 | 1.41 | | |

| | Standard Deviation of the Differences | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station Number | 1 | 2 | 3 | 5 | 6 | 7 | 9 | 10 | 11 | 14 | 15 | 16 | 17 |
| Surface Salinity | 0.01 | 0.22 | 0.64 | 0.44 | 1.20 | 1.01 | 0.73 | 0.90 | 0.73 | 0.59 | 0.88 | 0.61 | 0.83 |
| Mid-depth Salinity | 0.01 | 0.28 | 0.69 | 0.38 | 1.24 | 0.98 | 0.73 | 0.92 | 0.73 | 0.59 | 0.92 | | 0.83 |
| Bottom Salinity | 0.01 | 0.43 | 0.63 | 0.37 | 1.26 | 0.95 | 0.73 | 0.97 | 0.73 | 0.60 | 0.97 | | 0.83 |

| | Highest 10 Percent of Differences | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station Number | 1 | 2 | 3 | 5 | 6 | 7 | 9 | 10 | 11 | 14 | 15 | 16 | 17 |
| Surface Salinity | 0.01 | 0.55 | 1.63 | 0.91 | 3.04 | 1.53 | 2.26 | 2.14 | 2.01 | 2.42 | 2.47 | 2.24 | 2.79 |
| Mid-depth Salinity | 0.01 | 0.68 | 1.92 | 0.89 | 3.33 | 1.63 | 2.26 | 2.15 | 2.00 | 2.44 | 2.51 | | 2.78 |
| Bottom Salinity | 0.01 | 1.03 | 1.87 | 0.84 | 3.26 | 1.65 | 2.26 | 2.14 | 2.00 | 2.47 | 2.51 | | 2.78 |

Note: Statistics calculated after the spin-up period (hr 2136-6552)

#### 4.1.3.4 Salinity Changes – Salinity Mitigation Measures

Three types of salinity mitigation measures were considered: large scale, small scale, and local. The large-scale measures are those such as Rose City, Bessie Heights East and West, and Old River Cove. These large-scale measures have the potential to influence the entire system and were modeled with the TABS-MDS model. The small-scale features were evaluated with a desktop model, and the local measures such as shoreline restoration or plugging of a logging canal were not modeled. The salinity results were used to develop WVA benefits for the wide array of mitigation measures that were evaluated during the preliminary screening of mitigation measures. The model runs for the large-scale measures were primarily concerned with reclamation of wetlands along the Neches River. Salinity reductions predicted by the modeling would only be effective if all of the proposed measures were adopted. Least-cost analyses resulted in the exclusion of Bessie Heights West, a large feature that contained about one-third of the proposed reclamation area. An FWP reduction in salinity is not forecast in conjunction with reclamation of the remaining components of the Neches River BU Feature because salinity effects of this revised BU plan have not been modeled, and the removal of Bessie Heights West would be expected to significantly reduce salinity benefits.

### 4.1.4 Application of the WVA Model

#### 4.1.4.1 Comparison of the FWOP and FWP Conditions

The WVA methodology provides a comprehensive, quantitative estimate of FWP changes in the quality and quantity of emergent marsh, cypress-tupelo swamp, and bottomland hardwood forests.

Each WVA model consists of variables considered important to each habitat type and suitability indices (SI) for each variable. All of the variable SIs for a specific community (i.e., fresh/intermediate, brackish, or saline marsh; swamp; bottomland hardwood) are combined in a mathematical formula to calculate the Habitat Suitability Index (HSI), which represents the composite habitat quality of the wetland being evaluated. Within each HSI formula, important variables may be weighted relative to other variables in the formula. The HSI formulae employed for the SNWW ecological modeling are based on those developed by the CWPPRA Environmental Work Group (USFWS, 2002a, 2002b, 2002c).

The WVA methodology quantifies changes in specific wetland structural and functional characteristics determined to be significant indicators of habitat health and quality. It combines the effects of changes in wetland productivity and structure to calculate impacts measured as AAHU values. Future without project and FWP conditions for the period of analysis were projected using salinities from the HS model as input into the WVA model. The FWOP condition predicts changes expected to occur under the No-Action Alternative described in Section 3. The FWP condition addresses the changes expected to result from project construction, including impacts from the placement of dredged material, benefits of the BU features, and effects of the compensatory mitigation plan.

HSIs are established for the FWOP and FWP conditions for selected target years (TY) throughout the life of the project. Habitat units are calculated by multiplying these HSIs by the affected acreage at each target

year. The habitat units for the FWOP and FWP conditions totaled over the project life are divided by the total years of the project to determine AAHUs. Small changes in some variables like salinity, when applied to thousands of acres in the large hydrologic units in this study area, produce the changes in AAHUs shown tables 4.1-3 and 4.1-4 for Texas and Louisiana, respectively. The impacts or benefits of the project are then quantified by comparing AAHUs between FWP and FWOP conditions. This procedure fulfills the USACE requirement that compensation be evaluated using a unit of comparison that measures quality and quantity of habitat values over time.

The same procedure used to estimate FWP land loss was used to quantify the compensation associated with mitigation measures, which is described in detail in Chapter 5. Screened mitigation measures affected salinities in some areas, blocked shoreline retreat, and restored emergent marsh elevations in others. These changes were reflected in land loss tables specific to each mitigation measure as follows: (1) revised FWP land loss rates were calculated by substituting salinity values predicted by the HS model (Brown and Stokes, 2009) in the land loss rate formula for hydro-units on the Neches River; (2) acreages were adjusted in the land loss tables to account for the effect of mitigation measures, such as breakwaters or shoreline nourishment, which stopped or slowed existing shoreline retreat; and (3) acreages were adjusted in the land loss tables to add emergent marsh acres restored by the placement of dredged material or in-situ marsh terracing. Credit for marsh acreage was generally delayed by 1 year to allow time for planted and volunteer marsh vegetation to become established. This is based upon recent experience with CWPPRA and other marsh restoration projects in the lower Sabine and Neches watersheds where marsh plantings and natural vegetation rebounded quickly and robustly to create a stable marsh landscape.

Procedures to estimate the effects of mitigation measures deviate from the FWP land loss method in the specific instances where mitigation measures add mineral soils to degraded areas of former marsh. In these cases, the ICT projected that the loss rate for the mitigation areas would be lower because the addition of denser, mineral soils and the increase in marsh elevation would create a more stable landform. Accordingly, land loss rates due to the project were reduced by 50 percent in the land loss change spreadsheets for these areas. Other mitigation measures that did not involve the creation of a higher, more-stable landform were modeled using a land loss rate equivalent to the FWP rate.

#### 4.1.4.2 Emergent Marsh Community Models

The EMCMs were used to evaluate saline, brackish, intermediate, and fresh marsh habitats in the study area. Variables included in the models were selected based upon their importance to fish and wildlife in coastal marsh ecosystems. A large number of species-specific HSI models for a variety of fish and shellfish, freshwater fish, birds, reptiles and amphibians, and mammals were reviewed and considered in the development of model assumptions. Six variables represent wetland habitat quality in the model:

Table 4.1-3
SNWW WVA Impacts Summary – Before DMMP Benefits and Mitigation (Louisiana Impacts Sorted by AAHUs)

| HU # | Hydrologic Unit | Habitat Type | FWOP Net Change Acres | FWP Net Change Total Acres | FWP Net Change % Acres | FWOP Net Change AAHUs | FWP Net Change AAHUs | FWOP Salinity (ppt) | FWP Salinity (ppt) | FWP Net Salinity Change (ppt) |
|---|---|---|---|---|---|---|---|---|---|---|
| LA 3 | Black Bayou | Intermediate Marsh | –1,713 | –130 | –0.3 | 14,734 | –509 | 4.00 | 5.10 | 1.1 |
| LA 2 | Willow Bayou | Intermediate (Brackish lumped) | –2,116 | –102 | 0.3 | 11,249 | –328 | 6.30 | 7.20 | 0.9 |
| LA 4 | West Johnson's Bayou | Intermediate Marsh | –1,703 | –142 | –0.8 | 5,729 | –269 | 6.30 | 7.50 | 1.2 |
| LA 5 | Sabine Lake Ridges | Intermediate Marsh | –1,103 | –93 | –0.7 | 4,868 | –218 | 6.30 | 7.50 | 1.2 |
| LA 9 | East Johnson's Bayou | Intermediate Marsh | –895 | –46 | –0.2 | 13,820 | –190 | 4.20 | 5.20 | 1.0 |
| LA 1 | Perry Ridge | Fresh Marsh | –921 | –50 | –0.2 | 8,947 | –65 | 0.90 | 1.24 | 0.3 |
| LA 1 | Perry Ridge | Intermediate Marsh | –191 | –12 | –0.1 | 1,873 | –53 | 0.90 | 1.24 | 0.3 |
| LA 5 | Sabine Lake Ridges | Saline Marsh | –398 | –10 | –0.5 | 2,184 | –35 | 17.00 | 18.40 | 1.4 |
| LA 8 | Southwest Gum Cove | Fresh Marsh | –152 | –8 | –0.3 | 2,170 | –2 | 1.20 | 2.10 | 0.9 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh | –2,567 | –43 | –0.1 | 9,113 | –14 | 8.00 | 8.60 | 0.6 |
| LA 7 | Southeast Sabine | Fresh Marsh | –40 | 0 | 0.0 | 1,231 | –11 | 1.80 | 2.30 | 0.5 |
| LA 6 | Johnson's Bayou Ridge | Brackish Marsh | –707 | –22 | –0.3 | 1,285 | –6 | 6.00 | 6.70 | 0.7 |
| LA 8 | Southwest Gum Cove | Intermediate (Brackish lumped) | –233 | –15 | –0.2 | 3,253 | –4 | 2.40 | 3.30 | 0.9 |
| LA 6 | Johnson's Bayou Ridge | Saline Marsh | –93 | –5 | –1.0 | 195 | –2 | 12.00 | 13.80 | 1.8 |
| LA 3 | Black Bayou | Brackish Marsh | –803 | –4 | 0.0 | 1,643 | –1 | 3.00 | 3.80 | 0.8 |
| LA 4 | West Johnson's Bayou | Brackish Marsh | –1,189 | –6 | –0.2 | 768 | –1 | 6.00 | 6.70 | 0.7 |
| LA 2 | Willow Bayou | Brackish Marsh | –695 | –2 | | 498 | –1 | | | 1.4 |
| LA/TX 1 | Sabine Island | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 4,499 | 0 | 0.69 | 1.10 | 0.4 |
| LA/TX 2 | Blue Elbow | Cypress/Tupelo Swamp (BH lumped) | 0 | 0 | 0.0 | 300 | 0 | 1.00 | 1.60 | 0.6 |
| LA 7 | Southeast Sabine | Intermediate (Brackish lumped) | –96 | –1 | 0.0 | 3,204 | 0 | 1.80 | 2.00 | 0.2 |
| LA 1 | Perry Ridge | Bottomland Hardwood | 0 | 0 | 0.0 | 2,080 | 0 | 0.90 | 1.24 | 0.3 |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0 | 0 | 0.0 | 999 | 0 | 0.69 | 1.10 | 0.4 |
| Total | | | –15,615 | –691 | | 94,642 | –1,709 | | | |

Table 4.1-4
SNWW WVA Impacts Summary – Before DMMP Benefits
and Mitigation (Texas Impacts Sorted by AAHUs)

| HU # | Hydrologic Unit | Habitat Type | FWOP Net Change Acres | FWP Net Change Total Acres | FWP Net Change % Acres | FWOP Net Change AAHUs | FWP Net Change AAHUs | FWOP Salinity (ppt) | FWP Salinity (ppt) | FWP Net Salinity Change (ppt) |
|---|---|---|---|---|---|---|---|---|---|---|
| TX 7 | GIWW North | Fresh (Intermediate lumped) | –539 | –63 | –0.4 | 2,602 | –140 | 0.70 | 1.20 | 1.6 |
| TX 6 | Old River Cove | Brackish Marsh | –1,518 | –46 | –0.3 | 3,061 | –116 | 10.00 | 11.00 | 1.8 |
| TX 3 | Rose City PA24A | Fresh Marsh | –3 | –86 | –63.3 | 53 | –32 | | | 0.3 |
| TX 8 | Texas Point | Intermediate (Fresh lumped) | –245 | –6 | –1.3 | 940 | –19 | 5.50 | 8.00 | 0.8 |
| TX 12 | Blue Elbow South | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 418 | –18 | 1.67 | 2.60 | 0.6 |
| TX 10 | Cow Bayou | Fresh Marsh | –75 | –6 | –0.1 | 824 | –18 | 2.00 | 2.20 | 1.0 |
| TX 11 | Adams Bayou | Fresh Marsh | –28 | –3 | –0.7 | 305 | –15 | 2.10 | 4.10 | 1.5 |
| TX 5 | Bessie Heights | Intermediate (Brackish lumped) | 31 | –1 | 0.0 | 1,273 | –14 | 4.20 | 4.70 | 0.3 |
| TX 10 | Cow Bayou | Intermediate Marsh | –59 | –3 | 0.0 | 741 | –12 | 2.00 | 2.20 | 1.0 |
| TX 7 | GIWW North | Brackish Marsh | –62 | –2 | –0.1 | 380 | –8 | 9.00 | 9.60 | 1.6 |
| TX 8 | Texas Point | Brackish Marsh | –252 | –5 | –0.4 | 1,464 | –7 | 8.50 | 11.00 | 0.8 |
| TX 8 | Texas Point | Saline Marsh | –2,446 | –17 | –0.9 | 2,480 | –5 | 12.50 | 15.00 | 0.8 |
| TX 11 | Adams Bayou | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 44 | –4 | 2.10 | 4.10 | 0.8 |
| TX 13 | Groves | Intermediate Marsh | –68 | –3 | –0.7 | 220 | –3 | | | 1.0 |
| TX 3 | Rose City | Fresh Marsh | –93 | –3 | –0.1 | 1,365 | –1 | 0.25 | 0.55 | 0.3 |
| TX 2 | Neches-Lake Bayou | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 1,977 | 0 | 2.00 | 2.90 | 0.0 |
| TX 1 | North Neches River | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 2,399 | 0 | 0.90 | 1.70 | 0.0 |
| LA/TX 2 | Blue Elbow | Cypress/Tupelo Swamp (BH lumped) | 0 | 0 | 0.0 | 1,261 | 0 | | | 0.3 |
| TX 2 | Neches-Lake Bayou | Fresh Marsh | –24 | 0 | –0.1 | 808 | 0 | 2.00 | 2.90 | 0.1 |
| LA/TX 1 | Sabine Island | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 896 | 0 | | | 0.0 |
| TX 5 | Bessie Heights | Fresh Marsh | –40 | –2 | –0.1 | 1,313 | 0 | 1.00 | 1.50 | 0.5 |
| TX 1 | North Neches River | Fresh Marsh | –8 | 0 | 0.0 | 249 | 0 | 0.90 | 1.70 | 0.0 |
| TX 10 | Cow Bayou | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 55 | 0 | 2.00 | 2.20 | 1.0 |
| TX 4 | West of Rose City | Fresh Marsh | –24 | –1 | –0.1 | 238 | 0 | 0.10 | 0.40 | 0.4 |
| TX 5 | Bessie Heights | Bottomland Hardwood | 0 | 0 | 0.0 | 225 | 0 | 1.00 | 1.50 | 0.5 |
| TX 3 | Rose City | Cypress/Tupelo Swamp | 0 | 0 | 0.0 | 217 | 0 | 0.25 | 0.55 | 0.3 |
| TX 1 | North Neches River | Bottomland Hardwood | 0 | 0 | 0.0 | 277 | 0 | 0.90 | 1.70 | 0.0 |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0 | 0 | 0.0 | 503 | 0 | | | 0.0 |
| TX 3 | Rose City | Bottomland Hardwood | 0 | 0 | 0.0 | 698 | 0 | 0.25 | 0.55 | 0.3 |
| TX 6 | Old River Cove | Bottomland Hardwood | 0 | 0 | 0.0 | 149 | 0 | 1.00 | 1.50 | 0.5 |
| TX 10 | Cow Bayou | Bottomland Hardwood | 0 | 0 | 0.0 | 286 | 0 | 2.00 | 2.20 | 1.0 |
| TX 11 | Adams Bayou | Bottomland Hardwood | 0 | 0 | 0.0 | 402 | 0 | 2.10 | 4.10 | 0.8 |
| TX 2 | Neches-Lake Bayou | Bottomland Hardwood | 0 | 0 | 0.0 | 1,164 | 0 | 2.00 | 2.90 | 0.0 |
| | Totals | | –5,453 | –247 | | 28,124 | –412 | | | |

$V_1$ percent of the wetland covered by emergent vegetation

$V_2$ percent of the open water covered by SAV

$V_3$ marsh edge and interspersion

$V_4$ percent of the open-water area less than or equal to 1.5 feet deep

$V_5$ salinity

$V_6$ aquatic organism access

The reader is cautioned that straightforward comparisons of impacts associated with changes in salinity or other variables are not easily made between hydro-units. The varying AAHUs and acreage results are due to differences in project impacts, underlying conditions (i.e., existing land loss rate, marsh interspersion, SAV), and the size of the hydro-unit. Salinity is not the only determinant; changes in other variables can also have significant effects. Additional information about the weighting of variables is provided below. However, refer to Appendix C of the FEIS for detailed narratives of the FWOP and FWP conditions in each hydro-unit.

The primary focus of the SNWW application of the EMCM is the preservation of vegetated wetlands, but it is also recognized that some marsh restoration or protection strategies could have an adverse effect on aquatic organisms. Therefore, variables $V_1$ (percent emergent vegetation), $V_2$ (percent SAV), and $V_6$ (aquatic organism access) are grouped together and weighted more than the remaining variables. For all marsh models, $V_1$ receives the greatest weighting; however, the relative weights of $V_1$, $V_2$, and $V_6$ vary by marsh model to reflect different levels of importance between the marsh types.

The EMCM employs a split model format to account for the value of both marsh and open-water habitats. Two HSI formulas are calculated for each marsh type – one for emergent marsh habitat and one for open-water habitat. The HSI formula for emergent marsh contains the variables important for evaluating its habitat quality ($V_1$-percent coverage of emergent vegetation, $V_3$-marsh edge and interspersion, $V_5$-salinity, and $V_6$-aquatic organism access). The HSI formula for open-water habitat contains only the variables important to that habitat component ($V_2$-percent open water with SAV, $V_3$-marsh edge and interspersion, $V_4$-percent open water <1.5 feet deep, $V_5$-salinity, and $V_6$-aquatic organism access).

#### 4.1.4.3 Swamp Community Model

The SCM uses variables that evaluate the ability of swamps to provide resting, foraging, and nesting habitat for a wide variety of wildlife species. In general, the swamp model can be applied if woody canopy cover is at least 33 percent of the surface area, and at least 60 percent of the canopy consists of any combination of bald cypress, tupelo gum, red maple, buttonbush, and/or planertree (*Planera aquatica*). The following four variables represent swamp habitat quality in the model:

$V_1$ stand structure

$V_2$ stand maturity

$V_3$ water regime

$V_4$ mean high salinity during the growing season

All of the SIs are combined in a mathematical formula, the HSI, which represents the composite habitat quality. Variables $V_1$ and $V_3$ (stand structure and water regime) are considered the most important variables in characterizing swamp habitat quality and therefore are weighted more than other variables. Variables $V_1$ and $V_2$ were adjusted for the dampening effect of salinity on tree growth, using output from the HS model. Variable $V_4$ (salinity) is weighted lower than the other variables.

#### 4.1.4.4 Bottomland Hardwood Model

The BHM applies to forested wetlands that support a canopy of woody vegetation of which more than 40 percent of tree species consist of oaks, hickories, American elm, cedar elm, green ash, sweetgum, sugarberry, boxelder (*Acer negundo*), common persimmon (*Diospyros virginiana*), honeylocust (*Gleditsia triacanthos*), red mulberry (*Morus rubra*), eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*), and American sycamore (*Platanus occidentalis*). Variable selection for the model was based upon a review of various USFWS HSI models for bottomland hardwood wildlife. The following variables represent bottomland hardwood habitat quality in the model:

$V_1$ tree species composition

$V_2$ stand maturity

$V_3$ midstory/understory

$V_4$ hydrology

$V_5$ size of contiguous forested area

$V_6$ surrounding land uses

$V_7$ disturbance

The model incorporates site-specific habitat quality features (tree species composition, forest stand structure, stand maturity, and hydrology) and landscape parameters (forest size, surrounding land use, and disturbance). Because the primary application of this model is to quantify the loss of ecological values due to changes in the site-specific conditions, variables that are likely to be affected by these changes ($V_1$, $V_2$, $V_3$, and $V_4$) are considered more important than the landscape variables. Of the site-specific variables, $V_1$ (tree species composition) and $V_2$ (stand maturity) are considered equal and of greater importance than the other variables. Variable $V_3$ (understory/midstory) and $V_4$ (hydrology) are weighted less than $V_1$ and $V_2$. The "landscape" variables ($V_5$, $V_6$, and $V_7$) are not weighted. Variables $V_1$, $V_2$, and $V_3$ were adjusted for the dampening effect of salinity on tree growth, using output from the HS model.

### 4.1.5 Storm Surge Sensitivity Modeling

The potential for proposed project features to increase storm surge impacts in the study area was analyzed with a storm surge sensitivity analysis (Wamsley et al., 2010). The ADCIRC model was run to estimate water levels for two worst-case hypothetical storms, both with and without proposed SNWW CIP project features in place. Project features evaluated by the modeling are the deeper navigation channel, proposed PAs with maximum levee heights, and two expanded PAs. The two simulated storms exhibited minimum central pressures of 900 millibars, offshore pressure radii between 14.9 and 18.4 nautical miles, and

forward speeds of 11 knots. Each produced water levels near or higher than the estimated 500-year level, and both would be considered extreme events. One storm tracked in the northwesterly direction, producing maximum surges of 18 feet near the coast at Sabine Pass and surges of 13–14 feet in Sabine Lake near Port Arthur, Texas. The second storm tracked in a north-northeasterly direction, producing maximum surges of over 20 feet near Sabine Pass and surges of 15 to 17 feet in Sabine Lake near Port Arthur.

The sensitivity analysis concluded that the greatest changes would occur north of Port Arthur along the Neches River. These changes are primarily due to the proposed increase in depth of the navigation channel. All changes are local, and there are no project-induced increases in surges away from the immediate vicinity of the navigation channel. Water levels in the marshes and open-water areas immediately north of the river would increase on the order of 4 to 8 inches or less. The modeling indicates some interior flooding would occur within the City of Port Arthur with both storms, both with and without the project. Changes in peak surge within the city for these two events, with the project in place, are caused by a slight increase in surge elevation and/or duration causing additional overtopping of the surrounding levee or internal topographic features. Peak surges for 100-year events are estimated to be approximately 9 feet in the Port Arthur area. Although simulations of less-intense events were not made as part of this study, in light of the 14- to 24-foot levees surrounding Port Arthur, significant interior flooding is not expected for the base condition. Any changes in peak surge on the order of inches should not cause any significant change in interior flooding for the with-project condition.

The Preferred Alternative for the SNWW CIP also includes ODMDS and marsh restoration measures. All of the existing and proposed ODMDSs are located several miles from the Gulf shoreline in water too deep to affect wave setup on the shoreline. The influences of marsh restoration on hurricane surge have been documented by Wamsley et al. (2009a, 2009b). Surges tend to slightly increase over and just seaward of the marsh as the surge propagation is slowed, which may result in reductions in peak water levels landward of marsh features. The impact of the proposed SNWW CIP marsh restoration features is relatively small and expected to modify peak surge levels locally by a minimal amount (Wamsley et al., 2010). No significant reductions or increases in surge level would be expected from either the marsh restoration or ODMDS.

## 4.2 UNCERTAINTIES ASSOCIATED WITH ECOLOGICAL MODELING FOR THE SNWW CIP

An analysis of risk and uncertainty associated with the WVA model application to the SNWW CIP has been performed in consideration of recommendations contained in the Actions for Change directive (USACE, 2006d). This analysis will facilitate risk-informed decision-making regarding the levels of ecological impacts and resulting recommended compensatory mitigation that were established using the models. The primary risks associated with ecological modeling for the SNWW CIP relate to the accuracy of the impact assessment and the cost of mitigation. Risks to human health or safety associated with ecological impacts are small. Incremental marsh loss attributable to the Preferred Alternative

(approximately 691 acres or about 2/5th of 1 percent of emergent marsh in the study area) would not affect the overall effectiveness of the coastal wetlands in buffering inland areas from storm surge effects.

An evaluation of the risks and uncertainties involved in application of the ecological model, on which the amount of proposed compensatory mitigation is based, is necessary to evaluate the adequacy of the recommended amount of ecological mitigation, and to support the recommended Federal investment. The reader is referred to Appendix C of this FEIS for the complete sensitivity analysis, including detailed methodology and analysis. A brief summary of the results of the analysis is presented below.

There are two types of uncertainty that have been identified for the predictive ecological modeling conducted in this study—uncertainty associated with model quality and performance, and uncertainty associated with model predictions. In regard to the first type of uncertainty, extensive technical review of the WVA models has been conducted to ensure that they are technically sound and defensible (LBG and TEA, 2008). The assessment determined that the concept and application of the models are sound for planning efforts. Theoretical approaches of the WVA models use scientifically established structural surrogates to evaluate wetland quality. The models' variables provide a reasonable description of the emergent marsh, swamp, and bottomland hardwood habitats, and are capable of evaluating project effects to habitat-based, functional processes that may be affected by the project. Based upon the results of this assessment, the Deep Draft Navigation Planning Center of Expertise, in consultation with the National Ecosystem Planning Center of Expertise, concurred with the findings of this assessment and approved the use of the WVA EMCM, BHM, and SCM for the SNWW feasibility study (Memorandum for Commander, HQ USACE [CECW-PC] and Commander, Southwest Division [CESWD-PDS] from the Director of Deep Draft Navigation Planning Center of Expertise [CESAD-PDS-P], dated June 30, 2009). This satisfies the requirements of EC 1105-2-407, as the WVA models were developed by a Federal agency other than the USACE, and are therefore subject to approval for use rather than certification.

Uncertainty associated with predictions of the WVA models (i.e., how different predictable outcomes could affect ecological impacts and costs) was evaluated by varying input values for the most significant variables. The WVA models do not include a direct way to measure risk, i.e., the model does not calculate a probability distribution that provides a statistically significant confidence level for the model projections. Since salinity is the driving force influencing WVA model predictions, salinity-related variables were targeted in one sensitivity analysis. The other analysis focused on an assumption underlying the valuation of the percent of emergent marsh cover. A range of possible outcomes associated with variable $V_1$ (percent of emergent marsh) in the EMCM, and variables $V_4$ and $V_5$ (salinity) in the SCM and EMCM, respectively, were evaluated to determine how uncertainties related to variable assumptions and values could affect impact predictions and compensatory mitigation decisions. Since the analysis was conducted to evaluate uncertainties with the recommended level of compensatory mitigation, the analysis was performed for the Louisiana hydro-units in which unavoidable impacts would occur.

### 4.2.1 Salinity Sensitivity

Because of uncertainties associated with HS model predictions of salinity impacts, a sensitivity analysis was performed to evaluate the full range of potential project effects. Salinity changes predicted with implementation of the Preferred Alternative were provided by the HS model. High- and low-salinity values bracketing the 95 percent confidence level were entered into WVA model for all habitats in Louisiana hydro-units. Ranges of AAHU impacts were then produced based on the 95 percent salinity range.

For cypress-tupelo swamps, the sensitivity analysis yielded a range of potential loss from 0 to 9 AAHUs, with no impact predicted to be most likely. The uppermost reaches of the Sabine River would remain essentially fresh; however, the Blue Elbow swamp near the GIWW could experience suboptimal salinities at the high end of the salinity range. Even at the maximum salinity, levels would not be suboptimal to the extent that sustainability of the swamp forest would be threatened. No impacts would be expected in the bottomland hardwood habitats at the maximum range of salinity predicted by the sensitivity analysis.

The largest range of potential impacts could occur within the intermediate marsh communities located east of Sabine Lake. AAHU losses for the intermediate marshes could range from 312 to 2,407 AAHUs, as compared to the FWP's most likely loss of 1,571 AAHUs. The highest potential salinities are suboptimal for most of the intermediate marshes east of Sabine Lake, and some exceed the maximum tolerance range. At the highest potential salinities, intermediate marshes in Willow Bayou, West Johnson's Bayou, and Sabine Lake Ridges would likely convert to brackish marsh about 20 years after project construction.

Impacts at the highest potential salinities would not threaten the sustainability of any of the other marsh communities over the period of analysis. Salinities remain within or close to the optimal range. For fresh marsh communities, AAHU losses could range from 8 to 477, as compared to the most likely loss of 78 AAHUs. For saline and brackish marshes combined, AAHU losses could range from 20 to 253, as compared to the FWP's most likely loss of 60 AAHUs.

The salinity sensitivity analysis of the WVA models demonstrated that there is a wide range of potential outcomes in AAHU losses attributable to uncertainties in salinity predictions. These outcomes range from a loss of 340 to 3,146 AAHUs within the 95 percent confidence range of salinity, the primary driver in the EMCM and SCM. After adjustments for the Gulf Shore BU Feature benefits (210 AAHUs) and the BU offset of impacts to Federal lands (340 AAHUs), losses could range from zero to 2,596 AAHUs. Based on the cost per AAHU of the recommended mitigation plan ($77.5 million; 1,181 AAHUs), the cost of compensatory mitigation could range from $0 to about $170 million. The total predicted FWP loss of 1,499 AAHUs in Louisiana is based upon forecasts of the most likely salinity levels, and takes into account the potential FWOP effects of RSLR and changes in future freshwater inflows.

### 4.2.2 Percent Emergent Marsh Sensitivity Analysis

Ninety-nine percent of Louisiana impacts predicted by the ecological model were made using the EMCM. The most highly weighted variable in this model is $V_1$ (percent emergent marsh). This parameter is considered most significant because persistent emergent vegetation provides foraging, resting, and breeding habitat for a variety of coastal fish and wildlife species. Detritus from coastal marshes also provides a source of mineral and organic nourishment for organisms at the base of the food chain. Without the structure provided by the emergent marsh, the majority of the ecological benefits provided by this system disappears. Changes in the value of this parameter were predicted by relating changes in salinity to changes in marsh loss using a process that is described in Section 4.10. This sensitivity analysis explores the effects of an assumption that underlies the valuation of emergent marsh in this variable. The SNWW application of this model uses the same assumptions adopted by the EnvWG in its application of the model to CWPPRA restoration projects (USFWS, 2002b). In this model, optimal vegetative coverage is assumed to be 100 percent (SI = 1.0) for all marsh types. This assumption diverges from the general biological understanding that optimal cover falls in the 60 to 80 percent range, but it was adopted by the EnvWG to reflect CWPPRA's objective of long-term marsh creation and restoration. Questions have arisen as to whether maximizing the value of marsh coverage is appropriate for the SNWW application in which the primary purpose is the identification of project impacts and compensatory mitigation.

Selection of 100 percent marsh cover as the optimal habitat condition ($V_1$-Original) for the SNWW application was based upon several factors. Maximizing the value of emergent marsh over associated shallow-water habitat is based upon the important ecological concept of long-term sustainability. With the SNWW project, marshes would continue to degrade over the 65-year period of analysis due to the effects of RSLR. Without the associated marshes, the small open-water areas would lose their value as nursery habitat, becoming open-bay or open-Gulf habitat. Restoration or mitigation projects generally need to maximize the creation of emergent marsh, so as to ensure the sustainability of the land itself.

To evaluate the effect of this assumption on the SNWW application, the EMCM was rerun for all of the Louisiana marsh communities using a revised formula for the variable in which optimal vegetative coverage (SI = 1.0) is assumed for a marsh coverage of 60 to 80 percent ($V_1$-Revised). Overall, impacts using $V_1$-Revised dropped by 3 percent. As would be expected, the smallest percentage changes occurred in marshes where the percent emergent marsh remained between 60 and 80 percent for both the FWOP and FWP conditions. If the $V_1$-Revised formula were used to calculate the mitigation target for the recommended mitigation plan, the net loss would be 244 AAHUs. If $V_1$-Revised were used to compute compensatory mitigation as it is currently designed, mitigation costs would increase by at least 42 percent to meet the $V_1$-Revised mitigation target.

If the same mitigation measures were redesigned so that marsh fill would never exceed 80 percent, the amount of restored acres would drop from 2,696 to 2,215 acres. However, compensation as measured with the $V_1$-Revised formula would increase and the net loss would be 167 AAHUs. Based upon the cost of the recommended mitigation plan, it is estimated that the total mitigation cost would be about 3 percent greater than the recommended mitigation plan. More significantly, the modified plan would restore about

18 percent fewer acres and do less to ensure the long-term sustainability of the marsh than the recommended mitigation plan.

### 4.2.3 Recommendations Resulting from WVA Model Sensitivity Analysis

The recommended compensatory mitigation plan is based upon the most likely range of salinity change as established by the HS model, scientifically based projections of changes in habitat resulting from the predicted salinity change, and the professional judgment and knowledge of the area by the large team of natural resource and engineering professionals who applied the WVA model to the SNWW CIP. The ICT HW contained professionals with expertise in wetland impact evaluation, marsh restoration, wetland forest management, aquatic habitat evaluation, freshwater and marine fisheries, terrestrial and avian wildlife biology, as well as natural resource management personnel from all of the protected lands in the study area.

In addition, the recommended mitigation plan maximizes the value of emergent marsh when measuring impacts and determining compensatory mitigation for project-related losses to this nationally significant, endangered resource. Without the structure provided by the emergent marsh, the majority of the ecological benefits provided by these systems disappear. For these reasons, no changes to the recommended mitigation plan are proposed as a result of this sensitivity analysis. It is recommended that Best Buy Plan #6 mitigation plan (described in Chapter 5) be selected as it incorporates the level of compensation needed to address the most likely impacts of the SNWW CIP.

## 4.3 PHYSIOGRAPHY AND GEOLOGY

### 4.3.1 No-Action Alternative

The No-Action Alternative would not impact physiography or geology within the study area. Alterations to bathymetry from maintenance dredging of existing ship channels, in addition to topographic changes from the placement of dredged materials at PAs, would continue under the No-Action scenario.

### 4.3.2 Preferred Alternative

The total estimated amount of dredged material generated from the proposed project would be approximately 98 mcy of new work material and approximately 650 mcy of maintenance material over 50 years after the project is constructed. This material would be placed in BU features, PAs, and ODMDSs, as described in Section 2.5.

Impacts on local geology during dredging associated with the Preferred Alternative would include redistribution of existing sediment, local increases in turbidity, and potential changes in local scouring and shoaling rates. Net impacts on local geology would be minimal from these operations. Additionally, no impacts or modifications to geologic hazards such as faulting and subsidence are expected.

Two PAs would be created. The area where PA 24A would be created is currently a wetland habitat with a central upland ridge, which is set back from the shoreline of a Neches River oxbow and does not block overland flow to bottomland hardwoods along the shore. A critical section of marshhay cordgrass wetland was excluded from the proposed PA, and the boundaries were drawn to exclude bottomland hardwoods that line the Neches River oxbow west of the PA. The area where PA 18A would be created is already an upland area so there should be no topographic impact. Further information pertaining to specific PA descriptions and quantities of new work and maintenance material involved are presented in Section 2.4.

Three miles of shoreline located at Texas and Louisiana Points would be affected by the proposed Gulf Shore BU Feature (see Figure 2.5-2). Over the 50-year period of analysis, 16 placement episodes are expected, occurring in 3-year cycles, alternating between Texas and Louisiana. The Gulf Shore BU Feature would provide a regular source of predominantly fine-grained sediment that should contribute to mudflat accretion and periodically move onshore to become shore-attached through a process described by PIE (2003). On the western Louisiana and east Texas coasts, sediments accumulate as mudflats and underwater mudshoals (or "fluid mud") in the nearshore region. Nearshore, fluid mud can be trapped against the shoreline by prevailing south and southwesterly winds, and storms carry the trapped muddy ooze onto the chenier shoreline. The presence of additional fine-grained sediments in the littoral system that would be provided by the BU feature should reduce the current erosion rate, and minimize the small increase in shore erosion predicted with the project (Gravens and King, 2003). In systems that have an abundant supply of fine-grained sediments, the nearshore seabed can be blanketed with fluid mud. The presence of additional muddy sediment in the nearshore environment may attenuate waves and lessen wave-induced erosion (Hsiao and Shemdin, 1980; Tubman and Suhayda, 1976; Wells and Kemp, 1986). Although the BU sediments would be largely fine grained, approximately 18 percent of maintenance material is expected to be sand. Sands that are deposited on shore would nourish and stabilize eroding marshes; sand deposited in the nearshore zone should stay in the nearshore environment, moving back and forth across the shoreface (Wamsley, 2008). More details on the expected behavior of the material can be found in subsection 2.5.3.2.

Three degraded marsh areas along the Neches River would be combined into the Neches River BU Feature. This large BU feature would use new work material and future maintenance material to benefit a total of 4,958 acres of degraded marsh on the lower Neches River by restoring 2,853 acres of emergent marsh; improving 871 acres of shallow water by creating shallower ponds and interconnecting channels; and nourishing 1,234 acres of existing fringing marsh by winnowing fine-grained material from unconfined flows of dredged material effluent. It would fulfill 53 percent of the restoration target set by the CEPRA 2004 plan update for the lower Neches River (GLO, 2004). Further information pertaining to this BU feature can be found in subsection 2.5.3.2.

Construction of mitigation measures in Louisiana would use sediment obtained from nearby waterbodies to restore marsh. The Willow Bayou Mitigation Measure would use sediment obtained from dredging the bottom of Sabine Lake to restore soils and marsh elevation to open-water areas in the marsh east of Sabine Lake. A 1.8-mile-long borrow trench in Sabine Lake would be dredged about 1,000 feet from the Sabine NWR shore and would average 1,030 feet wide by 7.5 feet deep. The borrow trench would be

continuous and parallel the current shoreline; the common longshore circulation pattern in Sabine Lake is expected to eventually fill the trench with Sabine River sediments. An access channel from the GIWW near the mouth of the Sabine River would be needed for the dredge to reach the proposed borrow trench area. The exact locations of the borrow trench and access channel would be determined in consultation with the ICT after PED bottom surveys of potential locations. Black Bayou Mitigation Measures LA 3-15B and LA 3-18B would hydraulically dredge accumulated material from the 30-foot-deep Lake Charles Deepwater Channel (co-located with GIWW in Louisiana) and use it to restore marsh in open-water areas south of the GIWW. While changes would occur to local bathymetry and topography during construction of the proposed project, these alterations would be expected to have negligible impacts on the regional physiography of the submerged and subaerial portions of the study area. No impacts associated with geologic hazards are expected, and impacts on local geology are expected to be minimal.

## 4.4 WATER QUALITY

### 4.4.1 No-Action Alternative

Under the No-Action Alternative, there would be no construction dredging; therefore, there would be no new work material for placement. While no turbidity or possibility for the release of undesired chemicals would occur, there would also be no opportunity for the creation of marshes using dredged material beneficially.

Under the No-Action Alternative, water quality would be as it is presently, as described in Section 3.3, with a gradual increase in salinity from RSLR in the future without the proposed project. There would be short-term increases in turbidity and the possibility of release of undesired chemicals during maintenance dredging, as there is now. All maintenance material is currently placed into PAs or ODMDSs.

### 4.4.2 Preferred Alternative

USACE has received §401 State Water Quality Certification from Texas and Louisiana for this action. A CWA §404(b)(1) evaluation of the proposed action, provided in Appendix E, describes the effects of the proposed discharges. All relevant sediment and water quality data for both new work and maintenance dredging material were reviewed by a team of State and Federal resource agencies (ICT CW), including the TCEQ and LDEQ, and they found no cause for concern over water or sediment quality in any channel reach. New work sediments were deemed suitable for use in constructing restoration or mitigation sites, BU features, placement in ODMDSs, and upland confined PAs. Maintenance material would be handled according to the DMMP. The DMMP measures, to the greatest degree possible, the use of dredged material as a beneficial resource. The Gulf Shore BU feature shares the material from Sabine Pass equally between the states. The new work and maintenance material used in the BU features of the Preferred Alternative would allow the restoration of approximately 4,958 acres of emergent marsh in Texas. It would also be used for beach nourishment on Texas and Louisiana Points.

The Preferred Alternative is the least environmentally damaging practicable alternative. As noted above, there should be little, if any, difference in inland turbidity or DO levels between the No-Action

Alternative and the Preferred Alternative. Best Management Practices would be employed during construction of restoration and mitigation areas. Significant detrimental environmental effects have not been noted in past construction and maintenance operations and are not expected with the Preferred Alternative since much of the construction and maintenance material would be used beneficially, and the rest would go into PAs or ODMDSs. Short-term increases in turbidity may be caused by the unconfined flow of dredged material during construction of BU features and mitigation measures. There would be temporary, minor impacts from ocean placement at the new proposed ODMDSs, as discussed in detail in Appendix B. Temporary water quality impacts may occur during borrow trench and access channel dredging in Sabine Lake and the Lake Charles Deepwater Channel for mitigation measures (see also sections 5.5.1, Willow Bayou Mitigation, and 5.5.2, Black Bayou Mitigation).

There is the possibility of contamination of the maintenance material by a spill or other event, as there is now, but deepening of the channel should reduce the probability of a spill by reducing the number of vessel trips. Additionally, the USACE routinely tests the elutriates prepared from maintenance material according to ITM and RIA protocols before dredging to ensure that there is no contamination. As noted in Section 3.3, past Tier I, Tier II, and Tier III evaluations of maintenance material elutriates with chemical analyses and water column bioassays have indicated no cause for concern.

## 4.5 SEDIMENT QUALITY

### 4.5.1 Surficial Sediments

#### 4.5.1.1 No-Action Alternative

There would be no change in the quality of the surficial sediments of the project area unless there is an impact in the future without the proposed project.

#### 4.5.1.2 Preferred Alternative

The quality of surficial sediments that would be dredged during construction of the Entrance Channel Extension is discussed in Appendix B. Extensive chemical analyses, bioassays, and bioaccumulation studies of this material were conducted in accordance with EPA Regulations and the *Ocean Testing Manual*. The data indicate that there are no causes for concern related to chemical contaminants and that these sediments are suitable for ocean placement. Similar testing was performed numerous times on maintenance material dredged from the 22-mile existing SNWW entrance channel, and these sediments were always found to be acceptable for ocean placement. The sediments to be dredged for the Extension Channel are located from 22 to 35 miles from shore, and thus are sufficiently far removed from known existing and historical sources of pollution on the inland portion of the SNWW to provide reasonable assurance that the material is not contaminated. The ICT CW (which included representatives from the EPA and USFWS) approved the use of the grab samples for SNWW bioassay and bioaccumulation samples, and agreed that the materials were suitable for ocean placement.

### 4.5.2 Maintenance Material

#### 4.5.2.1 No-Action Alternative

The existing maintenance material was described in Section 3.4. The quantity and quality of this material would not be expected to change with the No-Action Alternative.

#### 4.5.2.2 Preferred Alternative

The quantity of maintenance material is expected to increase by roughly 60 percent in the SNWW with the Preferred Alternative but the quality of this material would not be expected to change. While more maintenance material is expected to be dredged with the Preferred Alternative, the source and the method of placement would not change, except that much more of the maintenance material would be used beneficially. As noted above, project actions should decrease the probability of a spill. The USACE also routinely tests the maintenance material according to ITM and RIA protocols before dredging to ensure that the material is environmentally acceptable under all applicable regulations.

### 4.5.3 Summary

As summarized in subsection 3.4.2, recently tested sediment quality data presented in PBS&J (2004a) and from March 2008 and April 2009 indicates no cause for concern, related to the new construction dredging and dredged material placement. Although it was identified that one reach within the Neches River contained elevated levels of PAHs within the tested sediments, the elutriate tests for those sediment sampling stations did not reveal high concentrations of PAHs. Therefore, it can be concluded that PAHs are not expected to be released during dredging and/or placement, and it can be further concluded that there are no channel reaches within the SNWW that exhibit a chemistry cause for concern.

## 4.6 HYDROLOGY

### 4.6.1 No-Action Alternative

Under the No-Action Alternative that includes 1.1 feet of RSLR, there should be an increase from the present condition in the tidal circulation and water exchange with the Gulf, and a corresponding increase in sediment transport in the navigation channels. No significant change is expected in the direction or amount of longshore sediment transport. Longshore transport and wave modeling have been performed, and a sediment budget has been prepared for the study area in conjunction with a shoreline erosion study of the Texas coast from Sabine Pass through Galveston Island (King, 2007; Morang, 2006).

Shorelines will continue to retreat due to RSLR, and the rate can be expected to increase with an increase in the rate of RSLR. The highly erodible and weakly compacted soil on Pleasure Island and the east shore of Sabine Lake would likely continue to erode from tidal currents and wind waves. Vessel-generated waves and surges would continue to accelerate the process on Pleasure Island as in the past. Existing Gulf shoreline erosion of up to 40 to 50 feet/year on the Texas shoreline (King, 2007) and an erratic pattern of

accretion and erosion on the Louisiana shoreline (USACE, 2004a) would also continue, with the potential for significant increases due to climate change and sea level rise (IPCC, 2007).

The FWOP does include expected changes in water demands and supply strategies that are part of the 2007 Texas State Water Plan (TWDB, 2007) and permitted flows from upstream reservoirs. Existing Sabine River flows that are dedicated to the State of Louisiana by the Sabine River Compact are also taken into consideration.

## 4.6.2 Preferred Alternative

### 4.6.2.1 Circulation, Exchange, Inflows, Velocities

Under the Preferred Alternative, the same RSLR and inflow changes assumed in the FWOP will apply, and there would be a deeper navigation channel that will allow a greater amount of tidal circulation and exchange with the Gulf than is currently the case. The deepening project would cause only a minimal increase of water surface elevation over the study area; the average increase would be 0.8 inch (Brown and Stokes, 2009). The channel deepening results generally in increases in velocity along the entire channel; however, magnitudes are quite small, less than 0.5 foot per second in most cases (Parchure et al., 2005). The largest changes are observed in the Sabine-Neches Canal, but the absolute magnitudes are still small.

The potential for proposed project features to increase storm surge impacts in the study area was analyzed with a storm surge sensitivity analysis (Wamsley et al., 2010). The ADCIRC model was run to estimate water levels for two worst-case hypothetical storms, both with and without proposed SNWW CIP project features in place. Project features evaluated by the modeling are the deeper navigation channel, proposed PAs with maximum levee heights, and two expanded PAs. The sensitivity analysis concluded that the greatest changes would occur north of Port Arthur along the Neches River. These changes are primarily due to the proposed increase in depth of the navigation channel. All changes are local and there are no project-induced increases in surges away from the immediate vicinity of the navigation channel. Water levels in the marshes and open-water areas immediately north of the river would increase on the order of 4 to 8 inches or less. The modeling indicates some interior flooding would occur within the City of Port Arthur both with and without the project. Changes in peak surge on the order of inches should not cause any significant change in interior flooding for the with-project condition.

The Preferred Alternative for the SNWW CIP also includes ODMDS and marsh restoration measures. All of the existing and proposed ODMDSs are located several miles from the Gulf shoreline in water too deep to affect wave setup on the shoreline. The influences of marsh restoration on hurricane surge have been documented by Wamsley et al. (2009a, 2009b). Surges tend to slightly increase over and just seaward of the marsh as the surge propagation is slowed, which may result in reductions in peak water levels landward of marsh features. The impact of the proposed SNWW CIP marsh restoration features are relatively small and expected to modify peak surge levels locally by a minimal amount (Wamsley et al., 2010). No significant reductions or increases in surge level would be expected from either the marsh restoration or ODMDS.

The Preferred Alternative would not have an effect on freshwater inflows to the system. However, by increasing slightly the amount of tidal exchange, the inflows would be conveyed to the Gulf marginally faster than would be the case in the No-Action Alternative.

#### 4.6.2.2 Sediment Transport

There are two main types of sediment transport in the system—sediment carried into the channels by heavy rains in the watershed and conveyed through the navigation channels, and sediment transport along the coast. Both are addressed here.

The low velocities near the bottom of the navigation channel offer conditions favorable for sediment deposition. The amount of sediment-laden runoff would be unchanged between the FWOP and FWP (Parchure et al., 2005). The slightly larger cross sections and lower current velocities would offer slightly better conditions for sediment to settle. This is one reason why the Preferred Alternative would require more maintenance dredging than the No-Action Alternative. Another reason is that the deeper channel will have a larger volume below the existing seabed, making it function as a larger sediment trap. Furthermore, the increased length of the channel results in higher dredging quantities for the offshore channel extension. Changes in salinity that also affect shoaling quantities are discussed in a later section.

The effect on Gulf shoreline change was investigated by Gravens and King (2003). Their shoreline impact study addressed the effects of changes in the wave climate produced by the deeper offshore channel and the changes in longshore sediment transport that would be expected from the altered wave climate. Under the Preferred Alternative, a deeper and longer entrance channel would have some effect on waves moving from the Gulf to the shore, and that would in turn exert an effect on the rate of longshore sediment transport.

The Gravens and King (2003) study also addressed a 45-foot alternative and noted that the effect of the Preferred Alternative (48-foot channel) would be intermediate and somewhat less than the 50-foot alternative. The direction of sediment transport is to the west on the Texas side of the channel and to the east on the Louisiana side, with little difference between existing conditions and the 50-foot channel. The effect of channel deepening is to reduce the westward transport on the Texas side and increase the eastern transport on the Louisiana side. The effect of channel deepening is to slightly reduce the net westward transport on the Texas side and the net eastern transport on the Louisiana side.

The Gulf Shore BU Feature proposes to restore 0.86 mcy of sediment to the littoral environment every 3 years using maintenance material from dredging the Sabine Pass Channel. Material placement during each 3-year dredging cycle would alternate between Texas and Louisiana, so that material would be placed on each state's shoreline every 6 years. Some material is expected to flow into the existing marsh while the remainder would flow into nearshore waters. This recurring action would nourish eroding marsh, restore sediment to the littoral zone, minimize projected FWP shoreline impacts, and potentially create new marsh. The BU dredged material is expected to be composed largely of unconsolidated muds. The fine-grained sediments are expected to initially be highly mobile, and some portion of the material would be rapidly lost from the vicinity of the shoreline. Because of the prevailing wave climate, the

mobile material within the surf zone should generally migrate to the west at both Texas and Louisiana Points (Wamsley, 2008). Transport processes identified by the Sabine Pass sediment budget (Morang, 2006) indicate that the material west of Sabine Pass would move toward the eroding shoreline at Texas Point. There, the additional fine-grained sediments could lower erosion rates through mudflat accretion and wave attenuation. A small quantity of material may migrate to the east and contribute to the Sabine Fillet at the west jetty (King, 2007; Morang, 2006). In Louisiana, the sand bar formed by BU sediments from the Cheniere LNG project may shelter the shoreline from wave energy sufficiently to allow fine-grained sediments to form a mudflat behind the sandbar (Nairn and Willis, 2002; PBS&J, 2004b). While a significant percentage of the sediment would be rapidly carried offshore, some is likely to move downcoast with the littoral current, enlarging the sand and mudflat already present at the east jetty.

#### 4.6.2.3 Coastal Shoreline Erosion Impacts

The changes in sediment transport, while very small, can be expected to have some effect on the rates of shoreline erosion. Under the Preferred Alternative, there is a slight reduction in the erosion rate near the jetties. Near the jetties, the average rate of shoreline accretion was calculated to be as much as 60 feet/year. However, between 0.5 mile and 3 to 4 miles on either side of the jetties the erosion would be increased by less than 0.5 foot/year for a 50-foot project, and farther from the jetties than that, the change in the shoreline change would decrease to zero. The effect of the 48-foot channel on the Gulf shoreline between 0.5 mile and 3.5 miles from each jetty was estimated to be 0.42 foot/year based upon the 45- and 50-foot project effects.

The Gulf Shore BU Feature should have a positive effect on reducing shoreline erosion. The presence of additional fine-grained sediments in the littoral system, which would be provided by the BU feature, should reduce the current erosion rate and minimize the small increase in shore erosion predicted with the project. In systems that have an abundant supply of fine-grained sediments, the presence of additional muddy sediment in the nearshore environment may attenuate waves and lessen wave-induced erosion (Hsiao and Shemdin, 1980; Tubman and Suhayda, 1976; Wells and Kemp, 1986). Furthermore, the predominantly fine-grained sediment provided by this BU feature should contribute to mudflat accretion by periodically moving onshore and becoming shore-attached. On the western Louisiana and east Texas coasts, sediments accumulate as mudflats and underwater mudshoals (or “fluid mud”) in the nearshore region. Nearshore, fluid mud can be trapped against the shoreline by prevailing south and southwesterly winds, and storms carry the trapped muddy ooze onto the chenier shoreline (Morgan et al., 1958; Wells and Kemp, 1982, 1986). Accretion of the shoreline can then occur by poorly understood processes (Huh et al., 1991; King, 2007; PIE, 2003).

Although the BU sediments would be largely fine grained, approximately 18 percent of maintenance material is expected to be sand. Sands that are deposited onshore would nourish and stabilize eroding marshes, and sand deposited in the nearshore zone should stay in the nearshore environment, moving back and forth across the shoreface (Wamsley, 2008). Sand placed at Louisiana Point should remain on the shoreface where it was deposited; no significant amounts of sand are expected to enter the Jetty Channel. On erosive mud shorelines like those in the BU area, the sand percentage should increase and it

would form sandy lenses or a veneer over the mud shoreline substrate. As the sand lenses thicken, the sands help protect the underlying mud from further erosion (Nairn, 1992). However, in smaller quantities, sand can also accelerate erosion of a mud beach. If the consolidated mud is not covered by a sand veneer, any sand that is mobilized by wave action would act as a scouring agent (King, 2007).

#### 4.6.2.4 Inland Shoreline Erosion Impacts

The primary area of concern for inland shoreline impacts is Pleasure Island along the confined channels of the Port Arthur and Sabine-Neches canals (Parchure et al., 2005). No increase in the existing erosion rate is predicted with the project for the eastern shore of Sabine Lake. The primary mechanism for shoreline erosion associated with the project is from passage of large vessels. Maynord (2003) investigated the mechanisms of ship-induced bank recession (shoreline erosion). The analysis employed a numerical model (HIVEL2D) to simulate the ship-induced velocity at the bank and employed information on the vessels in the existing and future fleets and information on the speeds that would be needed in both the No-Action and Preferred alternatives. The analysis focused on two sites on Pleasure Island; the north site is in the Sabine-Neches Canal, and the south site is in the Port Arthur Canal. The north site has no existing erosion protection, while the south site has riprap protection. Neither site will have a change in channel width. The analysis was calibrated to the existing rates of bank recession, and it used the model to account for differing numbers of vessel trips projected for the years 2030 and 2060 for both the No-Action and 50-foot alternatives. The Preferred Alternative is expected to have a lesser effect than the 50-foot alternative.

Maynord (2005) found that the rates of erosion are lower for the 50-foot alternative than for the No-Action Alternative at both the north and south sites for both 2030 and 2060 traffic levels. Overall, the effect of the Preferred Alternative should be to reduce the rate of erosion on inland channels relative to the No-Action Alternative because of fewer vessel trips that are predicted with the Preferred Alternative than in the No-Action Alternative.

### 4.6.3 Salinity

#### 4.6.3.1 No-Action Alternative

Under the No-Action Alternative, the modeled RSLR of 1.1 feet is expected to increase salinity levels from the present condition. RSLR is expected to increase salinities up to 2 ppt in portions of the project area in the FWOP area. The complicated circulation and salinity patterns of the SNWW system would change substantially. Freshwater enters the system via several tributaries, including the Sabine River, the Neches River, and other smaller inflows. The Neches River flows directly into Sabine Lake and the Sabine-Neches Canal. The Sabine River flows into Sabine Lake, the Sabine NWR, and into Calcasieu Lake via the GIWW. During times of low flow, the direction of flow in the GIWW is reversed and higher salinity Calcasieu waters flow westward into the Sabine basin (Gammill et al., 2002).

The Sabine-Neches Canal connects the Neches River Channel to Sabine Pass, flowing through a narrow, confined channel between Pleasure Island on the east and Port Arthur on the west. This canal conducts

both fresh water from the rivers and Gulf waters intruding via tidal propagation through Sabine Pass. As a result, substantial salinity stratification forms in the Sabine-Neches Canal. Stratification contributes to salt water intruding up the Sabine-Neches Canal, into the northwest corner of Sabine Lake, and the lower reaches of the Neches River Channel. Consequently, observed salinity in Sabine Lake is highest at both the southern end (where it connects to Sabine Pass) and at the northern end (where it connects to the Sabine-Neches Canal). Lowest salinities are observed in the central and eastern portions of Sabine Lake, farthest from the hydraulic connection to sources of saline water.

Wide swings in salinity associated with shifts from periods of drought to high freshwater inflows would continue. Hydrologic conditions in some wetlands in the study area are managed with passive water control structures (rock weirs, flap-gate culverts, rock plugs, and rock dikes). FWOP conditions were developed using field salinity data collected with these structures in place. It is assumed these would continue to operate as they do today. A summary of water controls is below and they are described more fully in Section 3.5.

- In Louisiana, one large, rain-fed, freshwater impoundment (Pool 3) is located in the center of the SNWR, at the eastern edge of the SNWW study area (Gammill et al., 2002). A containment levee was constructed in 1951 around a large area of unbroken marsh. It is managed to hold fresh water at high levels, increasing the water-to-marsh ratio for wintering waterfowl habitat. Pool 3 was not included in the study area because it is hydrologically isolated from the surrounding wetlands. Two CWPPRA hydrologic restoration projects in the Black Bayou and Willow Bayou marshes east of Sabine Lake have been constructed (USFWS-LDNR, 2008a, 2008b). FWOP conditions in the Willow Bayou hydro-unit assume that all elements of Construction Unit 1 of the Willow Bayou Hydrologic Restoration Project are in place. The FWOP condition reflects a small reduction in the land loss rate due to the effects of the breakwater and in-situ terracing. Likewise, FWOP conditions in the Black Bayou hydro-unit include the projected effects of the Black Bayou Hydrologic Restoration Project. In WVA computations, land loss throughout the unit was reduced by two-thirds for the 20-year CWPPRA project life to reflect erosion protection and flow reductions with the GIWW shoreline protection. In addition, FWOP salinity in the intermediate marshes was expected to increase to 4.2 to 5.1 ppt, the salinity level projected to result from the Black Bayou hydrologic management measures (rock dike, rock weirs, and self-regulating tide gate).
- In Texas, saltwater barriers restrict saltwater intrusion from the GIWW into Taylor Bayou to the north and into the J.D. Murphree WMA to the south. Low rock weirs restrict flow on some smaller channels in the Texas Point NWR. FWOP conditions for the GIWW North, Salt Bayou, and Texas Point hydro-units were developed using field salinity data collected with these structures in place. Restrictions to the access of marine organisms caused by these structures were reflected in the EMCM variable ($V_6$) for aquatic organism access.

Mean salinities used in the FWOP condition of the WVA model are presented in tables 4.6-1 (Mean Salinity at Median Inflow) and 4.6-2 (Mean High Salinity at Median Inflow). The tables show salinities modeled at field sampling stations, and include a range of salinities calculated for the 95 percent confidence level. In general, empirical salinity data were used, when available, for the FWOP salinity parameter in the WVA model. HS model output was used when empirical data were not available. For

marshes inland and far from model nodes, the salinity gradient was estimated based upon empirical data from adjacent hydro-units, and local resource managers' knowledge of the magnitude of water exchange with the larger channels and waterbodies.

Table 4.6-1
FWOP and FWP Mean Salinities and 95 Percent Confidence Range

| Mean Salinity (ppt)/Median Flow | | | | | |
|---|---|---|---|---|---|
| | | | | FWP Mean Salinity 95% Confidence Range | |
| Station Number | Data Collection Station | FWOP Mean Salinity | FWP 48-Foot Project Mean Salinity | Salinity (–2 SD) | Salinity (+2 SD) |
| 1 | Upper Neches River | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | Beaumont Turning Basin | 0.1 | 0.2 | 0.0 | 0.7 |
| 3 | Mouth of Neches River | 3.4 | 4.2 | 2.9 | 5.5 |
| 5 | Sabine River at Orange | 0.4 | 0.6 | 0.0 | 1.5 |
| 6 | Sabine-Neches Canal | 12.8 | 14.4 | 12.0 | 16.8 |
| 7 | Mouth of Sabine Pass | 22.7 | 22.9 | 20.8 | 24.9 |
| 9 | Mouth of Sabine River | 5.3 | 6.6 | 5.2 | 8.1 |
| 10 | South Sabine Lake | 10.4 | 11.6 | 9.8 | 13.4 |
| 11 | Black Bayou | 4.1 | 5.2 | 3.7 | 6.6 |
| 14 | Mouth of Johnson's Bayou | 5.1 | 6.7 | 5.5 | 7.9 |
| 15 | Keith Lake Fish Pass | 14.6 | 16.0 | 14.8 | 17.2 |
| 16 | Mouth of Willow Bayou | 4.3 | 5.7 | 4.5 | 6.9 |
| 17 | GIWW West at Taylor Bayou | 13.0 | 14.6 | 13.0 | 16.3 |

Table 4.6-2
FWOP and FWP Mean High Salinities and 95 Percent Confidence Range

| Mean High 33 Percent Continuous Salinity (ppt)/Median Flow | | | | | |
|---|---|---|---|---|---|
| Station Number | Data Collection Station | FWOP Mean High Salinity | FWP Mean High Salinity | 95% Confidence Range | |
| | | | | Salinity (–2 SD) | Salinity (+2 SD) |
| 1 | Upper Neches River | 0.0 | 0.0 | 0.0 | 0.1 |
| 2 | Beaumont Turning Basin | 0.2 | 0.6 | 0.4 | 0.9 |
| 3 | Mouth of Neches River | 8.0 | 9.4 | 8.6 | 10.3 |
| 5 | Sabine River at Orange | 1.1 | 1.7 | 0.5 | 2.9 |
| 6 | Sabine-Neches Canal | 20.5 | 21.3 | 19.6 | 22.9 |
| 7 | Mouth of Sabine Pass | 27.6 | 27.6 | 26.4 | 28.7 |
| 9 | Mouth of Sabine River | 11.8 | 13.7 | 12.6 | 14.8 |
| 10 | South Sabine Lake | 17.5 | 18.7 | 16.3 | 21.1 |
| 11 | Black Bayou | 9.5 | 11.2 | 9.7 | 12.7 |
| 14 | Mouth of Johnson's Bayou | 10.5 | 12.7 | 11.9 | 13.5 |
| 15 | Keith Lake Fish Pass | 21.2 | 22.1 | 20.9 | 23.4 |
| 16 | Mouth of Willow Bayou | 8.7 | 10.6 | 8.3 | 13.0 |
| 17 | GIWW West at Taylor Bayou | 20.2 | 21.0 | 20.1 | 21.9 |

Although expected to occur only infrequently, when low flows, considered drought flows for the purpose of this analysis, occur during late summer and fall of some years, the HS model predicts substantially higher salinities (Table 4.6-3 Mean Salinity at Low Inflow). The HS model defines drought conditions as the 10th percentile of the WAM Run 8 2060 flows. At the upper reaches of the Neches River, the relative salinity increase as a result of low inflow is relatively small, only 0.1 ppt under the FWOP condition. Salinity in the Sabine River at Orange would increase from 3.8 ppt under the modeled existing condition to 4.9 ppt under the FWOP condition. The HS model predicts salinities throughout the remainder of the project area would range from 0.5 to 2.2 ppt higher during droughts under the FWOP condition than under existing conditions. Modeled FWOP salinity at Black Bayou during median flow is 4.1 ppt increasing to 15.6 ppt under drought conditions. Likewise, at the mouth of Willow Bayou, the predicted salinity increases from 4.3 ppt at median inflows to 14.6 ppt during drought under the FWOP condition. The HS model analysis (Brown and Stokes, 2009) reports that the largest salinity differences would occur in the Neches River near Bessie Heights and along the western shore of Sabine Lake. These analyses indicate that drought conditions cause substantial increases in salinity in the project area and that RSLR associated with the FWOP condition has relatively little additional affect on salinity during droughts.

Table 4.6-3
Mean Salinity Predicted by the Hydrodynamic-Salinity Model*

| Mean Salinity (ppt)/Low Flow | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | FWP Mean Salinity Range | |
| Station Numbers | Data Collection Station | Modeled Existing Condition | FWOP Mean Salinity | FWP 48-Foot Project Mean Salinity | Salinity (–2 SD) | Salinity (+2 SD) |
| 1 | Upper Neches River | 0.0 | 0.1 | 0.26 | 0.0 | 0.6 |
| 2 | Beaumont Turning Basin | 1.0 | 1.9 | 2.6 | 2.2 | 3.0 |
| 3 | Mouth of Neches River | 11.4 | 13.6 | 14.0 | 13.3 | 14.7 |
| 5 | Sabine River at Orange | 3.8 | 4.9 | 5.8 | 4.8 | 6.8 |
| 6 | Sabine-Neches Canal | 23.0 | 24.6 | 24.7 | 23.8 | 25.6 |
| 7 | Mouth of Sabine Pass | 28.9 | 29.4 | 29.1 | 28.4 | 29.7 |
| 9 | Mouth of Sabine River | 15.9 | 17.4 | 18.4 | 18.1 | 18.7 |
| 10 | South Sabine Lake | 21.7 | 23.3 | 23.2 | 22.1 | 24.3 |
| 11 | Black Bayou | 14.1 | 15.6 | 16.6 | 16.2 | 16.9 |
| 14 | Mouth of Johnson's Bayou | 15.0 | 16.9 | 17.9 | 17.6 | 18.2 |
| 15 | Keith Lake Fish Pass | 24.2 | 25.5 | 25.5 | 24.7 | 26.3 |
| 16 | Mouth of Willow Bayou | 12.7 | 14.6 | 15.6 | 15.2 | 16.0 |
| 17 | GIWW West at Taylor Bayou | 22.9 | 24.5 | 24.5 | 24.1 | 25.0 |

* Brown and Stokes (2009) – Under low-flow conditions (based on WAM Run 8 output for 2060 [TWDB, 2007]). All conditions assume intermediate RSLR of 1.1 feet.

### 4.6.3.2 Preferred Alternative

#### *4.6.3.2.1 FWP Salinity Impacts*

The Preferred Alternative would deepen the navigation channel and allow more tidal circulation and exchange with the Gulf than at present. Salinity would increase in much of the system, and the salinity wedge would extend farther upstream in the Neches River Channel. Increased salinity is expected to reduce health and biological productivity of a large area of intertidal marsh in Louisiana and Texas.

Salinity changes in the SNWW estuarine system were projected with the HS model described in sections 3.1 and 4.1 of this FEIS (Brown and Stokes, 2009). The HS model also determined that the average water surface elevation would be altered slightly by the channel deepening. The water surface is lower by less than an inch at Sabine Pass. The average water surface elevation is somewhat higher in the upper reaches of the Neches River, where the average elevation increase is about 0.8 inch. The change likely results from an increase in the landward extent of tidal propagation.

Two scenarios (low flow and median flow) were developed in the HS model to evaluate changes resulting from the project (see tables 4.6-1, 4.6-2, and 4.6-3). The HS modeling indicated that the highest average salinity increases for the Preferred Alternative over the FWOP condition are found in the following locations:

Low Flow:

- Neches River, near Rose City (approximately 0.7 ppt)
- Sabine River at Orange (approximately 0.9 ppt)
- Eastern shore of Sabine Lake (approximately 1.0 ppt)

Median Flow:

- Neches River near Bessie Heights (approximately 1.8 ppt)
- Keith Lake Fish Pass (approximately 1.4 ppt)
- Eastern Shore of Sabine Lake (approximately 1.4 to 1.6 ppt)

In addition to changes in salinity and stratification within the navigation channels and Sabine Lake, salinities in interior marshes were predicted with the HS model. The hydrologic effect of smaller channels in the marshes was included and salinity gradients were projected for wetland areas set back from the primary waterbodies. Modeling results indicated that salinity increases in the interior marshes, based upon average salinities, would be 1.0 ppt higher in the marshes east of Sabine Lake, and 0.1 to 1.8 ppt higher in the Neches River marshes. Salinities in the cypress-tupelo swamps in the upper Neches and Sabine River reaches were predicted to be about 0.3 ppt and 1.0 ppt higher, respectively. Salinity impacts are not expected to result from borrowing material from Sabine Lake and the Lake Charles Deepwater Channel/GIWW (for Willow and Black Bayou mitigation measures) because the borrow areas do not connect to the Sabine River Channel or the Calcasieu Ship Channel.

The potential for salinity impacts to be magnified in areas subjected to hydrologic management was considered by the ICT during application of the WVA model. In the Black Bayou hydro-unit, the new structures would not restrict flow sufficiently to impound water and exacerbate impacts of the 1.4 ppt increase in salinity within the intermediate marsh. Flow is considered to be essentially unrestricted because of the many remaining hydrologic access points. In Willow Bayou, water control structures proposed for Construction Unit 2 were eliminated when HS modeling determined that they would be ineffective. Control structures built in Construction Unit 1 would not restrict flow sufficiently to impound water. Like Black Bayou, flow is considered unrestricted because of the many remaining hydrologic access points. In Texas, saltwater barriers on Taylor Bayou and along the GIWW are actively managed and can be opened to accept flows from the GIWW when salinity levels inside the marshes are higher than the GIWW. Furthermore, flows in and out of the marshes affected by these barriers remain through smaller drainages and the larger Keith Lake Fish Pass and Texas Bayou.

An extensive literature review conducted for the Louisiana Coastal Areas Ecosystem Restoration Study (LCA Study) documented that increases in salinity negatively affect primary productivity of selected indicator species found in typical wetlands of the Louisiana coastal zone (Visser et al., 2004). These studies used measurements of productivity, including total biomass, stem/leaf elongation, and photosynthesis, gathered in greenhouse experiments on saturated soils. Linear regression equations were developed to predict percentage changes in habitat productivity per 1 ppt salinity increase for each major coastal vegetation community, regardless of inundation. For every 1 ppt increase in salinity, total primary

productivity of swamps was reduced by 8.4 percent, fresh marsh by 11.1 percent, intermediate marsh by an average of 6.8 percent, brackish marsh by 2.6 percent, and saline marsh by 2.1 percent. These relationships were used to predict land loss rate changes in the current study. The method and results of that analysis are presented in Section 4.10. Habitats in the SNWW study area are dominated by the same marsh and swamp vegetation species found in the western Louisiana coastal zone. Supporting references for salinity-related productivity changes in vegetation include:

- **Swamp** – co-dominant species bald cypress and tupelo gum (Conner et al., 1997; Megonigal et al., 1997; Mitsch et al., 1991; Pezeshki et al., 1987a, 1990)
- **Fresh marsh** – co-dominant species maidencane and bulltongue (Greiner LaPeyre et al., 2001; Hester et al., 2001; Howard and Mendelssohn, 1999; McKee and Mendelssohn, 1989; Pezeshki et al., 1987b, 1987c; Spalding and Hester, 2007; Willis and Hester, 2004)
- **Intermediate marsh** – co-dominant species bulltongue and marshhay cordgrass (Baldwin and Mendelssohn, 1998; Greiner LaPeyre et al., 2001; Howard and Mendelssohn, 1999, 2000; Pezeshki et al., 1987b; Spalding and Hester, 2007; Webb and Mendelssohn, 1996)
- **Brackish marsh** – co-dominant species marshhay cordgrass and seashore saltgrass (Bertness et al., 1992; Broome et al., 1995; Ewing et al., 1995; Greiner LaPeyre et al., 2001; Hester et al., 2001; Kemp and Cunningham, 1981; Parrondo et al., 1978; Warren and Brockelman, 1989)
- **Saline marsh** – Smooth cordgrass and blackrush (Bradley and Morris, 1992; Eleuterius, 1989; Gosselink, 1970; Linthurst and Seneca, 1981; Parrondo et al., 1978; Pezeshki and DeLaune, 1995).

#### *4.6.3.2.2 WVA Model Evaluation of Salinity Impacts*

The impact of salinity changes on the estuarine habitats in the SNWW study area was assessed with the WVA model. Optimal salinity ranges assumed by the WVA model for the various habitat types are as follows:

- Swamp and Bottomland Hardwood (≤1 ppt)
- Fresh Marsh (≤2 ppt) (upper limit of 4 ppt during March–November growing season)
- Intermediate Marsh (≤4 ppt) (upper limit of 8 ppt during March–November growing season)
- Brackish Marsh (≤10 ppt) (upper limit of 16 ppt as an annual average)
- Saline Marsh (≥9 and ≤21 ppt) (upper limit in excess of 24 ppt as an annual average)

The optimal salinity ranges in the WVA model were based upon established salinity tolerances of common vegetation communities and salinity ranges associated with life history requirements of fish and wildlife species utilizing the habitats. Information from 32 HSI species models (USFWS, 1980) for estuarine fish and shellfish, reptiles and amphibians, birds and mammals was relied upon in establishing the optimal ranges (USFWS, 2002a).

The WVA model assumes that periods of high salinity are most detrimental in fresh/intermediate marsh and swamp when they occur during the growing season. This assumption is supported by a recent summary of annual primary productivity by season and habitat type that was developed for the habitat-switching module of the LCA Study (Visser et al., 2004). In swamps, 75 percent of annual primary productivity occurs from March 1 through June 30, and no primary production occurs from November 1 through February 28 (Keeland and Sharitz, 1995). The seasonal productivity of fresh marsh is longer, with approximately 38 percent of annual productivity occurring from March 1 through June 30, and 48 percent occurring from July 1 through October 31 (Sasser and Gosselink, 1984). Seasonal productivity of intermediate marsh is very similar to that of fresh marsh, with somewhat lower productivity in the July through October months (Hopkinson et al., 1978).

Median flow has been used to model the effects of FWP salinity changes for all vegetative communities. Run 8 of the TCEQ's WAM was used to represent the median-flow condition for salinity modeling. The TWDB (2007) projected flows for the year 2060 by modifying Run 8 "to include projected increased demand from existing water rights, expected change to return flows, projected new strategies to come online before 2060, and estimated year 2060 storage capacities for major reservoirs" (TWDB, 2007). These WAM Run 8 inflows were developed using current patterns of precipitation and evaporation. The median-flow condition was modeled for the period from approximately April through September.

Model output included mean salinities used to model impacts to brackish and saline wetlands during their growth season. These marshes are most influenced by long-term, prevailing salinity conditions. The productivity of brackish marsh is relatively stable throughout the year, with only slightly lower productivity from November 1 through February 28 (Hopkinson et al., 1978). Nearly half of the annual productivity of saline marsh occurs from July 1 through October 31, 29 percent in late spring and summer, and 24 percent in late fall and winter.

The median flow was also used to evaluate possible effects on fresh and intermediate marshes and forested wetlands. However, because these systems are more sensitive than brackish and saline wetlands to relatively small seasonal salinity changes, mean high salinity is used as the salinity parameter for the WVA models. Mean high salinity is the roaming mean of the highest 33 percent of consecutive daily salinity values during the growing season calculated for a specific period of record. This statistic is applied to model effects of high salinity during the growing season, when episodes of sufficient duration would reduce productivity of these freshwater habitats (Hester et al., 1996, 2001; McKee and Mendelssohn, 1989).

In the EMCM, effects of salinity changes are reflected most directly by two variables: $V_1$ (percent emergent marsh) and $V_5$ (salinity); however, changes in salinity can also result in changes to variables $V_2$ (percent SAV coverage), $V_3$ (marsh edge and interspersion); and $V_4$ (percent shallow water). The model assumes even small changes beyond the optimal salinity range of a marsh result in a small change to the land loss rate. This effect is captured in $V_1$ and described in relation to vegetation impacts in Section 4.10. Variable $V_5$ focuses on the effects of salinity on vegetation; changes within the optimal salinity ranges of each regime are not considered an impact and do not change the SI score of "1.0." However, even small

salinity increases outside of the optimal range reduce the SI below "1.0." This impact is based upon the assumption that small changes in salinity beyond the optimal range (suboptimal) for a specific hydrologic regime and its habitats affects the primary productivity of marsh grasses and forested wetlands.

FWOP and FWP salinities are presented for each hydro-unit in Texas and Louisiana in tables 4.6-4 and 4.6-5, respectively. Tables 4.6-6 and 4.6-7 present an acreage analysis by state and habitat type that identifies areas where FWOP and FWP salinities, respectively, are predicted to remain within, or extend into the suboptimal salinity range.

#### *4.6.3.2.3 Salinity Impacts by Vegetation Community*

**Bottomland Hardwoods**

Bottomland hardwoods in the study area are located on elevated ridges and natural river levees, as well as on upland terrace margins, most often separated from the navigation channels by fringing marsh or swamp. The study area contains 3,206 acres of bottomland hardwoods in Louisiana, and 5,458 acres in Texas. In the FWOP condition, this habitat is projected to remain within the optimal salinity range. The upper reach of the Sabine River is generally fresh, with salinity intruding only during times of drought and low freshwater inflow, or with tidal surges during hurricanes. Prevailing conditions are reflected in the median-flow scenario of the HS model, in which a FWOP salinity of 0 ppt is predicted in the Sabine River just south of IH 10. During FWP conditions, salinities would rise near the GIWW from a FWOP salinity of 2.5 ppt to a FWP salinity of 4.1 ppt. Upstream at the confluence of the Sabine and Old rivers, salinity is predicted to rise about 0.1 ppt under both the FWOP and FWP conditions.

The Sabine River watershed also contains bottomland hardwood communities located on the Texas side of the river in the Sabine Island (524 acres), Blue Elbow (189 acres), Cow Bayou (388 acres), and Adams Bayou (640 acres) hydro-units. FWOP and FWP salinity conditions for the Texas portions of Sabine Island and Blue Elbow are identical to those in Louisiana. Cow and Adams bayous enter the Sabine River south of the GIWW and receive runoff from developed areas south and west of the city of Orange. They have been rectified and deepened to provide shallow-draft access for oil field development vessels. The HS model projects FWOP mean salinity of about 0 ppt in Cow Bayou and 3.1 ppt in Adams Bayou. FWP salinities are predicted to range from about 1.0 ppt in Cow Bayou to 3.9 ppt in Adams Bayou. Although modeled salinities predicted under both the FWOP and FWP conditions are above the optimal range (≤1.0 ppt), in Adams Bayou the bottomland hardwoods are located on higher ridges or terrace margins, and are buffered from bayou salinities by intervening swamp and marsh.

In the Neches River watershed, the Neches River just south of IH 10 is normally fresh. The HS model predicts salinities in areas with bottomland hardwoods will remain near 0 in both the FWOP and FWP conditions. Several bottomland hardwood communities also occur south of IH 10 along the Neches River—1,775 acres in the Rose City hydro-unit, 293 acres in the Bessie Heights hydro-unit, and 197 acres in the Old River hydro-unit. FWOP mean annual salinities in these areas range from 0.3 ppt near Rose City to 1.5 ppt near Bessie Heights and Old River Cove. The bottomland hardwood stands are located well east of the river on the upland terrace margin and are not affected by salinity in the Neches River.

Table 4.6-4
Salinity Changes in Texas Hydro-units

| # | Hydrologic Unit Name | Habitat Type | FWOP Salinity (ppt) | FWP Salinity (ppt) | FWP Net Change (ppt) |
|---|---|---|---|---|---|
| **Bottomland Hardwoods (optimal salinity range ≤1 ppt)** | | | | | |
| **Neches River Watershed** | | | | | |
| TX 1 | North Neches River | Bottomland Hardwood | 0.0 | 0.0 | 0.0 |
| TX 2 | Neches-Lake Bayou | Bottomland Hardwood | 0.0 | 0.0 | 0.0 |
| TX 3 | Rose City | Bottomland Hardwood | 0.3 | 0.6 | 0.3 |
| TX 5 | Bessie Heights | Bottomland Hardwood | 1.5 | 2.0 | 0.5 |
| TX 6 | Old River Cove | Bottomland Hardwood | 1.5 | 2.0 | 0.5 |
| **Sabine River Watershed** | | | | | |
| TX 10 | Cow Bayou | Bottomland Hardwood | 0.0 | 1.0 | 1.0 |
| TX 11 | Adams Bayou | Bottomland Hardwood | 3.1 | 3.9 | 0.8 |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0.1 | 0.1 | 0.0 |
| **Cypress-Tupelo Swamp (optimal salinity range ≤1 ppt)** | | | | | |
| **Neches River Watershed** | | | | | |
| TX 1 | North Neches River | Cypress-Tupelo Swamp | 0.0 | 0.0 | 0.0 |
| TX 2 | Neches-Lake Bayou | Cypress-Tupelo Swamp | 0.0 | 0.0 | 0.0 |
| TX 3 | Rose City | Cypress-Tupelo Swamp | 0.3 | 0.6 | 0.3 |
| **Sabine River Watershed** | | | | | |
| TX 10 | Cow Bayou | Cypress-Tupelo Swamp | 0.0 | 1.0 | 1.0 |
| TX 11 | Adams Bayou | Cypress-Tupelo Swamp | 3.1 | 3.9 | 0.8 |
| TX 12 | Blue Elbow South | Cypress-Tupelo Swamp | 1.1 | 1.7 | 0.6 |
| LA/TX 1 | Sabine Island | Cypress-Tupelo Swamp | 0.1 | 0.1 | 0.0 |
| LA/TX 2 | Blue Elbow | Cypress-Tupelo Swamp | 0.6 | 0.9 | 0.3 |
| **Fresh Marsh (optimal salinity range ≤2 ppt)** | | | | | |
| **Neches River Watershed** | | | | | |
| TX 1 | North Neches River | Fresh Marsh | 0.0 | 0.0 | 0.0 |
| TX 2 | Neches-Lake Bayou | Fresh Marsh | 0.0 | 0.1 | 0.1 |
| TX 3 | Rose City | Fresh Marsh | 0.3 | 0.6 | 0.3 |
| TX 4 | West of Rose City | Fresh Marsh | 0.2 | 0.6 | 0.4 |
| TX 5 | Bessie Heights | Fresh Marsh | 1.5 | 2.0 | 0.5 |
| TX 7 | GIWW North | Fresh Marsh (Intermediate lumped) | 2.5 | 4.1 | 1.6 |
| **Sabine River Watershed** | | | | | |
| TX 10 | Cow Bayou | Fresh Marsh | 4.0 | 5.0 | 1.0 |
| TX 11 | Adams Bayou | Fresh Marsh | 3.5 | 5.0 | 1.5 |
| **Intermediate Marsh (optimal salinity range ≤4 ppt)** | | | | | |
| **Neches River Watershed** | | | | | |
| TX 5 | Bessie Heights | Intermediate (Brackish lumped) | 4.4 | 4.7 | 0.3 |
| TX 8 | Texas Point | Intermediate (Fresh lumped) | 7.0 | 7.8 | 0.8 |
| TX 13 | Groves | Intermediate Marsh | 4.0 | 5.0 | 1.0 |
| **Sabine River Watershed** | | | | | |
| TX 10 | Cow Bayou | Intermediate Marsh | 4.0 | 5.0 | 1.0 |
| **Brackish Marsh (optimal salinity range ≤10 ppt)** | | | | | |
| **Neches River Watershed** | | | | | |
| TX 6 | Old River Cove | Brackish Marsh | 11.2 | 13.0 | 1.8 |
| TX 7 | GIWW North | Brackish Marsh | 10.8 | 12.4 | 1.6 |
| TX 8 | Texas Point | Brackish Marsh | 9.8 | 10.6 | 0.5 |
| **Saline Marsh (optimal salinity range ≥9 to ≤21 ppt)** | | | | | |
| **Neches River Watershed** | | | | | |
| TX 8 | Texas Point | Saline Marsh | 13.8 | 14.6 | 0.8 |

Table 4.6-5
Salinity Changes in Louisiana Hydro-units

| # | Hydrologic Unit Name | Habitat Type | FWOP Salinity (ppt) | FWP Salinity (ppt) | FWP Net Change (ppt) |
|---|---|---|---|---|---|
| **Bottomland Hardwoods (optimal salinity range ≤1 ppt)** | | | | | |
| LA 1 | Perry Ridge | Bottomland Hardwood | 1.7 | 2.3 | 0.6 |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0.1 | 0.1 | 0.0 |
| LA/TX 2 | Blue Elbow | Bottomland Hardwood | 0.6 | 0.9 | 0.3 |
| **Cypress-Tupelo Swamp (optimal salinity range ≤1 ppt)** | | | | | |
| LA/TX 1 | Sabine Island | Cypress-Tupelo Swamp | 0.1 | 0.1 | 0.0 |
| LA/TX 2 | Blue Elbow | Cypress-Tupelo Swamp (Bottomland Hardwoods lumped) | 0.6 | 0.9 | 0.3 |
| **Fresh Marsh (optimal salinity range ≤2 ppt)** | | | | | |
| LA 1 | Perry Ridge | Fresh Marsh | 1.7 | 2.3 | 0.6 |
| LA 7 | Southeast Sabine | Fresh Marsh | 2.1 | 2.4 | 0.3 |
| LA 8 | Southwest Gum Cove | Fresh Marsh | 1.4 | 2.0 | 0.6 |
| **Intermediate Marsh (optimal salinity range ≤4 ppt)** | | | | | |
| LA 1 | Perry Ridge | Intermediate Marsh | 4.5 | 5.6 | 1.1 |
| LA 2 | Willow Bayou | Intermediate Marsh | 6.8 | 7.7 | 0.9 |
| LA 3 | Black Bayou | Intermediate Marsh | 5.1 | 6.5 | 1.4 |
| LA 4 | West Johnson's Bayou | Intermediate Marsh | 5.5 | 7.3 | 1.8 |
| LA 5 | Sabine Lake Ridges | Intermediate Marsh | 5.5 | 7.3 | 1.8 |
| LA 7 | Southeast Sabine | Intermediate Marsh | 2.1 | 2.4 | 0.3 |
| LA 8 | Southwest Gum Cove | Intermediate (Brackish lumped) | 2.8 | 3.9 | 1.1 |
| LA 9 | East Johnson's Bayou | Intermediate (Brackish lumped) | 3.8 | 4.8 | 1.0 |
| **Brackish Marsh (optimal salinity range ≤10 ppt)** | | | | | |
| LA 2 | Willow Bayou | Brackish Marsh | 7.2 | 8.6 | 1.4 |
| LA 3 | Black Bayou | Brackish Marsh | 4.2 | 5.3 | 1.1 |
| LA 4 | West Johnson's Bayou | Brackish Marsh | 5.3 | 7.0 | 1.7 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh | 7.1 | 8.3 | 1.2 |
| LA 6 | Johnson's Bayou Ridge | Brackish Marsh | 5.3 | 7.0 | 1.7 |
| **Saline Marsh (optimal salinity range ≥9 to ≤21 ppt)** | | | | | |
| LA 5 | Sabine Lake Ridges | Saline Marsh | 16.6 | 17.3 | 0.7 |
| LA 6 | Johnson's Bayou Ridge | Saline Marsh | 16.6 | 17.3 | 0.7 |

Table 4.6-6
FWOP Optimal Salinity Range – Acreage Analysis by Habitat Type*

| | Bottomland Hardwoods (acres) | | Cypress-Tupelo Swamp (acres) | | Fresh Marsh (acres) | | Intermediate Marsh (acres) | | Brackish Marsh (acres) | | Saline Marsh (acres) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range |
| **Texas** | | | | | | | | | | | | |
| Neches River Watershed | 3,717 | 0 | 5,501 | 0 | 12,592 | 731 | 37,651 | 344 | 30,469 | 1,832 | 3,262 | 2,446 |
| Sabine River Watershed | 1,552 | 0 | 4,656 | 0 | 2,271 | 103 | 1,522 | 59 | 0 | 0 | 0 | 0 |
| Total Acres of Habitat Type | 5,269 | 0 | 10,157 | 0 | 14,863 | 834 | 39,173 | 403 | 30,469 | 1,832 | 3,262 | 2,446 |
| Percentage | 100.0 | 0 | 100.0 | 0 | 94.6 | 5.4 | 99.0 | 1.0 | 94.2 | 5.8 | 57.1 | 42.9 |
| **Louisiana** | | | | | | | | | | | | |
| Sabine River Watershed | 3,206 | 0 | 6,641 | 0 | 23,995 | 1,113 | 125,227 | 8,050 | 19,200 | 5,961 | 3,646 | 491 |
| Percentage | 100.0 | 0 | 100.0 | 0 | 95.6 | 4.4 | 94.0 | 6.0 | 76.3 | 23.7 | 88.1 | 11.9 |
| **Total Project** | | | | | | | | | | | | |
| Project Total – Habitat Type | 8,475 | 0 | 16,798 | 0 | 38,858 | 1,947 | 164,400 | 8,453 | 49,669 | 7,793 | 6,908 | 2,937 |
| Percentage | 100.0 | 0 | 100.0 | 0 | 95.2 | 4.8 | 95.1 | 4.9 | 86.4 | 13.6 | 70.2 | 29.8 |

Total FWOP Project Acres Within Optimal Range = 285,040 acres (93.1%)

Total FWOP Project Acres Within Sub-optimal Range = 21,198 acres (6.9%)

*Calculated using WVA Impacts Summaries from tables 4.1-3 and 4.1-4 and Habitat Acreage from Table 7 in Appendix C.

Table 4.6-7
FWP Optimal Salinity Range – Acreage Analysis by Habitat Type*

| | Bottomland Hardwoods (acres) | | Cypress-Tupelo Swamp (acres) | | Fresh Marsh (acres) | | Intermediate Marsh (acres) | | Brackish Marsh (acres) | | Saline Marsh (acres) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range | Within Optimal Range | Sub-optimal Range |
| **Texas** | | | | | | | | | | | | |
| Neches River Watershed | 3,717 | 0 | 5,501 | 0 | 12,437 | 886 | 37,641 | 354 | 30,416 | 1,885 | 3,245 | 2,463 |
| Sabine River Watershed | 1,552 | 0 | 4,656 | 0 | 2,262 | 112 | 1,519 | 62 | 0 | 0 | 0 | 0 |
| Total Acres of Habitat Type | 5,269 | 0 | 10,157 | 0 | 14,699 | 998 | 39,160 | 416 | 30,416 | 1,885 | 3,245 | 2,463 |
| Percentage | 100.0 | 0 | 100.0 | 0 | 93.6 | 6.4 | 98.9 | 1.1 | 94.2 | 5.8 | 56.9 | 43.1 |
| **Louisiana** | | | | | | | | | | | | |
| Sabine River Watershed | 3,206 | 0 | 6,641 | 0 | 23,937 | 1,171 | 124,686 | 8,591 | 19,123 | 6,038 | 3,631 | 506 |
| Percentage | 100.0 | 0 | 100.0 | 0 | 95.3 | 4.7 | 93.6 | 6.4 | 76.0 | 24.0 | 87.8 | 12.2 |
| **Total Project** | | | | | | | | | | | | |
| Project Total – Habitat Type | 8,475 | 0 | 16,798 | 0 | 38,636 | 2,169 | 163,846 | 9,007 | 49,539 | 7,923 | 6,876 | 2,969 |
| Percentage | 100.0 | 0 | 100.0 | 0 | 94.7 | 5.3 | 94.8 | 5.2 | 86.2 | 13.8 | 69.8 | 30.2 |

Total FWP Project Acres Within Optimal Range = 284,170 acres (92.8%)

Total FWP Project Acres Within Sub-optimal Range = 22,068 acres (7.2%)

*Calculated using WVA Impacts Summaries from tables 4.1-3 and 4.1-4, Habitat Acreage from tables 4.1-3 and 4.1-4, Habitat Acreage from Table 7 in Appendix C.

The HW considered potential effects of brief salinity increases by adjusting growth rates of woody and herbaceous vegetation at rates correlated to the salinity SI in the SCM. Changes in salinity were reflected with changes in variables $V_1$ (tree species composition), $V_2$ (stand maturity), and $V_3$ (midstory/understory coverage) in consideration of potential impacts. Trees species found in the bottomland forest community such as oaks (*Quercus* spp.), hickories (*Carya* spp.), American elm, green ash, sweetgum, boxelder, etc., are generally sensitive to even low levels of salinity. Among many other adverse effects, salinity is known to cause a reduction in seed germination, with germination in many nonhalophytes inhibited by very small percentages of salt (Kozlowski, 1997). Woody plants usually are very sensitive during emergence and young seedling stages, but become progressively more tolerant with increasing age (Shannon et al., 1994). Given the small FWP salinity increase, only small reductions in growth rates were forecast, and no AAHU losses were projected by the BHM.

**Cypress-Tupelo Swamps**

Cypress-tupelo swamps in the study area occur streamside or in abandoned channels or other low areas within the floodplain. Approximately 6,641 acres of cypress-tupelo swamp are located in the Louisiana portion of the study area, and 10,157 acres in the Texas portion. Large continuous stands of swamp are present in the upper reaches of both the Sabine and Neches rivers, with thousands of acres protected in the Sabine Island and Blue Elbow Swamp WMAs. Smaller, isolated stands are found in the bottoms of small drainages along the upland margins, generally buffered from exposure to higher salinities by intervening marsh. Swamps are located in the same reaches of the river systems as the bottomland hardwoods, and experience the same FWOP and FWP predicted salinity conditions. Louisiana swamps in the study area are located in the Sabine Island (5,998 acres) and Blue Elbow (643 acres) hydro-units north of IH 10. During FWOP and FWP conditions, swamps in the Sabine Island hydro-unit would experience a salinity of 0.1 ppt. In the Blue Elbow hydro-unit, predicted salinity would increase from 0.6 ppt during FWOP conditions to 0.9 ppt during FWP conditions. No impacts to swamps in these areas are expected.

Swamps in the Texas portion of the study area occur in both the Sabine and Neches river watersheds. Swamps in the Sabine Island (1,194 acres) and Blue Elbow (2,548 acres) hydro-units straddle the border between the states, and thus the salinity changes reported for Louisiana swamps in these areas are the same in Texas. These predicted salinity changes are not expected to impact swamps in these areas. Swamps also occur in three hydro-units on the Texas side of the Sabine River watershed—Blue Elbow South (689 acres), Cow Bayou (110 acres), and Adams Bayou (115 acres). In the Neches River watershed, swamps occur in the hydro-units north of IH 10 (North Neches, 2,760 acres, and Neches-Lake Bayou, 2,277 acres), and a small swamp is located south of IH 10, at the upland margin of the Rose City hydro-unit (464 acres).

Under the median-flow condition, swamps in the Blue Elbow South hydro-unit are generally fresh with predicted salinities of 1.1 ppt in the FWOP condition and 1.7 ppt in the FWP conditions. Predicted salinity increases in Cow Bayou swamps from 0.0 ppt for the FWOP condition to 1.0 ppt for the FWP condition. The predicted salinities for Adams Bayou are higher, up to 3.1 ppt for the FWOP condition and

3.9 ppt for the FWP conditions. In total, FWP salinity increases in these swamps would result in the loss of 22 AAHUs.

The habitat switching module of the LCA Ecosystem Model projects that loss of swamp acreage would not be expected to occur until average annual salinities exceed 4 ppt, based on the literature review discussed above (Visser et al., 2004). None of the increases in salinity reported for the swamps in the Sabine River watershed would be expected to result in the conversion of swamp to marsh, and therefore the same swamp acreages were entered into the FWOP and FWP conditions of the SCM worksheets.

**Fresh Marshes**

Fresh marshes are widespread, but represent a smaller percentage of all marsh in the study area than intermediate and brackish marshes. Approximately 25,108 acres of fresh marsh occur in the Louisiana portion of the study area, and 15,697 acres occur in the Texas portion. In general, fresh marsh occurs along the Neches River, north of the GIWW in Louisiana and Texas, and in protected interior pockets of intermediate marsh throughout the study area. In the FWOP condition, 95 and 96 percent of this habitat in Texas and Louisiana, respectively, remain within the optimal salinity range. The proportion of fresh marsh predicted to remain in Texas within optimum salinities is 95 percent, with 94 percent remaining under the FWP condition. The WVA model predicts FWP AAHU losses of 173 AAHUs in the Neches River watershed and 111 AAHUs in the Sabine River watershed.

In Louisiana, fresh marshes are located in the Perry Ridge (18,859 acres), Southeast Sabine (2,634 acres), and Southwest Gum Cove (3,615 acres) hydro-units. Located north of the GIWW, Perry Ridge is by far the largest expanse of fresh marsh in the Louisiana study area. During most of the year, the Sabine River and the GIWW are fresh in the reaches adjacent to Perry Ridge. The Vinton drainage ditch provides hydrologic access to the eastern part of this area. However, in the FWP, salinities could increase in Perry Ridge from 1.7 ppt (FWOP) to 2.3 ppt (FWP).

The Southwest Gum Cove and Southeast Sabine hydro-units are located at the eastern edge of the SNWW study area, north and south of Pool 3, respectively. The northern hydro-unit is hydrologically connected to the GIWW through the Black Bayou Cutoff, and the southern unit is hydrologically connected to Sabine Lake through Willow Bayou. Average salinities during the growing season range from 1.2 ppt in the Southwest Gum Cove marsh to 1.7 ppt in the Southeast Sabine fresh marshes. Salinity in Southwest Gum Cove is projected to rise from 1.4 ppt (FWOP) to 2.0 ppt (FWP). Located closer to the coast, salinity in the Southeast Sabine hydro-unit is projected to rise from 2.1 ppt (FWOP) to 2.4 ppt (FWP).

In Texas, most of the fresh marshes are located in the Neches River watershed. However, smaller pockets occur in the Cow Bayou (1,775 acres) and Adams Bayou (599 acres) hydro-units in the Sabine River watershed. Mean annual salinities in these smaller bayous range from 0 ppt in the uppermost reaches to 3.5 ppt near the mouth of Cow Bayou. Adams Bayou salinity averages about 2.5 ppt. The HS model predicts salinity will increase to 4.0 ppt (FWOP) and 5.0 ppt (FWP) in Cow Bayou. In Adams Bayou, modeled salinities rise to 3.5 ppt (FWOP) and 5.0 ppt (FWP). FWP salinity would move from the

maximum of the fresh marsh optimal range to roughly the maximum of the optimal range for intermediate marsh in Adams Bayou.

In the Neches River watershed, all of the fresh marsh is located north of the GIWW. North of IH 10, approximately 436 acres of fresh marsh occur in the North Neches River hydro-unit, and 1,535 acres in the Neches-Lake Bayou hydro-unit. On the lower Neches River, fresh marsh occurs in the Rose City (3,327 acres), West of Rose City (492 acre), and Bessie Heights (2,147 acres) hydro-units. Nineteen percent of Rose City is open water, and a central expanse of tidally influenced mud flats is the site of eroded wetlands that were formerly fresh marsh and cypress-tupelo swamp. About half of the Bessie Heights hydro-unit is open water, averaging 2 to 3 feet in depth, that has developed in what was historically a large, mostly emergent, intermediate marsh. Salinities in these Neches River fresh marshes under the FWOP condition range from 0.0 in the North Neches River and Neches-Lake Bayou hydro-units to 1.5 ppt in Bessie Heights. Salinities would not be expected to change in the North Neches fresh marsh under the FWP condition. The greatest salinity increase projected for these marshes under the FWP condition is 0.5 ppt for the Bessie Heights marsh.

The GIWW North hydro-unit comprises three separate areas on the north side of the GIWW. All are located within the largest remaining coastal freshwater marsh in Texas (USFWS, 2005a). Most of this area is not hydrologically connected to the waterways, which form its southern and eastern boundary, the GIWW, and the Taylor Bayou Diversion Channel, respectively. FWOP salinities predicted by the HS model for the GIWW North fresh marsh average 2.5 ppt. PAs along the GIWW and levees, created when the waterways were originally dredged, serve as barriers along the banks of the waterway that protect the marshes from bank overwash. The TPWD data indicate that salinities in the fresh and intermediate marsh average 0.7 ppt. Areas selected for inclusion in the hydro-unit are likely to be affected by salinity increases associated with SNWW channel improvements. They are influenced by breaks in the levees and PAs, or through natural bayous that allow higher-salinity waters to enter the marsh system. Predicted salinity would increase to 2.5 ppt (FWOP) and 4.1 ppt (FWP) in portions of the fresh and intermediate marsh.

**Intermediate Marshes**

Intermediate marshes comprise the largest percentage of marshes throughout the study area, and most occur in Louisiana east of Sabine Lake. In total, approximately 133,000 acres of intermediate marsh occur in the Louisiana portion of the study area, and 39,500 acres in the Texas portion. Approximately 99 percent of Texas intermediate marsh (the majority of which is located in the Salt Bayou hydro-unit) is predicted to have salinities in the optimum range in the FWP condition. In Louisiana, about 94 percent of the intermediate marsh is predicted to have salinities in the optimum range under FWP conditions. The WVA model predicts FWP AAHU losses of 36 AAHUs in the Neches River watershed and 1,583 AAHUs in the Sabine River watershed.

In Louisiana, all but one of the hydro-units (Perry Ridge, 4,704 acres) are located south of the GIWW. Salinity in Perry Ridge intermediate marshes would rise from 4.5 ppt (FWOP) to 5.6 ppt (FWP).

Extensive intermediate marshes occur in the Louisiana portion of the study area south of the GIWW. These marshes are found in Willow Bayou (35,109 acres), Black Bayou (34,941 acres), West Johnson's Bayou (11,110 acres), Sabine Lake Ridges (9,270 acres), Southeast Sabine (5,400 acres), Southwest Gum Cove (6.605 acres), and East Johnson's Bayou (26,138 acres). The primary hydrologic connections to these marshes are the Black Bayou Cutoff/GIWW, Black Bayou/upper Sabine Lake, Willow Bayou/central Sabine Lake, and Johnson's Bayou (south-central Sabine Lake). Mean annual salinities at these hydrologic connections are 0.4 ppt in the GIWW, 2.8 ppt in Black Bayou, 4.3 ppt at Willow Bayou, and 6.3 ppt at Johnson's Bayou. However, mean annual salinities within these interior marshes are generally lower, ranging from 1.3 ppt in the northern marshes, through 2.0 ppt in the central marshes, to 6 ppt in the southern marshes. Black Bayou has the lowest projected salinity of these three marshes under the FWOP condition with a modeled salinity of 5.1 ppt and Willow Bayou has the highest with a FWOP salinity of 6.8 ppt. FWP salinities in these marshes are predicted to increase to 6.5 ppt in Black Bayou, 7.3 ppt in West Johnson's Bayou, and 7.7 ppt in Willow Bayou.

In hydro-units located farther from Sabine Lake (Southwest Gum Cove, Southeast Sabine, and East Johnson's Bayou), salinity increases of 0.3 to 1.1 ppt are expected under the FWP condition. However, salinities within the Southwest Gum Cove and Southeast Sabine hydro-units would remain within the optimal range. Salinity in East Johnson's Bayou is predicted to rise from 3.8 ppt (FWOP) to 4.8 ppt (FWP). For most of the intermediate marshes in this area, FWOP salinities during these higher-salinity periods are already at or beyond the high end of the optimal range, and FWP conditions move them further into the brackish range for at least several weeks a year.

In Texas, intermediate marshes are located on the lower Neches River (Bessie Heights – 6,913 acres, and Groves – 437 acres) and at Texas Point (1,631 acres). The Bessie Heights and Groves hydro-units are adjacent to the Neches River and fed by several hydrologic connections. Average salinity in Bessie Heights intermediate marsh is about 4.2 ppt during the growing season. Intermediate marshes in Bessie Heights are primarily located along its southern fringe, but are separated from the Neches River by upland PAs. About half of the Bessie Heights hydro-unit is open water, averaging 2 to 3 feet in depth, which has developed in a formerly large, mostly emergent, intermediate marsh. Salinity in Bessie Heights intermediate marsh is predicted to be 4.4 ppt (FWOP), increasing to 4.7 ppt (FWP). In the Groves hydro-unit, shallow, meandering streams cross the marsh and drain into the Star Lake Canal and Neches River. Mean annual salinities within the marshes themselves are close to the Neches River levels. In the portions of the Groves hydro-unit, FWP salinities are expect to rise from 4.0 ppt (FWOP) to 5.0 ppt.

At Texas Point, approximately 1,742 acres of intermediate marsh (with small pockets of fresh marsh) are located inland of the extensive brackish marsh in this hydro-unit. Marshes are hydrologically connected to the Sabine Pass Channel through Texas Bayou and a large, interconnected man-made canal. FWOP modeled salinities are 7.0 ppt. FWP salinity would increase to 7.8 ppt.

Intermediate marsh is also located along the lower third of Cow Bayou (1,144 acres) in the Sabine River watershed. Salinity under the FWP condition is projected to increase to 5.0 in parts of the Cow Bayou marshes from 4.0 ppt in the FWOP condition.

**Brackish and Saline Marshes**

Brackish marshes occur just inland of saline marshes along the coast and at Sabine Pass, and form fringing marsh around Sabine Lake, Keith Lake, Salt Bayou, and Old River Cove. In total, approximately 25,161 acres of brackish marsh occur in the Louisiana portion of the study area, and 32,201 acres in the Texas portion. Little to no change would be expected between the FWOP and FWP conditions with respect to the percentage of both brackish and saline marsh remaining within the optimal range. The WVA model predicts FWP AAHU losses of 131 AAHUs in the brackish marshes of the Neches River watershed and 23 AAHUs in the Sabine River watershed. For saline marsh, a FWP loss of 5 AAHUs would be expected at Texas Point, and a loss of 37 AAHUs would be expected at Louisiana Point.

In Louisiana, brackish marshes are found in the Willow Bayou (1,182 acres), Black Bayou (3,195 acres), West Johnson's Bayou (2,078 acres), Johnson's Bayou Ridge (2,744 acres), and Sabine Lake Ridges (15,962 acres) hydro-units. The hydrologic connections and mean annual salinities are generally the same as reported for intermediate marshes located east of Sabine Lake. However, brackish marshes in Sabine Lake Ridges and Johnson's Bayou Ridge are hydrologically connected to Sabine Pass through Lighthouse Bayou. Under average annual conditions, FWP salinities would remain within the optimal range (≤10 ppt), increasing an average of 1.4 ppt, and ranging from 5.3 ppt at Black Bayou to 8.6 ppt at Willow Bayou.

In Texas, brackish marshes occur in the Old River Cove (8,530 acres), GIWW North (647 acres), and the Texas Point (2,546 acres) hydro-units. About 30 percent of the Old River Cove hydro-unit is open water, and mean annual salinities are about 10.0 ppt. At GIWW North, salinity in some of the brackish marsh during late summer months is expected to rise from 10.8 ppt (FWOP) to 12.4 ppt (FWP) At Texas Point, FWOP mean salinity in the brackish marshes averages 9.8 ppt and FWP salinity is projected to rise to 10.6 ppt, just into the suboptimal range.

Saline marshes in the study area are restricted to the immediate coastal zone. In Louisiana, they occur in the Sabine Lake Ridges (3,767 acres) and Johnson's Bayou Ridge (370 acres) hydro-units. In the FWOP condition, 100 percent of this habitat in both Texas and Louisiana remains within the optimal salinity range. In Texas, 5,708 acres of saline marsh occur in the Texas Point hydro-unit. These areas are hydrologically connected to Sabine Pass and are generally protected from saltwater incursion from the Gulf by low shoreline ridges. FWP mean annual salinity is projected to rise an average of 0.8 ppt above the FWOP condition in these marshes, while remaining within the optimal range for saline marsh (≥9 and ≤21 ppt).

#### *4.6.3.2.4 Sensitivity to Potential Salinity Changes during FWP Drought Condition*

The HS model predicts salinities at 13 locations at median and low flow under the FWOP and FWP conditions (see tables 4.6-1 and 4.6-3). FWP salinities ranged from 0 to 22.9 ppt at median flows and from 0.26 to 29.1 ppt at drought flows. Salinities under the modeled existing condition during drought ranged from 0 to 28.9 ppt. The average salinity increase from FWOP to FWP conditions at the 13 stations was 1.0 ppt at median flows and only 0.5 ppt at low flows. This suggests that the relative effect of RSLR

on salinities is lower as drought conditions cause salinities to increase. The greatest salinity increases from FWOP to FWP conditions at low flow were estimated for the east shore of Sabine Lake, near Rose City on the Neches River, and the Sabine River at Orange, areas where the salinity is predicted to increase 0.7 to 1.0 ppt from the FWOP to the FWP condition. Predicted salinities in the portion of Sabine Lake adjacent to the Louisiana shore are projected to reach levels ranging from 15.6 to 17.9 ppt, under the FWP drought condition compared to a range of 12.7 to 15.0 ppt under the modeled existing drought condition.

FWP salinities under drought flows would average 8.2 ppt above FWP salinities at median flows. FWOP salinities under drought flows would average 8.9 ppt higher than FWOP salinities under median flows. Drought flows in the upper Neches River and Sabine River under the FWP condition are not likely to affect marshes in these areas since predicted salinities in the upper Neches River would be 2.6 and 5.8 ppt in the Sabine River at Orange. Salinities in adjacent marshes would be expected to be lower.

Possible impacts that may occur if predicted FWP salinities occur in the project area during drought will depend on the extent, frequency, and duration of low inflows. These possible impacts are difficult to predict because of the complexity of the project area ecosystem; uncertainty about future changes in major variables like inflow, temperature changes, and sea level rise; and limited understanding of ecosystem structure and function in the project area. There is currently substantial discussion in the scientific community regarding the role of tipping points in determining effects of ecosystem stressors. However, there are no current, reliable, studies describing salinity tipping points for marshes or wetlands in this part of Texas. It is clear that FWOP drought flows will substantially increase salinities above the modeled existing condition, over 8 ppt, but the FWP contribution to the additional salinity increase is small, averaging 0.5 ppt.

## 4.6.4 Groundwater Hydrology Impacts

### 4.6.4.1 No-Action

The No-Action Alternative would have no additional direct impacts to groundwater resources at or near the proposed study area beyond those that may result from existing dredging activities or placement of dredged material independent of this project. Any direct effects of those projects may result in local and regional changes (i.e., sedimentation, altered hydrology, or a relative rise in sea levels) over time and would be common to all alternatives considered in this FEIS. Their effects would be evaluated under their own environmental studies.

With the projected future effects of climate change, there is a potential for saltwater intrusion into shallow groundwater aquifers at or near the SNWW area due to a rise in sea levels. The USACE, Galveston District analyzed the potential for RSLR to affect aquifers in the study area (USACE, 2009b). If the sea level rises half an inch (0.04 foot), the freshwater/saltwater interface could potentially rise as much as 1.67 feet, which would not have a significant impact on a freshwater aquifer. However, for a 50-year assessment, sea level rise of 1.1 feet would cause the interface to rise up to 44 feet. For every foot the saltwater level rises, the height of free ground surface water reduces by a foot. As a result, the interface between saltwater and freshwater underground rises approximately 40 feet for every foot the sea level

rises. This could have a significant effect on the amount of fresh water in deep aquifers in the study area with or without the proposed project.

#### 4.6.4.2 Preferred Alternative

The potential to affect groundwater hydrology in this project is related to construction and maintenance dredged material placement in 16 existing and 2 expanded upland PAs, as proposed in the Preferred Alternative. Groundwater hydrology potential effects may result in physical (ability to infiltrate and/or contact groundwater in area aquifers) and chemical (TDS or salinity) attributes of the dredged material.

In the area, the Gulf Coast aquifer is subdivided into the Chicot aquifer (uppermost) and the underlying Evangeline aquifer, separated by differences in lithology and permeability. Higher permeabilities are usually associated with the Chicot aquifer. The Chicot aquifer has been divided into an upper unit and lower unit, separated by a clay bed in some areas and, in other areas, merged into one large mass of interbedded and interconnected sand and clay.

No effects are anticipated to the lower unit of the Chicot, any portion of the Evangeline, or the massive portions of the upper Chicot aquifers because clay barrier layers are anticipated to prevent contact with dredged material. Therefore, no adverse effects are anticipated to groundwater wells documented by the TWDB in the area counties.

Dredged material produced by construction of the Preferred Alternative would be managed in accordance with the DMMP. PAs would be able to accommodate material from both construction and maintenance dredging over the 50-year period of analysis. More details can be found in the DMMP (Appendix D). The upper stratigraphic units of the upper Chicot aquifer may become saturated from newly discharged dredged material and/or precipitation stored within the PA. With time and as material is discharged into the PA, the water would evaporate and the solids of the dredged material would compact to form a low permeability cap over the substrate within the PA. This cap, composed of new work material, would form an effective barrier to future dredged material infiltration.

SNWW dredge elutriate, water, and sediment data were collected and archived by the USACE within 5 years of this project's initiation. Data from this set collected within the area's footprint were compared to the regulatory thresholds set through Texas and Louisiana WQS. These findings are discussed in detail in sections 3.3 and 3.4. Water and sediment samples were collected at locations that are most likely to have been impacted by industrial properties undergoing remedial action. No WQS or WQC was exceeded by water or elutriate samples from any of the three sampling sites, and none of the concentrations was noticeably higher in the channel samples than the reference samples. Therefore, no adverse potential effects are expected if groundwater in the upper Chicot aquifer comes into contact with water or elutriate from construction and maintenance dredged material.

In general, water from the SNWW project area ranges in salinity from essentially zero to that of 30 ppt. Groundwater quality data from the TWDB database indicates that groundwater from water wells completed in the Chicot aquifer within the project vicinity generally has TDS concentrations less than

200 mg/L (fresh) to more than 3,000 mg/L (brackish). Most of the groundwater from the Chicot aquifer has an average TDS concentration of less than 1,500 mg/L. In general, storage of saline/brackish water on an upland impoundment would suggest that impacts to the uppermost contact with land surface could occur. Additionally, if groundwater occurs in this uppermost level, then saline/brackish water may blend with shallow-occurring groundwater. Greater permeability of the land surface would contribute to faster surface water entry into the subsurface, and potentially into the groundwater. This would suggest that impacts to groundwater may be likely during the first placement of dredged material into the PA; however, over the life of a PA, solids in the dredged material settle to the bottom and create a layer of low-permeability material. This physical barrier would, in time, minimize the intermixing of surface and groundwater in that area. Most of the PAs in the project area are existing, previously used impoundments, with an established layer of low-permeability material. Two new areas are proposed in upland areas adjacent to the Neches River where salinity levels in the navigation channel are lower overall. No domestic or livestock wells are in the vicinity of the PAs, and no reported complaints by groundwater users have been registered in the area. No prior use of the PAs has resulted in known groundwater resource impacts, and no impacts are anticipated from additional placement through this project. Salinity increases from dredged material water infiltration to the upper Chicot is not a concern.

With the projected future effects of climate change, there is a potential for saltwater intrusion into shallow groundwater aquifers at or near the proposed study area due to a rise in sea levels. These impacts would be the same as the No-Action Alternative discussed above in subsection 4.6.4.1.

## 4.7 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

### 4.7.1 No-Action Alternative

The No-Action Alternative would have no impact on hazardous materials associated with regulated facilities in the region. However, maintenance dredging of existing ship channels and from future channel deepening and/or widening projects, in addition to the placement of dredged materials at PAs, would continue under the No-Action Alternative. In the absence of project activity, the existing historic impacts related to area industry are also expected to continue.

### 4.7.2 Preferred Alternative

According to a review of regulatory agency database records and interviews conducted with regional TCEQ personnel, industrial activity has caused measurable impacts to the surface water, sediment, soil, and groundwater in localized areas within the study area. However, chemical analysis of sediment and surface water samples collected from the waterway indicate that these impacts have apparently been limited to the industrial facilities and adjoining properties (PBS&J, 2002). The nature and potential for any HTRW site to impact the surrounding environment varies considerably. The majority of the regulated facilities and incident locations identified in the regulatory agency database review do not pose an environmental concern for the project. However, several facilities within the study area do pose a greater potential to impact the environment. These facilities pose a potential concern based on the nature and

extent of contaminants at the site, their location relative to the PAs and the waterway, and the number of pathways in which the contaminants could reach the PAs and the waterway. The facilities that are considered priority HTRW sites of concern are summarized in Table 4.7-1; their locations on shown on Figure 4.7-1.

Table 4.7-1
Summary of Priority HTRW Sites within Sabine-Neches Waterway

| Site Name | Site ID | Constituents of Concern | Media Impacted | Status |
|---|---|---|---|---|
| Bailey Waste Disposal Site | 512 | Arsenic compounds, benzene, phenols, pyridenes, naphthalenes, and chlorinated hydrocarbons | Surface water, groundwater, soil | Cleanup complete in 1998; Operation and Maintenance underway since 1999 |
| State Marine | 203 | PAHs, metals | Surface water | Evaluation and cleanup are underway, but the nature and extent of contamination and the risks posed to human health and the environment are unknown |
| Palmer Barge Lines | 548 | Aluminum, barium, chromium, cobalt, iron, lead, magnesium, nickel, zinc, pesticides, VOCs, PAHs, PCP, and benzene | Surface water | Evaluation and cleanup underway since 2000; the EPA is considering various remedial alternatives |
| Star Lake Canal | 471 | Chromium, copper, PAHs, and PCBs | Surface water, sediments | Evaluation and cleanup underway since 2001, but the nature and extent of contamination and the risks posed to human health and the environment are unknown |
| International Creosoting | 30 | Arsenic, chromium, lead, creosote compounds, SVOC, and VOCs | Groundwater, sediment, soil, surface water | Clean up underway |
| Maintech International | 410 | PAHs | Groundwater, soil | Cleanup completed in 2000; undergoing Operation and Maintenance |
| Excell | 28 | TPH, benzene, toluene, ethylbenzene, and xylene | Groundwater | Investigation underway |
| Port of Beaumont, Beaumont Elevator | 113 | VOCs, herbicides, and pesticides | Groundwater, soil | Investigation underway |
| Woodcrest Site | 584 | VOCs | Soil | Investigation underway |

Source: Banks Information Solutions (2002).

The USACE has determined that the 316-acre PA 17 is needed for future material disposal in conjunction with the Preferred Alternative and that PA 17 would be included in the DMMP; however, issues related to contaminated materials in a capped landfill and other waste disposal areas within this PA remain unresolved at this time. Pursuant to Department of the Army Engineering Regulation 1165-2-132, HTRW Guidance for Civil Works Projects, construction of civil works projects in HTRW-contaminated areas should be avoided. The non-Federal local sponsor has been notified that they are responsible for the investigation and remediation of HTRW issues for use of PA 17 for the project. Additional information is needed to fully identify and delineate onsite contaminants, and the EPA remedial investigations planned for the Star Lake Canal Superfund Site, which could potentially affect parts of PA 17, need to be completed. Surface and subsurface sampling and analysis would be necessary to identify and delineate contaminants of concern and to determine whether contaminates are present at levels of concern. Based upon available information at the time of this document's production, it is expected that PA 17 contaminant concerns would be resolved in time for its scheduled use in maintenance dredging; however,

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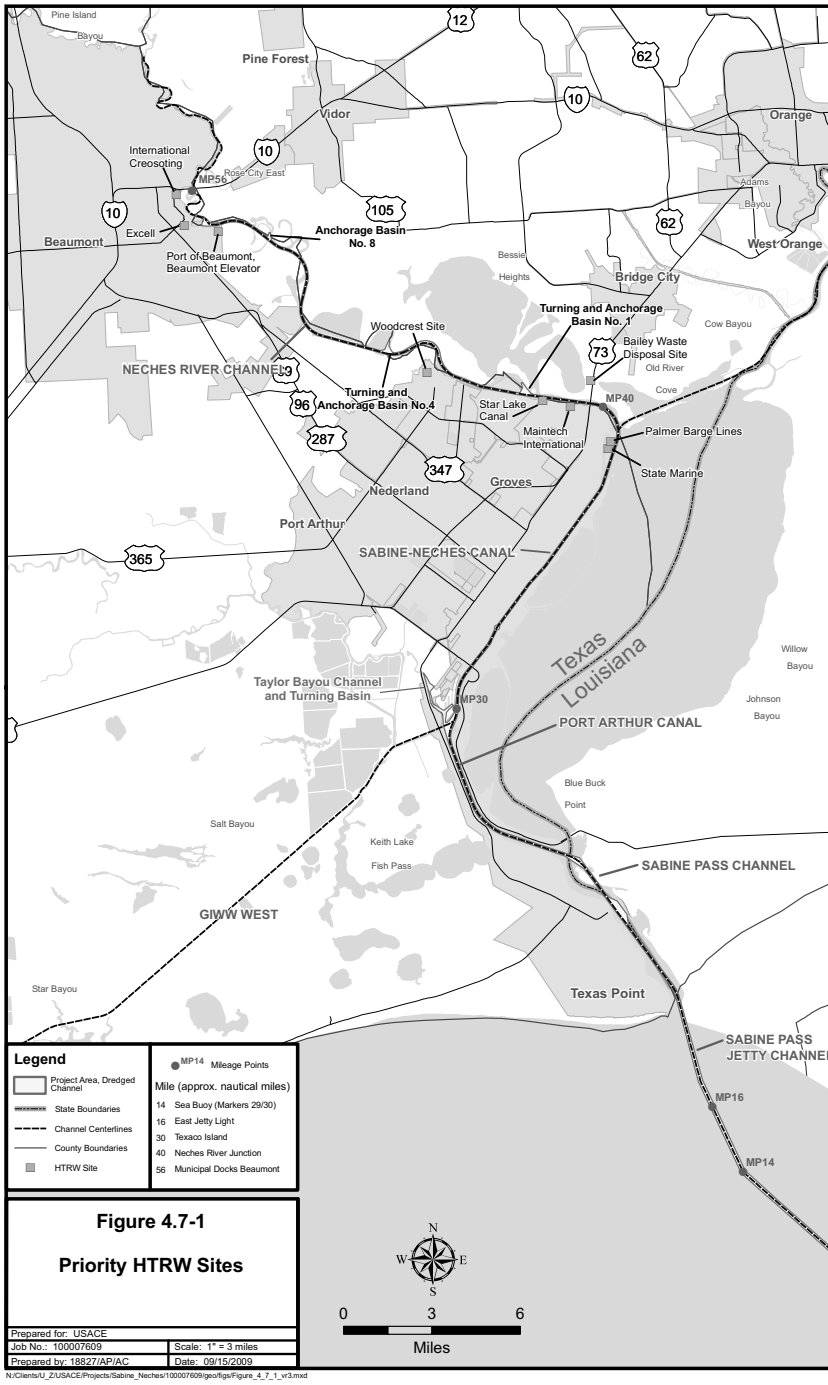


**Figure 4.7-1**

**Priority HTRW Sites**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 3 miles |
| Prepared by: 18827/AP/AC | Date: 09/15/2009 |

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if these issues are not resolved and PA 17 is not available, National Environmental Policy Act (NEPA) analysis and coordination would be performed to designate a new PA or expand an existing PA to replace the lost capacity.

A baseline evaluation of facilities that pose a potential concern to the project must also consider whether the release of contaminants is ongoing or has been effectively eliminated through remedial efforts. Based on these criteria, State Marine, Palmer Barge Lines, Star Lake Canal, and Beaumont Elevator continue to present on ongoing threat to impact the environment of the project area since these sites have not completed remedial activities. The remaining priority sites present a lesser threat due in part to either effective corrective action or distance to the waterway.

Based on the findings of the HTRW survey, there is the potential of encountering contaminated material during construction of the project. The contaminated material could increase project cost and/or lost time from discovery and remediation of the contaminated materials within the project area. The potential of encountering contaminated material appears to be greatest in areas adjacent to priority HTRW sites and in outfall canals adjacent to the SNWW. Surveys have been conducted to locate oil and gas wells and petroleum pipelines crossing the navigation channel (PBS&J, 2005). Prior to construction, additional pipeline surveys would be necessary for proposed BU features and mitigation measures.

The highest probability of residual contamination in water and sediments would be in the area of the Star Lake Canal outfall, the northern end of Pleasure Island, and near Taylor Bayou. According to TCEQ personnel, the Star Lake Canal and Taylor Bayou convey industrial wastewater effluent and stormwater to the SNWW. The sediment adjacent to the mouths of these canals could contain elevated levels of organic and inorganic compounds. Similarly, sediment adjacent to the State Marine and Palmer Barge Lines sites located near the north end of Pleasure Island could contain a variety of organic and inorganic compounds. These sources of potential contaminants are a result of migration and runoff of impacted groundwater and surface water into the waterway. However, based upon the recent chemical analysis of water and sediment collected within these channels, the potential for encountering contaminated material during dredging operations is considered minimal.

## 4.8 AIR QUALITY

This section provides a discussion of the air quality impacts associated with the No-Action and Preferred alternatives. The evaluation of air quality impacts associated with the proposed SNWW CIP was based on the identification of air contaminants and estimated emission rates for the Preferred Alternative. The air contaminants considered are those covered by the NAAQS (except for lead, which is not relevant to project emissions) including CO, $O_3$, $NO_x$, $PM_{10}$, $PM_{2.5}$, and $SO_2$. Air emissions were considered for channel improvement activities and placement of dredged material as well as emissions from vehicular traffic associated with the project employee commute. Project emissions were estimated based on preliminary assumptions regarding construction timing and equipment developed for this project. It is not within the scope of this analysis to perform the refined dispersion modeling necessary to predict

concentrations for each contaminant and alterative. Rather, the impact of emissions was analyzed relative to the existing inventory for air contaminant emissions in the BPA nonattainment area and the parishes of Cameron and Calcasieu.

The estimated air contaminant emissions, except $O_3$, were compared to the 2002 emissions inventory for the BPA ozone nonattainment area and for Cameron and Calcasieu parishes. Assuming an increase in air emissions would result in a corresponding increase in the ambient air concentration for that air contaminant, the ratio of the estimated emissions to the existing 2002 emissions for that contaminant provided a relative indication of the potential increase in ambient concentrations for the air contaminant. That difference was then compared to the NAAQS. As shown in Table 3.7-3 in subsection 3.7.3, monitored values indicate that concentrations of air contaminants (except $O_3$) for BPA are below the NAAQS over the period from 2004 to 2008. Because air emissions are generally dispersed with distance and time, a relatively small increase in emissions may be assumed to cause a correspondingly small increase in ambient air quality concentrations for that air contaminant, and it is therefore expected that the increase in emissions would not cause an exceedance of the NAAQS. Because authorization for the project is considered a Federal action, estimated emissions from the project were also considered in terms of the General Conformity Rules.

### 4.8.1 No-Action Alternative

No construction or new operating emission sources are associated with the No-Action Alternative. However, it is expected that air contaminant emissions would increase due to continued operational constraints on the existing system and projected increased ship traffic resulting both from growth of existing business and from new business.

### 4.8.2 Preferred Alternative

The evaluation of air quality impacts associated with the Preferred Alternative was based on the identification of air contaminants and estimated emission rates for this project alternative. Emissions inventories were estimated for project-related activities based on the schedule, dredging volumes, and other construction-related assumptions regarding construction timing and equipment developed for this project. The emission sources for this alternative would consist of marine vessel and land-based mobile sources that would be used during the channel improvement activities, as follows:

- **Marine Vessels**. Includes dredges (cutter and hopper), dredge support equipment (tugboats, survey boats, crew boats, and tenders), and shrimp trawlers; and
- **Land based.** Includes off-road (amphibious track hoe, dozer, dragline, excavator, and rolligon) and on-road (employee vehicles).

Air contaminant emissions associated with the channel widening would be primarily combustion products from fuel burned in equipment used for project dredging, support vessels, and dredged material placement equipment. Activities at dredged material placement sites would involve the use of earth-moving equipment. The marine vessel emissions sources are primarily diesel-powered engines. The off-road

construction equipment was assumed to be all diesel-powered, and on-road vehicles were assumed to be all gasoline-powered vehicles. Detailed emission estimates are provided in the General Conformity Determination (Appendix F).

#### 4.8.2.1 Air Quality Analysis Results

The project construction emissions represent the estimated emissions from the activities associated with the Preferred Alternative. These activities would be considered one-time activities, i.e., the channel widening activities would not continue past the date of completion. Because of the high moisture content of the dredged material, it is expected that there would be no particulate matter emissions from the placement of dredged material in placement areas.

A summary of the total estimated annual emissions, in tons, resulting from the use of dredging equipment, support vessels, off-road equipment, and on-road equipment is presented in Table 4.8-1. A detailed summary of emissions can be found in the General Conformity Determination (Appendix F).

The total estimated annual emissions for each year of construction were compared to the 2002 emissions inventory for the BPA nonattainment area and the emissions inventory for Cameron and Calcasieu parishes. This comparison is presented in Table 4.8-2.

As shown on Table 4.8-2, air contaminant emissions from the Preferred Alternative would result in a relatively small increase in emissions above those from existing sources in the BPA and for Cameron and Calcasieu parishes. As a result, it is expected that air contaminant emissions from the combustion of fuel in equipment used for dredging and placement activities would also result in correspondingly minor short-term impacts on air quality in the immediate vicinity of the project area and even less as emissions are dispersed over the BPA and Cameron/Calcasieu areas.

#### 4.8.2.2 General Conformity Applicability

For comparison with the thresholds defined in the General Conformity Rule, the estimated emissions of $NO_x$ and VOC for each year for the project activities subject to the General Conformity are summarized in tables 4.8-3 and 4.8-4. For purposes of General Conformity, only air contaminant emissions that might occur within the BPA nonattainment area out to the 9-mile natural resources limit for the State of Texas were considered. The 9 nautical mile boundary is the seaward limit of the submerged lands of Texas as defined in the Submerged Lands Act (U.S. Code Title 43, Chapter 29, Subchapter II, § 1312). Emissions of carbon monoxide, sulfur dioxide, and particulate matter are not considered in the General Conformity evaluation as this area is in attainment with the NAAQS for each of those pollutants.

Table 4.8-1
Estimated Annual Project Construction Emissions – SNWW CIP Preferred Alternative

| **Year 2011** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
|---|---|---|---|---|---|---|
| Dredge and Support Equipment | 41.56 | 371.87 | 8.42 | 8.89 | 61.61 | 4.21 |
| Construction Equipment | 28.74 | 34.67 | 2.74 | 2.82 | 7.27 | 2.92 |
| Employee Vehicles | 4.35 | 0.285 | 0.006 | 0.013 | 0.004 | 0.422 |
| **Subtotal** | **74.65** | **406.83** | **11.17** | **11.72** | **68.87** | **7.55** |
| **Year 2012** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
| Dredge and Support Equipment | 166.23 | 1,487.47 | 33.70 | 35.55 | 246.42 | 16.84 |
| Construction Equipment | 52.04 | 128.65 | 12.64 | 13.02 | 28.39 | 10.71 |
| Employee Vehicles | 19.03 | 1.246 | 0.026 | 0.057 | 0.018 | 1.842 |
| Subtotal | **237.29** | **1,617.37** | **46.36** | **48.62** | **274.83** | **29.39** |
| **Year 2013** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
| Dredge and Support Equipment | 167.80 | 1,500.92 | 34.00 | 35.87 | 248.65 | 17.00 |
| Construction Equipment | 55.84 | 123.20 | 14.69 | 15.13 | 28.42 | 10.28 |
| Employee Vehicles | 19.75 | 1.293 | 0.027 | 0.059 | 0.019 | 1.912 |
| Subtotal | **243.38** | **1,625.41** | **48.71** | **51.06** | **277.09** | **29.19** |
| **Year 2014** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
| Dredge and Support Equipment | 172.79 | 1,540.20 | 34.89 | 36.81 | 255.21 | 17.54 |
| Construction Equipment | 60.84 | 118.58 | 17.26 | 17.79 | 29.42 | 10.16 |
| Employee Vehicles | 19.44 | 1.273 | 0.027 | 0.058 | 0.018 | 1.883 |
| **Subtotal** | **253.08** | **1,660.06** | **52.18** | **54.66** | **284.65** | **29.58** |
| **Year 2015** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
| Dredge and Support Equipment | 171.41 | 1,513.49 | 34.30 | 36.18 | 250.92 | 17.51 |
| Construction Equipment | 60.01 | 106.21 | 18.61 | 19.17 | 28.33 | 8.67 |
| Employee Vehicles | 19.49 | 1.276 | 0.027 | 0.059 | 0.018 | 1.887 |
| **Subtotal** | **250.91** | **1,620.98** | **52.93** | **55.41** | **279.27** | **28.07** |
| **Year 2016** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
| Dredge and Support Equipment | 161.73 | 1,417.91 | 32.14 | 33.91 | 235.16 | 16.63 |
| Construction Equipment | 53.71 | 91.89 | 19.44 | 20.03 | 26.69 | 5.92 |
| Employee Vehicles | 19.26 | 1.261 | 0.026 | 0.058 | 0.018 | 1.865 |
| **Subtotal** | **234.71** | **1,511.06** | **51.61** | **54.00** | **261.87** | **24.42** |
| **Year 2017** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
| Dredge and Support Equipment | 155.59 | 1,363.78 | 30.92 | 32.61 | 226.19 | 16.00 |
| Construction Equipment | 56.96 | 88.30 | 22.47 | 23.16 | 28.10 | 6.10 |
| Employee Vehicles | 20.05 | 1.316 | 0.028 | 0.061 | 0.019 | 1.945 |
| **Subtotal** | **232.60** | **1,453.40** | **53.42** | **55.84** | **254.31** | **24.05** |
| **Year 2018** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
| Dredge and Support Equipment | 53.29 | 467.93 | 10.61 | 11.19 | 77.60 | 5.47 |
| Construction Equipment | 24.74 | 34.07 | 10.49 | 10.81 | 12.07 | 9.07 |
| Employee Vehicles | 6.82 | 0.446 | 0.009 | 0.020 | 0.006 | 0.660 |
| **Subtotal** | **84.84** | **502.45** | **21.10** | **22.02** | **89.68** | **15.20** |

Table 4.8-2
Total Annual Project Emissions Compared with BPA/Cameron/Calcasieu 2002 Emissions Inventory

| 2002 EMISSION INVENTORY | CO | $NO_X$ | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|
| **BPA** | **134,953** | **86,242** | **10,618** | **50,702** | **39,966** | **39,913** |
| **CAMERON/CALCASIEU** | **95,016** | **68,265** | **6,319** | **13,098** | **58,397** | **34,553** |
| **BPA/CAMERON/CALCASIEU** | **229,969** | **154,507** | **16,937** | **63,800** | **98,363** | **74,467** |
| **ANNUAL PROJECT EMISSIONS** | **CO** | **$NO_X$** | **$PM_{2.5}$** | **$PM_{10}$** | **$SO_2$** | **VOC** |
| **Year 2011** | **74.65** | **406.83** | **11.17** | **11.72** | **68.87** | **7.55** |
| % of BPA | 0.06 | 0.47 | 0.11 | 0.02 | 0.17 | 0.02 |
| % of Cameron/Calcasieu | 0.08 | 0.60 | 0.18 | 0.09 | 0.12 | 0.02 |
| % of BPA/Cameron/Calcasieu | 0.03 | 0.26 | 0.07 | 0.02 | 0.07 | 0.01 |
| **Year 2012** | **237.29** | **1,617.37** | **46.36** | **48.62** | **274.83** | **29.39** |
| % of BPA | 0.18 | 1.88 | 0.44 | 0.10 | 0.69 | 0.07 |
| % of Cameron/Calcasieu | 0.25 | 2.37 | 0.73 | 0.37 | 0.47 | 0.09 |
| % of BPA/Cameron/Calcasieu | 0.10 | 1.05 | 0.27 | 0.08 | 0.28 | 0.04 |
| **Year 2013** | **243.38** | **1,625.41** | **48.71** | **51.06** | **277.09** | **29.19** |
| % of BPA | 0.18 | 1.88 | 0.46 | 0.10 | 0.69 | 0.07 |
| % of Cameron/Calcasieu | 0.26 | 2.38 | 0.77 | 0.39 | 0.47 | 0.08 |
| % of BPA/Cameron/Calcasieu | 0.11 | 1.05 | 0.29 | 0.08 | 0.28 | 0.04 |
| **Year 2014** | **253.08** | **1,660.06** | **52.18** | **54.66** | **284.65** | **29.58** |
| % of BPA | 0.19 | 1.92 | 0.49 | 0.11 | 0.71 | 0.07 |
| % of Cameron/Calcasieu | 0.27 | 2.43 | 0.83 | 0.42 | 0.49 | 0.09 |
| % of BPA/Cameron/Calcasieu | 0.11 | 1.07 | 0.31 | 0.09 | 0.29 | 0.04 |
| **Year 2015** | **250.91** | **1,620.98** | **52.93** | **55.41** | **279.27** | **28.07** |
| % of BPA | 0.19 | 1.88 | 0.50 | 0.11 | 0.70 | 0.07 |
| % of Cameron/Calcasieu | 0.26 | 2.37 | 0.84 | 0.42 | 0.48 | 0.08 |
| % of BPA/Cameron/Calcasieu | 0.11 | 1.05 | 0.31 | 0.09 | 0.28 | 0.04 |
| **Year 2016** | **234.71** | **1,511.06** | **51.61** | **54.00** | **261.87** | **24.42** |
| % of BPA | 0.17 | 1.75 | 0.49 | 0.11 | 0.66 | 0.06 |
| % of Cameron/Calcasieu | 0.25 | 2.21 | 0.82 | 0.41 | 0.45 | 0.07 |
| % of BPA/Cameron/Calcasieu | 0.10 | 0.98 | 0.30 | 0.08 | 0.27 | 0.03 |
| **Year 2017** | **232.60** | **1,453.40** | **53.42** | **55.84** | **254.31** | **24.05** |
| % of BPA | 0.17 | 1.69 | 0.50 | 0.11 | 0.64 | 0.06 |
| % of Cameron/Calcasieu | 0.24 | 2.13 | 0.85 | 0.43 | 0.44 | 0.07 |
| % of BPA/Cameron/Calcasieu | 0.10 | 0.94 | 0.32 | 0.09 | 0.26 | 0.03 |
| **Year 2018** | **84.84** | **502.45** | **21.10** | **22.02** | **89.68** | **15.20** |
| % of BPA | 0.06 | 0.58 | 0.20 | 0.04 | 0.22 | 0.04 |
| % of Cameron/Calcasieu | 0.09 | 0.74 | 0.33 | 0.17 | 0.15 | 0.04 |
| % of BPA/Cameron/Calcasieu | 0.04 | 0.33 | 0.12 | 0.03 | 0.09 | 0.02 |

As shown in Table 4.8-3, estimated emissions of VOC for the Preferred Alternative are exempt from a General Conformity Determination because they are below the 100 tpy threshold for each year of anticipated activity. However, estimated $NO_x$ emissions for the Preferred Alternative exceed the general conformity threshold, i.e., greater than 100 tpy, for all years of construction. Therefore, a General Conformity Determination for $NO_x$ emissions would be required for these years.

Table 4.8-3
Summary of VOC Construction Emissions Subject to General Conformity

| Year | Dredge and Support Equipment | Construction Equipment | Employee Vehicles | Total |
|---|---|---|---|---|
| 2011 | 2.57 | 3.12 | 0.42 | 6.10 |
| 2012 | 12.38 | 11.43 | 1.84 | 25.65 |
| 2013 | 12.54 | 10.99 | 1.91 | 25.44 |
| 2014 | 13.82 | 10.86 | 1.88 | 26.57 |
| 2015 | 13.94 | 9.90 | 1.89 | 25.73 |
| 2016 | 14.22 | 8.69 | 1.87 | 24.78 |
| 2017 | 15.40 | 8.73 | 1.94 | 26.07 |
| 2018 | 5.47 | 34.89 | 0.66 | 41.02 |

Table 4.8-4
Summary of $NO_x$ Construction Emissions Subject to General Conformity

| Year | Dredge and Support Equipment | Construction Equipment | Employee Vehicles | Total |
|---|---|---|---|---|
| 2011 | 217.77 | 34.05 | 0.29 | 252.11 |
| 2012 | 1,106.59 | 126.17 | 1.25 | 1,234.01 |
| 2013 | 1,120.03 | 120.72 | 1.29 | 1,242.05 |
| 2014 | 1,222.80 | 116.52 | 1.27 | 1,340.59 |
| 2015 | 1,208.15 | 104.22 | 1.28 | 1,313.65 |
| 2016 | 1,212.23 | 90.55 | 1.26 | 1,304.05 |
| 2017 | 1,312.36 | 87.97 | 1.32 | 1,401.65 |
| 2018 | 467.93 | 34.07 | 0.45 | 502.45 |

To initiate the General Conformity process, the USACE, prepared a document entitled, “Draft General Conformity Determination, Sabine-Neches Channel Improvement Project.” This document was noticed for public comment and was submitted by the USACE to the TCEQ, the EPA, and other air pollution control agencies, as appropriate, concurrently with the DEIS. As part of the General Conformity process, the USACE made this document available to the public for review and comment for a period of 30 days. The TCEQ has provided written concurrence that emissions from the Preferred Alternative are conformant with the Texas SIP for the BPA (Appendix A1). Based on the TCEQ's comments, the

USACE has prepared a Final General Conformity Determination for the proposed SNWW CIP (Appendix F).

## 4.9 NOISE IMPACTS

Project-related noise impacts were evaluated by considering the noise emissions related to dredge and placement operations of the proposed channel improvement project at noise-sensitive land uses (residential, educational, health care, recreational). Potential noise impacts associated with dredging and placement activities were evaluated by modeling predicted noise levels as a function of distance between the noise-generating equipment and noise-sensitive land uses in the vicinity of the project area. Noise levels were calculated based on industry accepted standards and properties of noise attenuation.

### 4.9.1 No-Action Alternative

Under the No-Action Alternative, the channel would not be deepened to project specifications. However, the existing regime of maintenance dredging, which generally includes a cutterhead suction dredge and various tending/crew boats within the channel, would continue as normal. Table 4.9-1 summarizes dredging-related noise levels produced by equipment type.

Table 4.9-1
Typical Noise Levels

| Equipment | Noise Level (dBA) |
|---|---|
| Cutterhead Dredge (at 160 feet) | 79[1] |
| Hopper Dredge (at 50 feet) | 87[2] |
| Large Tug boat (at 50 feet) | 87[3] |
| Small Tug Boat | 72[3] |
| Bulldozer (at 50 feet) | 82[4] |
| Bucket Crane (at 50 feet) | 82[4] |

[1] Geier & Geier Consulting (1997).
[2] Assumed same as large tug.
[3] Epsilon Associates (2006)
[4] FHWA (2006).

Potential short-term noise impacts related to the No-Action Alternative would occur during maintenance dredging activities throughout the channel's length. Noise-sensitive land uses exist in various locations along both sides of the channel's banks. These areas are concentrated in the cities of Port Arthur, Port Neches, and Beaumont. Other noise-sensitive land uses include recreational areas (J.D. Murphree State WMA, Sea Rim State Park, Sabine Pass Battleground State Park, and Pleasure Island) in the southern portion of the project. Table 4.9-2 summarizes the estimated noise levels produced by maintenance dredging activities at increasing distances from the ship channel. The No-Action Alternative would not result in permanent noise level increases, however, short-term impacts could be considered potentially significant at noise-sensitive land uses within 600 feet of maintenance dredging activities.

Table 4.9-2
Calculated Noise Levels of Maintenance Dredging

| Distance From Center of Channel | Calculated Noise Level From Dredging Activities |
|---|---|
| 160 feet | 79 dBA ($L_{eq}$) |
| 300 feet | 73 dBA ($L_{eq}$) |
| 600 feet | 67 dBA ($L_{eq}$) |
| 1,200 feet | 61 dBA ($L_{eq}$) |
| 2,400 feet | 55 dBA ($L_{eq}$) |

### 4.9.2 Preferred Alternative

Under the Preferred Alternative, the channel would be deepened as described in Section 2.4. Equipment to be used for the proposed action would include separate crews consisting of a 30-inch hydraulic cutterhead dredge, three 500-horsepower tugboats, and one survey/crew boat within the channel. A large hopper dredge with tending boats would be used beyond the channel in the Gulf. However, noise levels associated with this portion of the project were not calculated since no noise-sensitive land uses are located beyond the channel. Although more than one crew could operate on the channel simultaneously, they would operate on separate reaches of the channel, and therefore would not be within the vicinity of noise-sensitive land uses at the same time. Dredging operations are expected to occur approximately 20 hours per day for a total of 7 years. Dredging activities would generate noise from a variety of equipment sources, however, the primary sources of equipment noise would include the dredges (with their associated pumps and generators) and tugboats (see Table 4.9-1). Smaller vessels, such as tending boats and survey boats, would not substantially contribute to the noise associated with dredging activities.

The proposed action under the Preferred Alternative is not expected to result in long-term noise impacts. No permanent noise sources would be installed as part of this project. In the short term, however, the proposed action could result in temporary elevated noise levels at noise-sensitive land use locations. Because the same type of equipment used for maintenance dredging would be used for the proposed action, short-term noise impacts related to the proposed action would be nearly identical to the short-term impacts that occur during current maintenance dredging, as discussed above in subsection 4.9.1. Table 4.9-2 summarizes the estimated noise levels produced by the proposed action at increasing distances from the ship channel. As is the case with current maintenance dredging, short-term impacts could be considered potentially significant at noise-sensitive land uses within 600 feet of the proposed project's dredging activities.

Reduction of the short-term noise levels could be achieved by using quieter-running equipment and by adding supplemental noise shielding around engines and pumps of the dredging equipment. Additional acoustical shielding panels could be used when the dredges operate in close proximity to residential areas. Additionally, dredging operations could be limited to daytime hours in proximity to residential areas. Limiting the hours of operation, however, would increase the length of the project significantly.

## 4.10 VEGETATION

### 4.10.1 No-Action Alternative

Under the No-Action Alternative, the combined effects of RSLR, shoreline recession, and interior marsh loss are expected to result in the significant loss of marsh and expansion of open-water areas, and this is likely to be exacerbated by the effects of global climate change. These processes would continue a trend of wetland loss that has been occurring in the study area in recent decades (Berman, 2005; Morton, 2003; Morton et al., 2005; Shinkle and Dokka, 2004; Titus and Narayanan, 1995). In Louisiana, a net land loss of 21 percent between 1978 and 2000 has been reported in the Chenier Plain subregion of coastal Louisiana, which includes the Sabine estuary (USACE, 2004a). In Texas, the most extensive losses of interior coastal wetlands in the state (12,632 acres between 1930 and 1978) have occurred in the Neches River delta. In total, over 90 percent of the emergent marshes in the Lower Neches River delta have been converted to open water, which is more than half of the total wetland loss in the State of Texas (Morton and Paine, 1990; Sutherlin, 1997; White et al., 1987). During this same period, NOAA documented a historical trend of mean sea level rise at its Sabine Pass tide gage of 0.2 inch/year over 48 years from 1958 through 2006 (USDC-NOAA, 2009), one of the highest on the Gulf Coast.

FWOP land loss projections for the SNWW project are based upon a single "most likely" estimate of 1.1 feet of RSLR by 2069. There is great uncertainty in the prediction of RSLR, which combines rates of global sea level rise and local subsidence. Uncertainties are related to the rate and degree of global climate change, including changes in the accumulation of greenhouse gases in the atmosphere, future trends in temperature and regional precipitation, the timing and quantity of freshwater inflows, sediment delivery to coastal marshes, and the rates of vegetative growth and biomass accumulation (Barras et al., 2004; IPCC, 2007; Langley et al., 2009; Nielsen-Gammon, 2009). In particular, some recent studies of geologic terrestrial and marine records support the plausibility of sea level rise on the order of 3.3 ± 1.64 feet by A.D. 2100 (Carlson et al., 2008; Rahmstorf, 2007; Rohling et al., 2008). Uncertainties in the rate of regional subsidence are related to the effect of anthropogenic factors such as oil, gas, and groundwater withdrawals, the compaction of deep reservoir rocks, the reactivation of surficial faults, and the erosion and/or accumulation of surface sediments (Gonzalez and Törnqvist, 2006; Milliken et al., 2008a, 2008b; Morton et al., 2006). This results in a very wide range of potential RSLR, calculated as stipulated by the most recent USACE relative sea level guidance (EC 1165-2-211, July 2009) to be between 0.3 and 2.8 feet over the period of analysis.

For this study, FWOP projections of land loss include the effects of rising salinities and shoreline recession associated with RSLR. Approximately 5,500 acres (7.5 percent) in Texas and 15,500 acres in Louisiana (10.5 percent) are forecast to be lost by 2069. In the near term, the marsh degradation process provides fisheries organisms with short-term benefits by releasing organic and mineral-rich sediments into the open-water system as the marsh is lost (Minello and Rozas, 2002). In the long term, the important ecological functions of the wetlands in the affected area would decline, resulting in the loss of fish and wildlife and their habitats, adverse effects on water quality, and reductions in erosion protection.

#### 4.10.1.1 FWOP Shoreline Recession

The forecasted RSLR would result in the recession of Gulf and Sabine Lake shorelines in the SNWW study area. Potential problems associated with sea level change can be categorized into two classes; those of the open coast and large waterbodies where both water level and wave action are concerns, and those of inland tidal waters where wave action is usually much less severe (NRC, 1987). The NRC report discusses different approaches that can be used to model the change in shoreline configuration associated with RSLR. Two of those techniques were applied to project shoreline recession in the SNWW study area over the period of analysis (2019 through 2069).

The first technique is recommended for areas of active wave attack and erosion, and was applied to the Texas Gulf shoreline and the eastern shoreline of Sabine Lake. It is a historical trend analysis that includes an adjustment for higher future rates of RSLR. The second method was applied to the shorelines of interior lakes and inland waterways where the wave climate is subdued and the stable or accreting Louisiana Gulf shoreline (as described below). This method involves applying the projected change in sea level over the period of analysis to preexisting topography.

Two major factors influencing erosion and eventual shoreline profiles are fetch and exposure to predominant directions of wave approach (Wilson and Allison, 2008). In the SNWW study area, prevailing winds and wave approach are from the southeast; however, low-pressure weather systems (northers) frequently move across the upper coast from the north during winter months (Anderson, 2007). The portions of the study area most affected by these prevailing wind patterns are the Gulf shoreline and the eastern shore of Sabine Lake. In Sabine Lake, fetch and wave attack associated with prevailing southeasterly winds primarily affect the western shore, an area that is protected from erosion by riprapped levees around PAs 8 and 11. These levees are quite large and sufficiently high such that the rates of RSLR predicted here would have little to no effect. Winter northers, however, do affect the unprotected eastern shore of Sabine Lake (Greco and Clark, 2005; Parchure et al., 2005).

For the Gulf and east Sabine Lake shorelines, the historical trend, modified by the projected RSLR over the period of analysis, was used to project shoreline recession (NRC, 1987). Historical rates of change incorporate the inherent variability of the shoreline response based upon local coastal processes, local subsidence rates, coastline exposure, the local sedimentary environment, and eustatic sea level changes. This method assumes that the amount of recession during the historical record is directly correlated with the rate of sea level rise. Therefore, an accelerated rate of RSLR is assumed to result in a commensurate accelerated increase in shoreline recession. For example, a projected fourfold rise in the rate of RSLR in the study area would result in a fourfold increase in the recession rate. For the SNWW study area, the future rate of RSLR was forecast to be roughly 4.2 times the existing rate.

For this study, rates of existing historical Gulf shoreline change were obtained from several recent studies (Barras et al., 1994; BEG, 2009; USACE, 2004a). Most of the Texas shoreline in the study area experienced very high rates of shoreline retreat from the 1950s through 2002, ranging from –5 to –51 feet/year. However, small reaches near the SNWW west jetty and near Sea Rim State Park are stable

or accreting. The BEG (2009) has developed a projected shoreline for the upper Texas coast for the year 2056, based upon historical Gulf shoreline changes. The historical rate of change includes historic rates of RSLR but not the accelerated rates expected in the future. The projected shoreline retreat was adjusted to account for the accelerated rate of future RSLR by multiplying the width of the BEG shoreline retreat by the projected increase in the rate of RSLR and mapping a revised shoreline with GIS, adjusted as needed for controlling features such as roadways or large chenier ridges that are likely to block retreat.

A similar method was followed for Sabine Lake; however, in this case an average annual loss rate provided by the USFWS was applied as the baseline historical rate. Erosion on the east shore of Sabine Lake is caused primarily by wind-induced waves and soft sediments (Parchure et al., 2005). The historical rate was calculated with a GIS analysis of aerial photographs taken between 1978 and 2004 (Greco and Clark, 2005). This analysis estimated an average shoreline retreat rate of 4.5 feet/year for the Sabine Lake shoreline between the Sabine River and Willow Bayou. For the purposes of this analysis, the 4.5 feet/year rate is applied to the entire east Sabine Lake shoreline as shoreline retreat is also a problem along the Sabine Lake shoreline between Willow Bayou and Blue Buck Point (LCWCR/WCRA, 1998). The 4.5-foot/year rate was increased by a factor of 4.2 to account for the accelerated rate of RSLR, resulting in an estimated 1,200 feet of shoreline retreat by the year 2069. The current shoreline was recessed by this width, except where other controlling features such as levees, cattle walkways, or roadways would block retreat, and the lost acreage was calculated by GIS.

For the Louisiana Gulf shoreline in the study area, no change was projected through the year 2050 (Barras et al., 1994). The history of shoreline change for this area, developed in conjunction with the Louisiana Coastal Areas Ecosystem Restoration Report (USACE, 2004a), documented that the segment of the Chenier Plain shoreline between Sabine Pass and Ocean View Beach (located 6 miles beyond the 10-mile SNWW study boundary) prograded seaward at an average rate of +12.9 feet/year between 1883 and 1994. Between 1985 and 1995, the average rate of progradation slowed to +1.2 feet/year. The shoreline in the study area is dominated primarily by the effect of the Sabine Pass jetties, which intercept the westward-moving littoral drift and tend to trap sediment, creating a more stable shoreline than that nearer to Ocean View Beach. For this study, a stable shoreline through the period of analysis was assumed, and the projected RSLR at the Gulf shoreline (1.1 feet in year 2069) was applied to the preexisting topography using the GIS method described below.

For the Louisiana Gulf shoreline and the shorelines of all other major waterways and waterbodies in the study area, the second method was applied. Preexisting topography along shorelines was assumed to be fixed; current shoreline elevation was combined with the projected increase in sea level to project a new shoreline. The increase in sea level at the end of the period of analysis (year 2069) is equivalent to the change in water surface elevation projected by the HS model for the FWOP with RSLR condition; this change is +1.1 feet throughout the study area. Slope is a major controlling variable in the determination of shoreline changes using this method. Steep slopes would experience little shoreline displacement while gentle slopes would show a much larger lateral change. It is assumed that man-made features such as jetties, roads and highways, dikes and levees, bulkheads and fill would continue to be maintained at a

sufficient elevation that they would block shoreline retreat, and that current beneficial use projects that use dredged material to isolate interior wetlands from large waterways would be continued.

In the WVA EMCM, hydrologic unit acreages were adjusted to remove acres lost to RSLR-related shoreline recession for the FWOP land loss projection in the WVA model. This adjustment was made in the WVA land loss tables. The rate of acreage lost due to shoreline recession was assumed to be linear. The acres lost per year were subtracted from the base acreage before the revised land loss rate for the interior marsh was applied. This adjustment results in the removal of an equivalent amount of acres (lost due to RSLR only) from both the FWOP and FWP conditions. FWOP and FWP interior land loss rates were then applied to the remaining acreage, as described below, to determine the effect of salinity changes over the period of analysis in both the FWOP and FWP conditions.

In summary, the total acres of marsh forecast to be lost in the FWOP condition due to shoreline recession is 6,394 acres. The loss for each affected hydro-unit is shown in Table 4.10-1.

Table 4.10-1
Acres Lost to FWOP Shoreline Recession

| HU # | HU name | Marsh Type | Marsh | Water | Total |
|---|---|---|---|---|---|
| **Louisiana** | | | | | |
| LA 2 | Willow Bayou | Brackish | 627 | 20 | 648 |
| LA 3 | Black Bayou | Brackish | 621 | 9 | 630 |
| LA 4 | West Johnson's Bayou | Brackish | 957 | 130 | 1,087 |
| LA 5 | Sabine Lake Ridges | Brackish | 685 | 49 | 734 |
| | | Saline | 106 | 33 | 138 |
| | Louisiana Subtotal | | 2,996 | 240 | 3,236 |
| **Texas** | | | | | |
| TX 7 | GIWW North | Fresh | 8 | 0 | 8 |
| | | Intermediate | 4 | 0 | 4 |
| TX 8 | Texas Point | Fresh | 1 | 0 | 1 |
| | | Intermediate | 68 | 2 | 70 |
| | | Brackish | 813 | 40 | 852 |
| | | Saline | 2,043 | 151 | 2,194 |
| TX 9 | Salt Bayou | Fresh | 0 | 0 | 0 |
| | | Brackish | 27 | 3 | 30 |
| | Texas Subtotal | | 2,962 | 196 | 3,158 |
| **Total** | **Project Area** | | **5,958** | **436** | **6,394** |

### 4.10.1.2 FWOP Interior Marsh Loss

#### *4.10.1.2.1 Interior Marsh Loss*

Land loss rates for interior marsh areas were adjusted to account for increasing salinity due to RSLR over the period of analysis using the land loss methodology of the WVA and a productivity-based land loss projection methodology based upon a salinity-vegetation productivity relationship developed for the habitat productivity component of the LCA Ecosystem Model (Visser et al., 2004).

The deepening project would result in a minimal increase in water elevation over the majority of the project area (averaging less than ½ inch). Thus no FWP impacts due to water elevation increases are anticipated. It is, however, assumed that all tidally influenced habitats would see a gradual increase in water elevation associated with a RSLR of 13.2 inches by 2069.

The effects of the projected rate of RSLR on coastal marshes are very difficult to predict. The RSLR rate at which marsh will convert to open water depends on the rate of marsh elevation gain by sediment accumulation and/or biological mechanisms such as biomass accumulation (Langley et al., 2009). Dams on both the Sabine and Neches rivers have decreased sediment deposition downstream in the coastal marshes, making biological processes very important in their long-term sustainability. It is possible that biomass accumulation would offset much if not all of the RSLR change in water surface elevation. "Primary productivity of salt marsh vegetation is regulated by changes in sea level, and the vegetation, in turn, constantly modifies the elevation of its habitat toward an equilibrium with sea level (Morris et al., 2002). A rise in relative sea level brings an increase in production and biomass density that enhances sediment deposition by increasing the efficiency of sediment trapping. This can lead to an absolute increase in the elevation of the marsh platform and result in a landward migration of the marsh (Gardner et al., 1992, Gardner and Porter, 2001). This may change total wetland area, depending upon local geomorphology and anthropogenic barriers to migration, such as bulkheads, canals, etc.

Existing coastal marshes appear to have adapted to historical ranges of mean sea level, and gradual changes in RSLR. There has been a decrease in the loss rate in the Sabine-Calcasieu area from 7.0 to 2.6 square miles (17.1 to 3.3 percent) (Barras et al., 1994). Furthermore, the high rate of RSLR in this region may be ameliorating, as the average increase at the Sabine Pass tide gage was 0.3 inch/year for the 41-year period between 1958 and 1999 compared to 0.2 inch/year for the 48-year period between 1958 and 2006 (USDC-NOAA, 2006, 2009). FWOP projections of coastal land loss in the Louisiana portion of the SNWW study area forecast relatively stable landforms and shorelines through 2050 (Barras et al. 1994), not accounting for the effects of tropical storms and hurricanes. In general, the interior marshes in the Louisiana portion of the SNWW study area appear to have stabilized and are not undergoing rapid conversion of large areas to open water like areas to the east in Louisiana (LCWCR/WCRA, 1998; USACE, 2004a). Recent Louisiana LIDAR data shows that existing marsh is higher than the projected RSLR for the period of analysis and thus should be able to withstand the gradual rise in elevation (Louisiana State University, 2009).

Similar large-scale FWOP land loss projections are not available for the Texas portion of the study area. However, this study assumed that the Texas portion would also remain relatively stable with respect to the effects of RSLR through the period of analysis because the same chenier landforms, marshes, and sediments are present throughout the study area. A GIS study of aerial photographs of the Salt Bayou/Keith Lake system confirmed that the open-water trend has slowed and possibly reversed itself in that area in recent years (TPWD, 2003). Texas interior marshes most at risk to the effects of RSLR are located in the Texas Point NWR and just outside and to the west of the SNWW study area in the McFaddin NWR. Most recently, marshes in these areas have been highly stressed due to the combined

effects of Hurricane Ike's storm surge and a subsequent drought, which caused prolonged high salinities throughout these marshes.

However, many different climatic, physical, and biological processes can affect the rate of accumulation. Recent experimental evidence suggests that increasing atmospheric $CO_2$ concentrations could stimulate biogenic mechanisms of elevation gain in a brackish marsh, and further, that this effect could be enhanced under salinity and flooding conditions expected with future RSLR (Langley et al., 2009). This response is further complicated by variations in sediment supply from river discharges and variations in primary production due to changes in nutrient loading, precipitation, temperature, and other factors (Morris et al., 2002). Gulf shoreline erosion associated with accelerated rates of RSLR may increase the amount of near shore sediment. Wilson and Allison (2008) have shown that material released by Gulf shoreline erosion remains nearshore rather than being dispersed into offshore waters, therefore remaining available for redeposition by tidal flooding or storm surge overwash. In addition to RSLR, future changes in climate would influence the quantity and timing of freshwater delivery to the coastal estuaries. At this time there is no consensus in the direction or amount of changes in precipitation in the study area, while a temperature increase of 4°F is likely by 2059 (Nielsen-Gammon, 2009). Whatever the net effect of climate change on basin runoff, most climate change projections agree that more frequent high-intensity rainfall events are likely. In most drainages, this type of event would most likely produce increased sediment runoff, and thus periodically increase sediment delivery to the coastal marshes. Uncertainties related to all of these processes could result in very different predictions of future marsh conditions.

It must be recognized that large areas of interior marsh could quickly convert to open water under certain extraordinary events. If RSLR accelerates to the extent that the coastal plant community cannot sustain an elevation within its range of tolerance, rates of primary production would decrease, resulting in an unstable and rapidly deteriorating marsh community (Morris et al., 2002). In addition, if shoreline recession cuts existing foredune formations, large areas of interior marsh could quickly be exposed to higher-salinity Gulf waters and wave attack. In this case, large marsh areas could quickly be lost to the Gulf.

The EMCM was used to forecast land loss in the emergent marshes of the study area. Variable $V_1$ (percent emergent marsh) of this model requires the projection of the number of acres of emergent marsh that would remain at the end of the period of analysis, both without and with the project. The WVA land loss methodology assumes that historical trends can be used to predict future land loss rates. Baseline historical land loss rates were determined by measuring changes over the most recent 15- to 20-year time period for which reliable data were available. These rates include the chronic, regional effects of subsidence, altered sediment delivery, global sea level rise, and tropical storms and hurricanes. They were calculated from a period that postdates high oil and gas extraction in the region and thus exclude subsidence that may be related to the higher rates of extraction, which have waned significantly in recent decades. After changes in acreages were calculated, the amount of emergent marsh that converted to open water was expressed as a percentage loss per year.

Increasing salinity levels associated with accelerating RSLR would be expected to reduce the primary productivity of the marsh and increase the land loss rate. Associating a decrease in primary productivity with an increase in salinity is based upon documented biological responses of inundated vegetation to salinity. The expected reduction in biological productivity of wetlands in the study area as a result of salinity stress is discussed in Section 4.6. Decreased plant productivity has been demonstrated to result from the interaction of excessive submergence and salinity. This interaction leads to a decrease in organic matter accumulation, which, in turn, results in greater submergence because the rate of increase in marsh elevation cannot keep up with the rate of submergence due to RSLR (Day and Templet, 1989; Day et al., 1995; DeLaune et al., 1994; Nyman et al., 1993; Spalding and Hester, 2007). The death of wetland vegetation often results, followed by peat collapse, erosion, and wetland loss (DeLaune et al., 1994; Gough and Grace, 1999; Salinas et al., 1986; Visser et al., 1999; Webb and Mendelssohn, 1996).

FWOP effects of RSLR to interior marsh areas are expected to be limited to the effects of increasing salinity. FWOP land loss rates were adjusted for the gradually rising salinity using the productivity-based land loss projection described below. Although emergent marshes throughout the tidally influenced portions of the study area would experience a gradual increase in water elevation associated with a RSLR of 1.1 feet by 2069, biomass accumulation was assumed to offset all of the RSLR increase in water surface elevation. The total amount of interior marsh expected to be lost in the FWOP condition, exclusive of the approximately 6,000 acres lost to shoreline recession, is approximately 15,000 acres.

#### *4.10.1.2.2 Productivity-Based Land Loss Projection*

In order to provide a science-based and systematic evaluation of the project effects for the SNWW WVA model application, the HW applied a productivity-based method of land loss projection that is based upon a salinity-productivity relationship developed for the habitat productivity component of the LCA Ecosystem Model (Visser et al., 2004). In the LCA Ecosystem Model, productivity algorithms were developed for all herbaceous and forested wetlands based on available published and unpublished data. That report documented extensive literature on the effect of salinity on the productivity of the dominant species in each of the habitats in this study area (see Section 4.6). These studies used various measurements of productivity, including total biomass, stem/leaf elongation, and photosynthesis, that were gathered using greenhouse experiments on saturated soils. To better illustrate the relationship of salinity and productivity, linear regression equations were developed that predict percentage changes in habitat productivity per 1 ppt salinity for each major coastal habitat type, regardless of inundation, as shown in Table 4.10-2. These predicted changes in primary productivity for every 1 ppt increase in salinity were used to predict land loss rate changes in the current study.

#### *4.10.1.2.3 Assumptions and Uncertainties of the Productivity-Based Land Loss Projection*

Relating changes in salinity to specific amounts of land loss is problematic. While there is extensive literature that relates increases in salinity to decreased productivity, vegetation stress, and eventual wetland loss, the USACE and the ICT are not aware of any studies that have documented specifically how much land loss is associated with specific increases in salinity. Similarly, no data are currently available

that relate salinity reduction with a reduction in land loss (Visser et al., 2004). Therefore, the HW assumed a direct linear correlation between decreased primary productivity due to salinity increases and increased land loss rates due the project (see Table 4.10-2). The HW considered increasing land loss rates for salinities that changed from optimal to suboptimal conditions and, conversely, also considered decreasing land loss rates in target years 20 to 50. The latter consideration is based upon historical observations that land loss rates generally stabilize and lessen a few decades after channel deepening projects are completed. Since the effects of these considerations would generally offset one another, the HW opted for the simpler 1:1 relationship.

Table 4.10-2
Productivity-Based Land Loss Projection

| Habitat Type | % Productivity Lowered and Land Loss Rates Increased per 1 ppt Increase in Salinity |
|---|---|
| Fresh marsh | 11.1 |
| Intermediate Marsh | 11.4 (*Sagittaria*), 2.3 (*Spartina patens*); mean = 6.8 |
| Brackish | 2.6 |
| Saline | 2.1 |

The relationship between productivity decreases and land loss rate increases is assumed to be linear; thus, a 1 percent decrease in productivity translates to a 1 percent increase in the land loss rate. For example, in Table 4.10-2, the productivity of fresh marsh decreases by 11.1 percent with every salinity increase of 1 ppt for fresh marshes. This translates to an 11.1 percent increase in the land loss rate for every 1 ppt increase in salinity. The following standard formula was applied to calculate FWP rates used in the WVA land loss spreadsheets.

FWP land loss rate = (((fwp salinity ppt – fwop salinity ppt) x percent productivity decrease per habitat type) + 1) x baseline land loss rate)

#### 4.10.1.3 FWOP SAV

The salinity change occurring with RSLR in the No-Action Alternative would be very gradual, and therefore the SAV community structure in the majority of intermediate marshes would likely change to include more salinity-tolerant species, such as widgeon-grass, pondweed (*Potamogeton pectinatus*), Eurasian watermilfoil, and freshwater eelgrass (USGS, 1997). It is expected that any SAV cover lost as a result of this change would be replaced by the salinity-tolerant SAVs continuing to grow within their tolerance range. As a result, no change in percent SAV cover would be expected during the period of analysis.

#### 4.10.1.4 FWOP Effects of Hydrologic Management Structures

The hydrologic management of emergent tidal marsh has also been shown to contribute to land loss in nearby areas, such as the eastern section of the Sabine NWR, by increasing both salinity and the duration of inundation in managed marshes. The potential for hydrologic management in the study area to contribute to land loss is reviewed in subsection 4.6.3.2.1. None of the current hydrologic management

measures in the study area (the western Sabine NWR excluding Pool 3, the Black Bayou area, the Texas Point and McFaddin NWRs) lead to long-term ponding or significant delays in the ability of the wetlands to drain after periodic salinity incursions (i.e., droughts or hurricanes), and thus no adverse FWOP impacts associated with managed marshes would be expected.

#### 4.10.1.5 FWOP Adjustments for CWPPRA Marsh Restoration Projects

FWOP adjustments to acreages for constructed or funded CWPPRA projects in the east Sabine Lake marshes (Clark et al., 2000; USFWS and NRCS, 2008a), at Black Bayou (USFWS and NRCS, 2008b), and at Perry Ridge (USGS-NWRC, 2002a, 2002b) were applied in the WVA land loss spreadsheets as had been done previously. Acres of restored marsh were added in the FWOP and FWP marsh (acres) columns in the target year in which they were completed.

### 4.10.2 Preferred Alternative

#### 4.10.2.1 FWP Effects on Cypress-Tupelo Swamps and Bottomland Hardwood

The Preferred Alternative would have no direct construction impacts to bottomland hardwoods or swamps, and the FWP "most likely" salinity levels would not result in the loss of any swamp or bottomland hardwood forest acreage. In the swamp communities, salinities would exceed the optimal range at Adams Bayou and in the Blue Elbow South hydro-unit. However, FWP salinities would not exceed 4 ppt and thus would not be high enough to result in the conversion of swamp to marsh, or in the loss of forested wetland acreage (Visser et al., 2004). Bottomland hardwoods on the upland terrace margin near the mouth of the Neches River, along Adams Bayou, and at Perry Ridge would be exposed to occasional insults of salinities exceeding the optimal range, but at levels that are insufficient to cause a significant loss of productivity.

#### 4.10.2.2 FWP Land Loss

##### *4.10.2.2.1 FWP Shoreline Recession*

Shoreline recession along the eastern shoreline of Sabine Lake would not be affected by the proposed project (Parchure et al., 2005). The deepening project does not significantly increase tidal amplitude, velocity, or water surface elevation and thus would cause no additional recession of the lake shoreline (Brown and Stokes, 2009).

Bank erosion along the SNWW navigation channels is not expected to increase in the FWP condition, and thus would not contribute to shoreline recession over the period of analysis (Maynord, 2005). Existing erosion of navigation channel banks is caused primarily by vessel wakes. It is predicted that the deeper channel would result in slightly few vessel trips than the FWOP condition and thus not increase erosion.

FWP erosion of the Gulf shoreline is predicted to increase slightly over the FWOP condition. A deeper and longer entrance channel would have some effect on waves moving from the Gulf to the shore, and that would in turn exert an effect on the rate of longshore sediment transport (Gravens and King, 2003). It

is predicted that this would result in the loss of 18 acres of Gulf shoreline within 4 miles from the jetties over the period of analysis.

#### *4.10.2.2.2 FWP Interior Marsh Loss*

FWP impacts would be expected to result when increased FWP salinities interact with FWOP submergence to cause a marginally higher land loss rate, exacerbating the process already occurring in the FWOP condition. The EMCM was used to forecast FWP land loss; rates were adjusted using the productivity-based projection to include the effect of gradually rising FWOP salinities and the abrupt FWP incremental salinity increase in TY 15 (the year of project completion). See tables 4.1-3 and 4.1-4 for the FWP impacts to wetland acres by habitat type in Louisiana and Texas, respectively, before the application of benefits from BU features.

Table 2.4-16 provides a summary of the project impact analysis and net losses/benefits after application of the BU plan benefits. In Louisiana, the WVA model forecasts that 691 more wetland acres in Louisiana would be lost over the period of analysis in the FWP condition. The highest losses are projected to occur in intermediate marsh (78.5 percent), with 8.5 percent in fresh marsh, 11 percent in brackish marsh, and 2 percent in saline marshes. Wetland losses in Louisiana are fully compensated by marsh mitigation measures described in Section 5.0. In Texas, the overall net change in wetland acreage is positive due to the benefits of the Neches River BU Feature. There is a net gain of 2,606 acres of emergent marsh, 12 percent fresh, 42 percent intermediate, and 46 percent brackish marsh.

#### *4.10.2.2.3 FWP SAV*

SAV impacts would be similar to expected changes in the FWOP condition. The SAV community structure in the majority of intermediate marshes would likely change to include more salinity-tolerant species, such as widgeon grass, pondweed, Eurasian watermilfoil, and freshwater eelgrass (USGS, 1997). An increase in salinity would occur with dredging of the Sabine Pass and Sabine Pass Jetty channels. The HS model projects that the incremental salinity increase would average 1.3 ppt near the mouths of Sabine and Keith lakes, 0.8 ppt in the east Sabine Lake marshes, 0.7 ppt on the lower Neches and Sabine rivers, and less than 0.15 ppt on the upper Neches and Sabine rivers. Since salinity change is a function of the total dredging template, the time required to reach a new FWP equilibrium would likely be considerable, ranging from a conservative minimum of several months to even a year, because each wetland would be responding to salinity inputs from multiple sources (Gary Brown personal communication, 2009). The most rapid change (on the order of 2 to 3 months) would likely occur in marshes immediately adjacent and open to tidal exchange with the navigation channel that has just been dredged. Because of the salinity effect of the existing navigation channel, wetlands adjacent to the channel are likely to contain SAVs with greater salinity tolerances, and thus would be able to adapt to the FWP change more easily.

The Neches River BU Feature and the Louisiana mitigation measures would likely cause SAV impacts because of temporary but greatly increased turbidity associated with the hydraulic placement of dredged material for marsh restoration. It was assumed that construction would result in the die-off of SAVs in the vicinity of placement activities during the year of construction, followed by quick rebounds associated

with increased nutrient input, and the creation of shallow, protected ponds within the restored marsh. No seagrass would be affected by the Gulf Shore BU Feature, and no impacts to other types of submerged aquatic vegetation are expected from channel deepening. Seagrasses and other types of submerged aquatic vegetation are not found along the margins of SNWW channel because conditions conducive for SAV growth (i.e., calm waters and low turbidity) are not present.

##### *4.10.2.2.4 Adjustments for Land Gains from BU Features and Mitigation Measures*

Marsh restoration proposed as BU features or compensatory mitigation adds mineral soils to degraded areas of former marsh. The addition of denser mineral soils and the increase in marsh elevation were assumed to create a more stable landform, and the increase in the land loss rate due to the project was reduced by 50 percent in the WVA land loss change spreadsheets. Other mitigation measures that did not involve the creation of a higher, more-stable landform were modeled using a land loss rate equivalent to the FWP rate.

## 4.11 AQUATIC ECOLOGY

The following presents a discussion of potential impacts to freshwater and marine communities from the No-Action and Preferred alternatives. A description of each community type discussed below can be found in Section 3.10.

### 4.11.1 Freshwater

Freshwater fauna adapted to low-salinity environments are generally restricted to the upper reaches of the tributaries of Sabine Lake and their distribution depends on the extent of freshwater inflow into the estuary. Portions of the tidal reaches of the Neches (downstream of the saltwater barrier) and Sabine rivers generally support freshwater fishes. The Rose City Marsh and the upper reaches of Bessie Heights Marsh that are farthest from the study area are also freshwater ecosystems under normal conditions. Other predominantly freshwater streams that flow into Sabine Lake or the tidal reaches of the Neches and Sabine rivers include Taylor, Cow, Adams, and Little Cypress bayous in Texas, and Black and Johnson's bayous in Louisiana. Additional descriptions of the existing environment are provided in Section 3.10.

Sabine Lake was predominantly a freshwater-dominated ecosystem prior to early navigation improvements, subsidence, oil and gas exploration, and subsequent marsh erosion. Saltwater intrusion into the lake and its tributaries is largely responsible for the transformation of the lake into a euryhaline environment. While most of this change occurred in the early part of the twentieth century, the peripheral marshes and tributaries have continued to change as a result of saltwater intrusion, although at a much slower rate than before.

In particular, specific impacts to the freshwater ecosystems within the study area include the degradation of Bessie Heights, Rose City, and Old River Cove marshes through subsidence, intrusion of salt water, and vegetation loss, which have caused substantial conversion of freshwater marsh to open water. As the organic soils that support marsh vegetation erode because of saltwater intrusion, open-water areas expand

and exposure to salt water increases along the remaining marsh edge. This process further facilitates encroachment of salt water into the tributaries of these marsh areas. These processes also impact other freshwater marsh and tributary areas adjacent to Sabine Lake.

The Rose City Marsh presently consists of freshwater habitats. There is little or no information that describes the present state of this freshwater ecosystem or its recreational benefits. However, anecdotal information indicates that a viable freshwater community exists in the open water, channels, and tributaries of the Rose City Marsh. This area supports some recreational fishing to an unknown extent.

The movement of saline water into Bessie Height Marsh is generally greater than Rose City Marsh since it is farther downstream and has more hydraulic connections to the Neches Ship Channel. The diversity, distribution, and importance of freshwater fauna in this area are not well known but are likely spatially restricted as a result of saltwater intrusion. Species that occur in the open-water portions of Bessie Heights Marsh tend to be euryhaline.

Marshes at Old River Cove are exposed to higher salinities than all other marshes on the Neches River tidal because of their location where the Neches Ship Channel connects with the Sabine-Neches Ship Channel. Like Bessie Heights, the distribution and role of freshwater fauna in this area are not well known; however, intrusion of saline water probably restricts their diversity and distribution. Much of this area is managed by TPWD as the Old River Unit of the Neches River WMA. A 2,500-acre area of controlled, isolated wetlands covers the eastern half of the marsh. Intake and outfall canals for a large power plant draw higher-saline waters from Old River Cove and discharge them into the Neches Ship Channel just upstream of the Rainbow Bridge. Salinities west of the outfall canal tend to be lower because this area is buffered by the bank of the canal and receives lower salinity overland flow from the Bessie Heights area. Widgeon grass is abundant in shallow waters west of SH 87, but SAVs are not common east of the highway. Roadside ditches and the utility canals provide access to estuarine species.

#### 4.11.1.1 No-Action Alternative

Two factors are likely to influence freshwater communities in the FWOP scenario. It is possible there would be a long-term reduction in freshwater inflow to the estuary since the human population of the state is expected to double during the life of the proposed project. The doubling of the population may increase demand for freshwater inflow, which may in turn result in lower freshwater inflows to the estuary. The second factor is relative sea level rise, which is predicted to continue. RSLR would gradually increase salinities in portions of the estuary. In the absence of the project and associated marsh restoration projects, the loss of freshwater marsh habitats would likely continue, in part due to continued RSLR, although RSLR is not expected to significantly change salinities in freshwater portions of the project area. Salinities would likely increase in tributaries to the estuary, causing continued conversion of fresh water to brackish marsh, in turn, favoring colonization by euryhaline species. These changes would occur slowly under most circumstances, although catastrophic changes associated with events like hurricanes might cause changes to occur more rapidly. There is considerable uncertainty regarding freshwater inflows to the estuary in the future.

#### 4.11.1.2 Preferred Alternative

The Preferred Alternative includes the Neches River BU Feature, which is designed to restore the elevation in the Rose City, Bessie Heights, and Old River Cove marshes. The restoration efforts would likely impact short- and long-term, existing open-water communities. A significant portion of the open water of each marsh would be converted to shallow marsh with emergent vegetation. This habitat conversion should reduce intrusion of salt water into portions of those marshes.

Short-term impacts would be associated with marsh construction. Placement of dredged material might result in an initial increase in turbidity in the marsh and nearby tributaries. Increased turbidity might result in a short-term reduction in the distribution of SAV in the Rose City and Old River Cove marshes. The initial placement of dredged material would aid in reducing saltwater intrusion and would create more areas of quiescent water allowing SAV to repopulate the areas quickly after construction of the mitigation marshes.

Long-term impacts include the conversion of open-water habitat to marsh habitat. Some recreational benefits exist in the present open-water areas of the marshes. Under normal conditions, Rose City and Bessie Height marshes are essentially open-water, shallow, brackish to freshwater lakes. The marsh restoration would significantly reduce the amount of open-water area. Additionally, the freshwater ecosystem would be protected from future saltwater intrusion. Restoration efforts in this area would maintain channels, drainages, and some open water, which would greatly improve the complexity and diversity of marsh habitats and improve the ecological and recreational benefits of this marsh.

The upper reaches of the Neches and Sabine rivers and their tributaries in the study area support valuable freshwater habitats. Modeling of potential salinity intrusion into the Neches and Sabine rivers associated with the project indicated that mean salinities on the upper Neches River would remain near existing conditions over most of the study area. However, slightly higher salinities are expected in swamps and fresh marsh communities on or near the Sabine River near the GIWW and in the extensive fresh marsh north of the GIWW in Texas. These potential changes are expected to cause small reductions in the health and biological productivity of freshwater habitats. Increases in salinity are expected to cause additional stress on some fresh and intermediate marsh vegetation, over approximately 173,750 acres of fresh and intermediate marsh in Texas and Louisiana over the study area as a whole. No loss of swamp or bottomland hardwoods is projected. Reduced growth of some trees in the cypress-tupelo swamps, particularly near the Sabine River, is expected as a result of the slight increase in salinity from the project. The loss of freshwater habitat would be expected to increase access to mineral-rich sediments and organic nutrients in the short term for estuarine fauna, leading to a temporary increase in productivity. But the increased productivity would decline as the freshwater habitats disappear, eventually leading to some reduction in freshwater fauna productivity (Minello and Rozas, 2002). The Neches River BU Feature is intended to create 4,958 acres of restored emergent marsh, improved shallow-water habitat, and nourished existing marsh in Rose City East, Bessie Heights East, and Old River Cove. The Neches River BU Feature is also intended to offset the direct loss of 86 acres of freshwater wetland used for the creation of

PA 24A. Once the project, including the DMMP BU features and compensatory mitigation, leads to an overall net gain in marsh habitat, no detrimental impacts to fauna are anticipated.

## 4.11.2 Marine

### 4.11.2.1 Estuarine Habitats and Fauna

#### *4.11.2.1.1 No-Action Alternative*

Under the No-Action Alternative, estuarine habitats and fauna would continue as described in subsection 3.10.2.1. However, it should be noted that the No-Action Alternative does not imply that there would be no dredging or placement activities. Maintenance dredging will continue as it has in the past.

#### *4.11.2.1.2 Preferred Alternative*

Due to the reproductive capacity and natural variation in phytoplankton populations, short-term, localized increases in turbidity associated with dredging within the project area are not expected to be significant (Brannon et al., 1978; May, 1973; Odum and Wilson, 1962). Under most conditions, fish and other motile organisms are only exposed to localized suspended-sediment plumes for short durations (minutes to hours) (Clarke and Wilber, 2000). Should marsh communities benefit from the Preferred Alternative, finfish and shellfish would also benefit. The potential for the deepening to cause widening at the top of cut as the side slopes adjust to the new project depth has been evaluated. The present 40-foot channel has been in existence since the early 1970s and has had adequate time for the dense clay sediments to stabilize. Deepening will be performed by making a box cut in the bottom of the existing channel. Some slumping of the side slope at the base of the channel may occur as the deeper channel stabilizes, but no slumping is expected at the top of cut. Therefore, no impacts to oyster reef located adjacent to the top of cut in Sabine Pass are expected. No emergent marsh or shallow bottom is present adjacent to the top of cut.

There are one-time effects of the borrow trench and access channel in Sabine Lake and dredging of accumulated sediments in the Lake Charles Deepwater Channel. The Preferred Alternative would impact approximately 275 acres (225 acres for the borrow trench and 50 acres for the access channel) of lake bottom within Sabine Lake, a designated Louisiana Public Oyster Area. Dedicated dredging of Sabine Lake would be performed to supply sediment needed to restore 687 acres of emergent marsh, improve 167 acres of shallow water, and nourish 1,112 acres of existing marsh within the 1,966 total acres in Willow Bayou Mitigation Areas LA 2-18B and LA 2-ADD B. Approximately 3.1 mcy of material would be dredged from a 1.8-mile-long trench in Sabine Lake, located at least 1,000 feet from the Sabine NWR shore, averaging 1,030 feet wide by 7.5 feet deep. The borrow trench would be continuous and parallel the current shoreline; the common longshore circulation pattern in Sabine Lake is expected to eventually fill the trench with Sabine River sediments. An access channel, approximately 8 miles long, from the GIWW near the mouth of the Sabine River would be needed for the dredge to reach the proposed borrow trench area. The exact locations of the borrow trench and access channel would be determined in consultation with the ICT after PED bottom surveys of potential locations. Also, accumulated material

would be dredged from the 30-foot Lake Charles Deepwater Channel, which is co-located with the GIWW in Louisiana (13 miles long by 125 feet wide beginning just past Pavel Island Channel and extending eastward, removing approximately 15 feet of accumulated sediment). The Lake Charles Deepwater Channel was completed in 1926 (USACE, 1998c) and the last known dredging occurred in 1940. Material would be hydraulically dredged and placed in Black Bayou Mitigation Areas LA 3-15B and 3-18B. The mitigation measure at West Black Bayou (LA 3-10R) would be constructed using maintenance material from the Sabine River Channel to Orange over a 30-year period. The Sabine River Channel dredging is a FWOP impact because it occurs as part of the normal maintenance dredging practices for the Sabine River Channel.

One-time impacts of the borrow trench and access channel dredging in Sabine Lake for the mitigation measures in Willow Bayou include an increase in water column turbidity during dredging activities; however, such effects are temporary and local. No further effects to water quality are expected. Benthic fauna would be removed due to evacuation of sediment during dredging activities; however, benthic organisms can rapidly recolonize, and no long-term effects are anticipated. Details of potential impacts from borrow trench dredging to benthos, salinity, SAV, oysters, and water quality are found in subsections 5.5.1 (Willow Bayou Mitigation) and 5.5.2 (Black Bayou Mitigation).

The potential for the removal of sediments from Sabine Lake for marsh mitigation to affect oyster reef has been evaluated. An oyster assessment was performed in 2006 (T. Baker Smith, Inc., 2006) near the area of the proposed Sabine Lake access channel and borrow trench in conjunction with an unrelated Department of Army permit application. Bottom types were found to consist of 90 percent firm mud and buried shell, 8 percent soft mud, and 0.7 percent exposed shell/reef. No live oyster reefs were found. Similar bottom types are expected in the area of the proposed access channel and borrow trench, which are located directly east of the surveyed area. Optimal salinities for oyster growth are from 10 to 15 ppt (Armstrong et al., 1987). Salinities in this area of Sabine Lake range from 1 to 6 ppt year-round, too fresh for oyster development (Fagerburg, 2003). During construction of the access channel and borrow trench, no impacts to extant live oyster reefs are likely. Nonetheless, prior to project implementation, a full water bottom assessment would be conducted by the USACE in accordance with the LDWF survey standards. This survey would be necessary in order for the LDWF to consider a waiver of compensation for impacts to the water bottoms of the Sabine Lake Public Oyster Area.

With the deepening of the channel, a small increase in salinity would be observed (see Section 4.6). Most organisms occupying these environments are ubiquitous along the Texas and Louisiana coast and can tolerate a wide range of salinities (Parker, 1965; Pattillo et al., 1997). Therefore, no adverse effects on fauna are expected due to changes in salinity that may result from the Preferred Alternative, except loss of habitat due to salinity impacts on marshes. Small increases in salinity under median-flow conditions would affect all tidally influenced brackish and saline marshes in the SNWW study area (approximately 37,000 acres). As discussed in Section 4.6, these potential changes are expected to cause small reductions in the health and biological productivity of these habitats. Increases in salinity are expected to cause additional stress on some marsh vegetation. However, since the project, including the DMMP BU features

and compensatory mitigation, leads to an overall net gain in marsh habitat, no detrimental impacts to fauna are anticipated.

There is little difference in the likelihood of oil spills with the No-Action or Preferred Alternative except that inclusion of bend easings should make channel transits safer. In the unlikely event a petroleum product spill should occur, however low the probability, adult crustaceans such as shrimp and crabs and adult finfish are probably mobile enough to avoid most areas of high oil concentrations. Larval and juvenile finfish and shellfish tend to be more susceptible to oil than adults and could be affected extensively by an oil spill during their active immigration periods. Due to their lack of mobility, they are less likely to be able to avoid these areas and could be negatively impacted if a spill were to occur. Benthic fauna may be killed, but phytoplankton may be adversely or favorably affected by oil spills. It is unlikely that an oil spill in the project area would result in significant, long-term impacts to either phytoplankton or benthic communities, since these organisms have the ability to recover rapidly from a spill due primarily to their rapid rate of reproduction and to the widespread distribution of dominant species.

#### 4.11.2.2 Offshore Habitats and Fauna

##### *4.11.2.2.1 No-Action Alternative*

Under the No-Action Alternative, Gulf habitats and fauna would continue as described in subsection 3.10.2.2 with maintenance dredging and placement of dredged material in four designated ODMDS sites.

##### *4.11.2.2.2 Preferred Alternative*

Construction excavation removes benthic organisms from their habitat and sends them through the dredge into the hopper. Most cannot be expected to survive placement in the adjacent ODMDS. However, the benthic community can rapidly recolonize, both on the channel bottom and in open-water PAs. Since the benthic community occupying the channel bottom is continually disturbed by passing ships, maintenance dredging, while it may kill the organisms dredged, is not expected to change the community living there after recolonization.

Construction of the Extension Channel would physically disturb benthic communities in the proposed channel prism. Impacts to benthic organisms during maintenance dredging are expected to be minor. While there is some recolonization between cycles, sediments in the channel are continuously disturbed by passing ships. Placement of dredged material in the offshore placement site would bury those benthic organisms incapable of escaping or burrowing up through the dredged material. Organisms that are buried must vertically migrate or die (Maurer et al., 1986). Maurer et al. (1986) demonstrated that many benthic organisms were able to migrate vertically through 35 inches of dredged material under certain conditions; however, the species present in early successional stages of recovery are not the same as those buried by the dredged material. Although vertical migration is possible, most organisms at the center of the disturbance do not survive, but survivability was shown to increase as distance from the disturbance increased (Maurer et al., 1986). Benthic organisms would not long survive placement into upland PAs.

Potential beneficial effects of the suspended material associated with dredging operations include a resuspension of nutrients, absorption of contaminants in the water column, and addition of a protective cover allowing certain nekton to avoid predation (Stern and Stickle, 1978). As with the various detrimental effects, the importance of each of these latter effects would vary among groups and with the physiochemical parameters existing at the time and location of dredging and placement operations. Material to be dredged is not contaminated and should not pose contamination issues with respect to aquatic communities. Impacts in the new ODMDSs would be the same as those in the existing ODMDSs and are not expected to be significant.

#### 4.11.2.3 Essential Fish Habitat

##### *4.11.2.3.1 No-Action Alternative*

Under the No-Action Alternative, EFH would continue as described in subsection 3.10.2.3 with periodic maintenance dredging and dredged material placement for the existing channel.

##### *4.11.2.3.2 Preferred Alternative*

EFH for adult and juvenile brown and white shrimp, red drum, gag grouper, scamp, red, gray, and lane snapper, greater amberjack, king and Spanish mackerel, cobia, and Gulf stone crab occur in the SNWW study area and may include estuarine emergent wetlands, estuarine mud, sand, and sand and shell substrates, SAV, estuarine and offshore water column. Shell substrate in the project area would be dredged with the Preferred Alternative. Open-bay bottom habitat would be impacted by the Preferred Alternative relative to the No-Action Alternative. In addition, Sabine Lake and the GIWW/Lake Charles Deepwater Channel would be impacted in one-time contracts to remove sediment for Willow and Black bayous mitigation measures, causing temporary increases in water column turbidity and removal of benthic fauna.

Initial placement operations would cover benthic organisms with dredged material in the ODMDS sites. Recovery of some benthic organisms would likely occur relatively quickly, although the assemblage in the dredged material might differ from the assemblage that existed at the PA prior to construction. Sheridan (1999) found that recovery of the benthic community would continue for at least 18 months for some parameters and beyond 3 years for others.

With the Preferred Alternative, increased water column turbidity during dredging would be localized and temporary. Teeter et al. (2003) found that the area of high turbidity extended roughly to the edge of the fluid mud flow, or about 1,300 to 1,650 feet from the discharge pipe. Modeling of dredged material discharge in the Laguna Madre determined that turbidity caused by dredging only lasts on the order of weeks to a few months, and therefore impacts to the estuarine and offshore water column would be minimal (Teeter et al., 2003). Material to be dredged is not contaminated and should not pose contamination issues with respect to EFH. Accidental spills have the potential to impact EFH, and larval and juvenile finfish could be affected significantly should a spill occur. Larval and juvenile finfish tend to be more susceptible to spills than adults and could be affected extensively by a spill during their active

immigration periods. Due to their lack of mobility, they are less likely to be able to avoid these areas and could be negatively impacted if a spill were to occur; however, there would be no increase in spill chances because of the larger channel and the fewer vessel trips that are predicted with the Preferred Alternative versus the No-Action Alternative.

The Preferred Alternative would temporarily and locally impact EFH species by turbidity; however, these impacts would be minimal since these species are motile enough to avoid areas of high turbidity. Benthos, as a food source, would be lost at the ODMDS sites until recovery occurs; however, these areas are small relative to the benthic habitat near Sabine Pass and any impacts would be negligible. Restored marsh and improved shallow-water habitat in the proposed mitigation and Neches River BU Feature total 13,053 acres of EFH creation, with 43 percent (5,636 acres) being emergent marsh. Approximately 1,828 acres of open water would be improved as EFH habitat by creating smaller, shallow-water pools and channels in which fetch and turbidity are reduced. In addition, another 5,589 acres of existing marsh within the influence areas targeted for mitigation measures and BU would be nourished by the winnowing of fine-grained sediments during unconfined placement of the dredged material.

The DEIS initiated EFH consultation under the MSFCMA. NMFS provided concurrence with the findings on March 8, 2010 (Appendix A3).

#### 4.11.2.4 Ballast Water

##### *4.11.2.4.1 No-Action Alternative*

Under the No-Action Alternative, ship traffic in the SNWW would increase at rates predicted by the economic analysis.

##### *4.11.2.4.2 Preferred Alternative*

Although ship traffic would increase with the Preferred Alternative, the FWP increase would be less than the predicted growth of ship traffic under the No-Action Alternative, and therefore no additional impacts with respect to ballast water are expected. The economic analysis has determined that the maximum size of vessels using the deepened channel is not expected to increase; rather, vessels would be loaded to deeper drafts to take advantage of the increased depth. Therefore, an increase in the volume of ballast water is not expected. Furthermore, no changes in foreign ports of call are predicted.

#### 4.11.2.5 Recreational and Commercial Fisheries

##### *4.11.2.5.1 No-Action Alternative*

Under the No-Action Alternative, recreational and commercial fisheries would continue as described in subection 3.10.2.4. Additional discussion of impacts associated with normal maintenance dredging activities is discussed in subsection 4.11.2.5.2.

#### *4.11.2.5.2 Preferred Alternative*

Temporary and minor adverse effects from the proposed project and mitigation measures on recreational and commercial fisheries may result from altering or removing productive fishing grounds and interfering with fishing activity. Sheridan (1999) found that sheepshead, spotted seatrout, brown shrimp, pink shrimp (*Litopenaeus duorarum*), white shrimp, and blue crab numbers increased as SAV coverage improved following dredging, with few species collected at the site of the disturbance. Only spot (*Leiostomus xanthurus*), Atlantic croaker, and southern flounder were somewhat more numerous at the dredged material PA. However, the evaluation of effects on the estuarine habitats and fauna and Gulf habitats and fauna of the region (sections 4.10 and 4.12) concluded that no significant impacts to food sources for nekton were likely. Therefore, reductions of nekton standing crops would not be expected from the No-Action or Preferred Alternative. In particular, major species of nekton, including sciaenid fishes and penaeid shrimp, should not suffer any significant losses in standing crop. Recreational and commercial fishing would therefore not be expected to suffer from reductions in the numbers of important species from the Preferred Alternative.

Repeated dredging and placement operations may temporarily reduce the quality of recreational and commercial fisheries in the vicinity of dredging operations. This may result from decreased water quality and increased turbidity during project dredging and mitigation measures, as well as from a loss of attractiveness to game fishing resulting from loss of benthic prey. This condition is not permanent, and the quality of fishing in the vicinity of the channel and PAs should steadily improve after dredging is completed and would likely be similar to existing maintenance dredging, as under the No-Action Alternative. During project dredging and mitigation measures, game fish would leave prime recreational fishing areas for more-favorable, less-turbid locations; however, once dredging is completed, conditions would improve and game fish would return to the area. The additional habitat created by construction in the BU sites should provide additional recreational fishing opportunities. Construction activity in this portion of the channel should not significantly affect overall fishing in the general project area.

The impacts from the Preferred Alternative to both boat and wade-bank fishing would be temporary, potentially resulting in local disturbances, particularly along the edges of the channels. After dredging is completed, these areas should return to predredging conditions. A significant portion of the overall recreational fishing effort in the project area occurs in Sabine Lake and offshore; however, project dredging activities and mitigation measures should not significantly affect overall fishing.

Commercial fishing for shellfish (specifically blue crab) in Sabine Lake is very important; however, no significant long-term impacts are expected for the No-Action or Preferred Alternative.

## 4.12 WILDLIFE

### 4.12.1 No-Action Alternative

Existing dredging activities and placement of dredged material could result in sedimentation and altered hydrology, which could have a temporary, short-term, and localized impact on some species. On larger

temporal scales, the No-Action Alternative would result in no immediate direct impacts to the terrestrial wildlife species or wildlife habitats at or near the proposed study area. However, the combined effects of subsidence, saltwater intrusion, and wetland loss from sea level rise would convert estuarine and coastal habitats and their wildlife communities. These habitat changes are likely to be exacerbated by the effects of global climate change. In the absence of the project and associated marsh restoration projects, the loss of freshwater marsh habitats would likely continue due to RSLR. Salinities would likely increase in estuary tributaries, causing continued conversion of freshwater to brackish marsh, in turn favoring colonization by euryhaline species. Last, a long-term reduction in freshwater inflow to the estuary (since the human population of the state is expected to double during the life of the proposed project) could also result in coastal and estuarine habitat conversion.

## 4.12.2 Preferred Alternative

### 4.12.2.1 Dredging/Construction Activities

Direct effects of the proposed project are those associated with navigation channel improvements, and the placement of dredged material. They include (1) impacts to benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats resulting from dredging to construct navigation improvements, ODMDSs, borrow areas for mitigation measures, and marsh restoration in shallow, open-water areas for BU features and mitigation measures; (2) dredging impacts to bottom-feeding and pelagic organisms such as sea turtles; (3) impacts to marshes and upland habitats from the enlargement of PAs; and (4) impacts to shorebirds and their habitat from the regular placement of maintenance material on the Gulf shoreline.

While dredging activities from the proposed project are unlikely to have a direct impact on terrestrial wildlife species, they may have an indirect impact. Such activities may cause temporary, local impacts to aquatic communities and habitats, including increased turbidity, which in turn may indirectly affect birds in the immediate vicinity by potentially reducing the availability of the food supply. These impacts are local and temporary and are not likely to be significant considering the overall availability of similar habitats in the general area and the mobility of the birds. The slightly increased possibility of accidental spills of oil, chemicals, or other hazardous materials during construction dredging activities also poses a threat to the aquatic community and, thus, the food source of many coastal birds in the area. Accidental spills could adversely affect phytoplankton and zooplankton assemblages, which make up the foundation of the aquatic food chain. While adult shrimp, crabs, and fish are mobile enough to avoid areas of high concentrations of pollutants, larval and juvenile finfish and shellfish are more susceptible to those threats. Any effects would be short term.

The noise of equipment and increased human activity during dredging activities may disturb some local wildlife, particularly birds, especially during the breeding season. Such impacts, however, should be temporary and without significant long-term implications. Salinity effects are unlikely, and most infaunal organisms in the area are relatively tolerant of salinity fluctuations.

Dredging activities for the channel improvement would occur adjacent to many of the rookeries noted in subsection 3.11.2; however, it is unlikely that dredging activities would result in impacts to these

rookeries since no placement would occur in the rookeries and the birds are accustomed to the noise of maintenance dredging.

Dredged material would be used beneficially for marsh creation in the Neches River BU Feature and for shore nourishment in the Gulf Shore BU Feature. Mitigation measures include marsh restoration in the Willow Bayou hydro-unit and in the Black Bayou hydro-unit. In addition, 16 existing and 2 new upland PAs would be used for construction and maintenance of the 48-foot project.

Placement of dredged material at these sites would have similar impacts to the dredging activities in that they would be unlikely to result in direct effects on terrestrial wildlife species but may have indirect effects. Temporary impacts to aquatic communities and habitat from increased sedimentation and turbidity would be expected. This in turn may affect birds and amphibians in the area by potentially reducing the availability of their local food supply temporarily. The impacts may be more noticeable if the sites are located near known bird rookeries. Noise and increased human activities during construction may temporarily affect terrestrial wildlife in areas adjacent to the restoration sites. Construction activities during the placement of material on the beach may temporarily preclude its use by wildlife; however, the duration of the activity would be temporary and the size of the construction area would not be large enough to cause any significant loss of habitat. These impacts would likely be minor and short term. The resultant additional marsh and beach restoration would provide additional habitat for wildlife in the area. Therefore, the proposed activity would not have adverse effects on terrestrial wildlife.

#### 4.12.2.2 Operational Activities

Upon completion of the initial dredging activities associated with the project, few impacts are likely. Maintenance dredging activities would have similar temporary impacts as the initial dredging, but on a much smaller scale and for a shorter term. The number of vessels in the area would not increase or decrease; therefore, the potential for erosion of PAs would not change. The possibility of accidental oil or chemical spills would decrease because of safer navigability. Such spills pose a threat to the aquatic community and, thus, the food source of many coastal birds in the area. Impacts from noise and human activity are unlikely to be a factor.

Construction activities during the placement of dredged material at marsh creation sites and on beaches may temporarily preclude its use by wildlife; however, the duration of the activity would be temporary and the size of the construction area would not be large enough to cause any significant loss of habitat. The resultant additional marsh and beach restoration would provide additional terrestrial habitat for wildlife in the area. Therefore, the proposed activity would not have adverse effects on terrestrial wildlife.

## 4.13 THREATENED AND ENDANGERED SPECIES

A BA for this project has been prepared to fulfill the USACE requirements as outlined under Section 7(c) of the ESA of 1973, as amended, and is included in Appendix G1. The USACE is consulting with the NMFS and USFWS as required by Section 7(a)(2). NMFS issued a Biological Opinion (BO) on a previous similar project alternative. That opinion found that the proposed action was not likely to

jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species (Appendix G2). While the project alternative changed, project-related impacts remained the same, and therefore the BO conclusion would remain the same.

## 4.13.1 No-Action Alternative

The No-Action Alternative would result in no immediate direct impacts to any endangered wildlife species or endangered species habitat at or near the proposed study area. The potential impacts to endangered sea turtles from maintenance dredging are covered by the BO for the USACE's maintenance dredging activities in the Gulf (NOAA, 2003), and therefore are not addressed in this FEIS.

## 4.13.2 Preferred Alternative

### 4.13.2.1 Dredging/Construction Activities

No federally or State-listed plant species are of potential occurrence in Jefferson or Orange counties, Texas, or Cameron or Calcasieu parishes, Louisiana (NDD, 2005a, 2005b, TPWD, 2010; USFWS, 2005c, 2009). Thus, the proposed project would not result in impacts to any threatened or endangered plant species.

The proposed project is unlikely to affect any threatened or endangered terrestrial species. Many are inland species that are not likely to occur in the affected areas, while others are migrants that pass through the region seasonally. Federally listed species likely occurring in the study area at some time of the year include the piping plover. Several threatened and endangered sea turtle species, of potential occurrence in study area waters, could be affected by project construction and maintenance activities. Potential impacts to threatened and endangered terrestrial and marine species have been assessed by the USACE in a BA presented in Appendix G1 of this FEIS.

Dredging activities, which would occur in open water, would not directly affect the wintering piping plover. The greatest potential for impacts to the wintering piping plover would be associated with the placement of dredged materials for shoreline nourishment activities in areas of suitable habitat (the Gulf Shore BU Feature). The USFWS has designated the entire shoreline between Constance Beach and Sabine Pass (Unit LA 1, in part) as critical habitat for the piping plover. Proposed beach nourishment activities at Louisiana Point would occur along approximately 3 miles of this unit, beginning approximately 0.5 mile east of Sabine Pass. Details of the Gulf Shore BU Feature beach nourishment activities are included in Section 4.2 of the BA (Appendix G1). A survey of both the Texas and Louisiana shore nourishment sites was conducted in July 2006 (see Attachment A to the BA). No habitat was found on the Texas side; the current shoreline within the proposed nourishment zone in Texas is an eroding marsh and contains no beach. In Louisiana, several areas suitable for piping plovers were identified. Large tidal sand/mudflats and sandbars located just offshore of Louisiana Point appeared to provide wintering piping plover feeding habitat. In addition, sandy beaches beginning 2 miles from the east jetty contain tidal flats with sparse vegetation suitable for feeding and roosting habitat. Placement of dredged

materials (i.e., Gulf shoreline nourishment) at Texas Point and Louisiana Point would not adversely affect piping plovers or designated Critical Habitat for the wintering piping plover. These impacts of placement activities would be temporary and local in nature. Some birds could be temporarily displaced, but there is sufficient habitat nearby to accommodate them. In general, the BU feature should result in positive effects on the piping plover by increasing the extent of suitable habitat in the study area. On the Louisiana side, where some Critical Habitat exists, additional beach may allow siltation to create some microtopographic relief on the backbeach, providing another primary constituent element for the Critical Habitat. Based on the facts listed above, the proposed project may affect but is not likely to adversely affect the piping plover or its Critical Habitat.

Loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles may be present in study area waters during certain times of the year. Thus, construction and postconstruction maintenance activities could result in impacts to the sea turtles, should they be present in the project area. A pipeline dredge would be used in those reaches of the SNWW inland of the Jetty Channel, and a hopper dredge would be used in the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel. Sea turtles easily avoid pipeline dredges because of the slow movement of the dredge. The potential for incidental take of sea turtles by hopper dredges would be minimized by the use of draghead deflectors. Since new work dredging would require continuous hopper dredging for approximately 6 years, a winter dredging window for construction cannot be accommodated. Maintenance dredging has been conducted during all seasons between 1996 and 2005. Relocation trawling has been used since 2002, when maintenance dredging in the Sabine Bank Channel resulted in the lethal take of two sea turtles (Rob Hauch, pers. communication, 2006). In 2006, maintenance dredging in the Sabine Bank Channel resulted in the lethal take of one Kemp's ridley sea turtle (USACE, 2006c). Apart from direct mortality, dredging activities could have an impact on sea turtles through an increase in sedimentation and turbidity. There have been no reports of sea turtles nesting in the study area. Feeding opportunities within the proposed channel could attract sea turtles, where they might be exposed to additional risks from boat traffic, contaminants, fishing activities, tangled fishing lines, and accumulated plastic detritus, but that is true at the existing channel.

The effects on sea turtles of placing dredged material at the proposed ODMDSs include (1) a collision potential from the vessel; (2) the deposition of dredged material on turtles and forage areas; and (3) the possibility of trash and debris from the dredge operation. Regarding the deposition of dredged material, modeling indicates that most of the dredged material is confined to a relatively small area. Because this is a short-term effect, and considering the mobility of the turtle species and the lack of limestone ledges in the proposed ODMDSs, the sea turtles should easily be able to avoid a descending plume and available food sources should not be seriously reduced (NMFS, 2003). Regarding the vessel and debris possibility, it is the combined effect of many marine activities (e.g., oil spills, oil and gas operations, commercial fishing, marine transportation, etc.) that constitute the hazard and not a single activity such as a dredge operation. These activities, combined with natural predation and development on land, result in a cumulative adverse effect on sea turtles (Rosman, 1987). The Outer Bar Channel would be deepened at the existing width of 800 feet, and the width would quickly taper to 700 feet in the Sabine Bank Channel.

The dredging operation in the existing offshore channels is similar to, but of longer duration than, routine maintenance dredging. The Entrance Channel Extension would begin 18 miles offshore where sea turtles should be more dispersed than nearer the jetties. Only three lethal takes have been observed during maintenance dredging between 1996 and 2006, a period that entailed water temperatures ranging from 49.0 to 89.6°F. Based on the facts listed above, the proposed project may affect and is likely to adversely affect sea turtles. No critical habitat for sea turtles is present within the study area; therefore, the project is unlikely to adversely affect critical habitat.

#### 4.13.2.2 Operational Activities

Upon completion of the initial dredging activities associated with the project, few impacts to endangered species or critical habitats are likely. Maintenance dredging activities would have similar temporary impacts as the initial dredging for recurring but shorter terms. The probability of accidental oil or chemical spills would decrease because there would be fewer vessel trips. Such spills pose a threat to the aquatic community and, thus, the food source for the piping plover. Impacts from noise and human activity are unlikely to be a factor. Maintenance dredging activities for the proposed project are covered by an existing agreement between the NMFS and USACE regarding the taking of sea turtles with hopper dredges, to ensure that significant impacts do not occur (NOAA, 2003).

#### 4.13.2.3 USFWS Coordination and NMFS Biological Opinion

##### *4.13.2.3.1 Piping Plover, Brown Pelican, and Bald Eagle*

Placement of dredged materials (i.e., Gulf shoreline nourishment) at Texas Point and Louisiana Point would not adversely affect wintering populations of piping plovers or designated Critical Habitat for the piping plover. These activities should result in positive effects on the piping plover by increasing the extent of suitable habitat in the study area. On the Louisiana side, where Critical Habitat is designated, additional beach may allow siltation to create some microtopographic relief on the backbeach, providing another primary constituent element of the piping plover Critical Habitat. Based on the information listed above and presented in detail in the BA (Appendix G1), the Preferred Alternative is not likely to adversely affect the piping plover or its Critical Habitat.

The current Preferred Alternative eliminates proposed widening from the Sabine Pass Jetty Channel through the Port Arthur Canal, removes proposed beneficial use of dredged material at Bessie Heights West, and modifies the size and configuration of the Rose City BU feature. However, all other project features remain the same, and effects to threatened and endangered species and Critical Habitat have not changed. The USFWS, in letters dated March 20 and March 22, 2007 (Appendix A2), concurred that the deepening and widening 48-foot alternative was not likely to adversely affect the piping plover or its Critical Habitat. The USFWS Louisiana Field Office stated that no further ESA consultation would be required with its office unless changes are made to the scope or location of the project. Changes to the Preferred Alternative have not affected project impacts; therefore, no change is anticipated to the USFWS's "no effect" determination. The USFWS Clear Lake Field Office letter was silent on the need for further consultation. However, the USACE staff confirmed by telephone that no further ESA

consultation would be required unless changes are made to the scope or location of the project. The Clear Lake Field Office did recommend that steps be taken to determine whether bald eagles are nesting within or near the project area since the number of bald eagles in Texas is increasing. Prior to project construction, the USACE will check with the TPWD and local landowners to determine whether there have been recent bald eagle sightings and determine the need for surveys at that time.

The USFWS provided further guidance in a letter dated February 5, 2010, and recommended that all activity in Louisiana occurring within 2,000 feet of a brown pelican rookery be restricted to the non-nesting period (i.e., September 15 through March 31). However, because nesting periods vary considerably among Louisiana's colonies, it is possible that this activity window could be altered based upon the dynamics of the individual colony. Prior to project construction, the LDWF Fur and Refuge Division will be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies. In Texas, the USFWS recommended all activity occurring within 1,000 feet of a rookery be restricted to the non-nesting season.

#### *4.13.2.3.2 Sea Turtles*

Based on the facts listed above and presented in detail in the BA (Appendix G1), the Preferred Alternative may affect and is likely to adversely affect sea turtles. No Critical Habitat for sea turtles is present within the study area; therefore, the Preferred Alternative would not affect sea turtle Critical Habitat.

A BO, prepared by the NMFS for the previous 48-foot deepening and widening alternative, is presented in Appendix G2. The BO (dated August 13, 2007) concluded that the action, as proposed, was likely to adversely affect but is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, hawksbill, leatherback, or green sea turtles. The effects of the current Preferred Alternative on sea turtles are the same as those previously coordinated, and it is not anticipated that this determination would change. Although some short-term reduction in numbers and reproduction is expected, the anticipated take of sea turtles would not appreciably increase the risk of extinction of these species in the wild. The BO authorizes incidental lethal take of four turtles (three Kemp's ridley and one loggerhead or green sea turtle) during the course of the proposed project's hopper dredging. This estimate is based on the implementation of relocation trawling to prevent additional lethal takes by hopper dredges. Further, this opinion authorizes the per-fiscal-year non-lethal, non-injurious take (minor skin abrasions resulting from trawl capture are considered non-injurious), external flipper-tagging, and taking of tissue samples of 32 sea turtles in any combination, though 7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles would be expected in association with any relocation trawling conducted during the course of the proposed project.

NMFS determined that the following reasonable and prudent measures are necessary and appropriate to minimize impacts of the incidental take of sea turtles during the proposed action. Only incidental takes that occur while the following measures are in full implementation are authorized. For brevity, the reasonable and prudent measures are only summarized below. The reader is referred to the BO in Appendix G of this FEIS for the detailed measures, terms, and conditions.

**Reasonable and Prudent Measures:**

1. **Temperature- and date-based dredging windows**:
   - Hopper dredging activities shall be completed, whenever possible, between December 1 and March 31, when sea turtle abundance is lowest throughout Gulf coastal waters.
   - Pipeline or hydraulic dredges, because they are not known to take turtles, must be used whenever possible between April 1 and November 30.
2. **Observer Requirements**: The USACE shall arrange for the NMFS-approved protected species observers to be aboard the hopper dredges to provide 100 percent monitoring of the hopper bin, screening, and dragheads for sea turtles and their remains between April 1 and November 30, and whenever surface temperature are 52°F or below.
3. **Deflector Dragheads**: A state-of-the-art rigid deflector draghead must be used on all hopper dredges at all times.
4. **Relocation Trawling**: Relocation trawling is required after the take of one sea turtle during the project. In general, it is also recommended as a useful conservation tool. The BO authorizes the per-fiscal-year nonlethal noninjurious take, external flipper-tagging, and taking of tissue samples of 32 sea turtles in any combination, though anticipates 7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles in association with any relocation trawling conducted during hopper dredging.

## 4.14 CULTURAL RESOURCES

### 4.14.1 No-Action Alternative

Under the No-Action Alternative, archeological sites around the margins of eroding marsh areas would increasingly be exposed to the erosive effects of wind, tidal action, and RSLR as marshes convert to water, increasing fetch and erosive potential. Archeological sites along the SNWW navigation channel would continue to be exposed to the erosive forces of boat wakes; this would increase in the future as vessel trips rise to support projected imports under the current lightering requirements. Maintenance dredging of the SNWW would continue, with the potential to affect unidentified shipwrecks in or alongside the existing channel.

### 4.14.2 Preferred Alternative

The proposed CIP would not affect the two properties listed in the NRHP that are located near the project area (the Sabine Pass Lighthouse and the Rainbow Bridge) or the SAL, the USS *Clifton*, nor would it affect the submerged, offshore Sabine River Valley. Although the existing channel and ODMDSs cross the center of the submerged valley, the footprint of the deeper channel and existing ODMDSs would not be enlarged. The channel extension and new ODMDSs are located south of the valley. The Sabine Pass Lighthouse, which is listed in the NRHP, is located in an area that would not be affected by channel improvements to the SNWW. Use of the nearby PA 5 would not limit or remove access to the lighthouse.

All areas that would be impacted by the SNWW CIP have not been assessed for their potential to contain properties eligible for the NRHP in accordance with the National Historic Preservation Act (NHPA). Therefore, the SNWW CIP has the potential to adversely affect eligible historic properties. The USACE has negotiated a Historic Properties Programmatic Agreement (HPPA) under 36 CFR 800.14(b) to govern subsequent investigations, to coordinate surveys of impact areas, to test potentially eligible sites (Table 4.14-1), and to manage data recovery or avoidance measures as necessary. A copy of the signed HPPA is provided in Appendix H of this FEIS.

Table 4.14-1
Terrestrial and Marine Historic Properties Potentially Adversely Affected by the SNWW CIP

| Resource | Location | Eligibility |
|---|---|---|
| Marine | | |
| TB8.1 | Neches River Channel | Potentially Eligible |
| IS4.2 | Neches River Channel | Potentially Eligible |
| IS4.10s | Neches River Channel | Potentially Eligible |
| TB4.1 | Neches River Channel | Potentially Eligible |
| TB4.2 | Neches River Channel | Potentially Eligible |
| TB4.3s | Neches River Channel | Potentially Eligible |
| IS4.6 | Neches River Channel | Potentially Eligible |
| IS4.12s | Neches River Channel | Potentially Eligible |
| IS4.11s | Neches River Channel | Potentially Eligible |
| IS4.8 | Neches River Channel | Potentially Eligible |
| IS4.9s | Neches River Channel | Potentially Eligible |
| IS3.1 | Sabine-Neches Canal | Potentially Eligible |
| IS2.1 | Port Arthur Canal | Potentially Eligible |
| IS2.14s | Port Arthur Canal | Potentially Eligible |
| Terrestrial | | |
| 41JF29 | Neches River | Potentially Eligible |
| 41JF43 | Neches River | Potentially Eligible |
| 41OR10 | Neches River | Potentially Eligible |
| 41OR11 | Neches River | Potentially Eligible |
| 16CM26 | Near LA 2-19B Mitigation Area | Potentially Eligible |
| 16CM86 | Within LA 3-10R Mitigation Area | Potentially Eligible |
| 16CM103 | Near LA 2-18B Mitigation Area | Potentially Eligible |

Additional investigations are anticipated at this time, including survey of the proposed channel extension, areas affected by construction of the DMMP BU features, and areas affected by the construction of mitigation measures. No surveys are recommended for new or existing ODMDSs as placement activities are not expected to adversely impact unrecorded wrecks that may be present, given the depth of water through which the material would settle, the expected depth of burial at the time of placement, and the dispersive nature of the seabed environment in this portion of the Gulf. Impacts to archeological sites in and around the margins of degraded marsh areas proposed as DMMP BU features or as mitigation measures would be avoided to the greatest extent possible. The restoration of currently eroding marsh areas would prevent the further erosion of sites by stabilizing landforms and creating protective marsh buffers.

Costs for additional terrestrial archeological survey and testing, and nautical archeological survey and dive assessments are included in the Engineering and Design cost of the project estimate. Funds for potential archeological data recovery are also included in the project cost estimate as a full Federal cost per Section 7 of PL 93-291. While no specific historic property impacts have been identified at this time, there is a high potential to affect a significant historic shipwreck. The highest potential for historic property data recovery is associated with channel deepening through Sabine Pass, the site of a significant Civil War naval battle. To cover estimated costs for historic property data recovery, funds have been included in the project cost estimate for potential data recovery projects during the construction phase.

## 4.15 SOCIOECONOMIC RESOURCES

### 4.15.1 No-Action Alternative

Under the No-Action Alternative, the study area would continue on its present course of economic development, population growth trends, and residential and industrial development patterns. The demand for community facilities, services, and housing would not increase within the study area since there is low projected population growth. The locations of these resources would generally follow development and land use plans identified by surrounding cities and Hardin, Jefferson, and Orange counties and Cameron and Calcasieu parishes. Because no property is likely to be removed from the tax rolls, the tax base would not be affected. The No-Action Alternative could possibly have a negative effect on the local economy within the study area. Transportation costs and operational inefficiencies with the existing ship channel could possibly change industry trends, thereby changing the number of employed persons.

Under the No-Action Alternative, the counties of Hardin, Jefferson, and Orange in Texas, and Cameron and Calcasieu parishes in Louisiana areas of the proposed project would continue to have slow to moderate population growth and moderately low commercial, residential, and industrial land development (see Section 3.14). The channel areas starting at the Port of Beaumont and continuing to the Gulf would continue to function as a leader in industrial facilities and international commerce in the study area. The ports would also continue to develop their industrial properties but at a slower rate than with the Proposed Alternative. Without the channel deepening, higher transportation costs and operational inefficiencies related to large vessels would continue. As a result, future growth at the ports would likely be slower and less than if the SNWW were improved.

### 4.15.2 Preferred Alternative

#### 4.15.2.1 Population and Social Characteristics (Demographics)

The Preferred Alternative would not likely have an effect on population growth trends within the study area. Population in this area is projected to grow at a low rate. As a result of the Preferred Alternative, demand for community facilities, services, and housing would not increase in the study area. The location of these resources would generally follow development and land use plans currently identified. Most of the construction workers are likely to come from the labor force that is already living within Hardin,

Jefferson, and Orange counties, in Texas, and Cameron and Calcasieu parishes in Louisiana; therefore, immigration to the study area would be small. Over 72 percent of housing within the study area is occupied. Thus it is unlikely there would be an increase in single-family home construction. The projected population growth trend over 60 years for the study area has very little or no increase. Population growth for this area is not expected to change much from present. This alternative would have a minimal effect on the demographics of the study area.

#### 4.15.2.2 Environmental Justice

The population living within the study area is primarily comprised of white persons (59.6 percent), followed by black or African American persons (26.7 percent), and Hispanic or Latino persons (9.6 percent); therefore, the proposed project would not be located within a minority area. Jefferson County consists of the highest minority populations of both African Americans (33.4 percent) and of Hispanic Origin (10.6 percent). In Jefferson County, census tracts 51 and 61 consist of the two highest populations of African American persons at 93.5 and 93.3 percent, respectively. Census tracts 101 and 56 in Jefferson County consist of the highest percentages of Hispanic persons at 45.3 and 41.4 percent, respectively. Both census tracts 51 and 61 in Jefferson County would be considered minority areas. The average median household income for the study area census tracts was $28,884, which is above the Department of Health and Human Services (HHS) 2006 poverty guideline of $20,000 for a family of four (HHS, 2006). The percent of persons living below poverty for the study area was 18.5 percent, which is higher than the State of Texas (15.0 percent), but is not more than 10 percent higher than the percent living below poverty for the Texas counties of Hardin (11.1 percent), Jefferson (16.3 percent), and Orange (13.6 percent), and Cameron Parish (12.2 percent) and Calcasieu Parish (15.0 percent) in Louisiana; therefore, the study area is not considered a low-income area.

The minority and low-income populations living within the study area would likely experience no adverse changes to the demographic, economic, or community cohesion characteristics within their respective neighborhoods as a result of the proposed project. Generally speaking, the populations living within the study area would not likely see any change from the proposed project. Therefore, the Preferred Alternative would not result in disproportionately high and adverse impacts on minority and low-income persons living within the study area.

#### 4.15.2.3 Community Values

The Preferred Alternative would neither divide nor isolate any particular neighborhood nor separate residents from community facilities. It would likely have a negligible effect on population growth trends within the study area, and residential, commercial, and industrial development would likely continue at the same rate. Population in this area is projected to continue with its low growth rate, regardless of the proposed project, and demand for community facilities, services, and housing would continue at a rate that is consistent with the projected population growth. The location of these resources would generally follow development and land use plans identified by local jurisdictions. Therefore, the proposed project would not result in a negative impact to community values.

#### 4.15.2.4 Housing

The Preferred Alternative is not expected to result in a substantial increase in population within the study area. In Calcasieu Parish, 10 percent of total housing is vacant, while in Cameron Parish there is 33 percent vacant housing. Hardin County consists of 10.2 percent vacant housing. Jefferson and Orange counties both have 9 percent vacant housing. Population growth is not expected to increase in the area; therefore, available housing would not affect the proposed project.

#### 4.15.2.5 Economic Characteristics of Area Population

With the Preferred Alternative, as with the No-Action Alternative, the study area would continue to have large industrial facilities of the Neches Channel such as Trinity Industries, ExxonMobile, Mobile Chemical, and North Star Steel located near the Port of Beaumont. Other industries such as Huntsman, Ameripol Synpol/Huntsman, Motiva Enterprises, Air Liquide, and Entergy-Sabine Plant are located just north of Port Neches. The Preferred Alternative would not result in negative impacts to the local economy.

#### 4.15.2.6 Leading Economic Sectors

The "industrial mix" in the study area of manufacturing, port-related, construction, transportation, and public utilities is typically reliant on contract labor. When a project is completed, companies would lay off their workforce until the next contract is awarded. In terms of competition for workers, the port-related, manufacturing, and industrial-related employers of the study area do not have to compete much with other industries because of the higher wages these employers offer over the services, retail, and wholesale trade and government services. Another factor affecting employment among manufacturing and port-related employers is the increased reliance on mechanized means of production. This type of production has a relatively small increase in the number of employees. During project construction, the study area may have a slight increase in construction employment and local purchases of construction materials but would be temporary, if any change at all.

#### 4.15.2.7 Labor Force and Employment

The increase in jobs, economic output, and the tax base would be fairly slow and consistent with historical growth trends. The ports and their associated industries and international commerce currently serve an important role for the study area economy. These industries provide jobs, income, and a tax base for the area, and the effects reverberate within other industries such as housing, retail services, and wholesale trade. The Preferred Alternative would likely promote the development of industrial sites along the ship channel in Hardin, Jefferson, and Orange counties and Cameron Parish. This goal would be consistent with a steady historical trend towards increased reliance on these industries and these types of development within the region.

As previously discussed, the primary economic bases of the study area include petrochemical processing, construction, mineral extraction, tourism, commercial fishing, and agriculture. As a result of the proposed

project, the positive economic effects to the study area economy would be moderate at the least and substantial at best.

#### 4.15.2.8 Personal Income

Within the study area census tracts, tract 16 in Jefferson County had the lowest per capita income ($11,833) and tract 223 in Orange County had the highest ($48,586). Tract 16 is located within Beaumont and would benefit very little, if any at all, from the Preferred Alternative.

#### 4.15.2.9 Oil and Gas Production

SNWW refinery capacity presently represents 6 percent of the U.S. total; furthermore, SNWW's 2002–2006 crude petroleum waterborne imports comprised 12 percent of U.S. and 18 percent of Petroleum Administration Defense District (PADD III) imports (USACE, 2008b).

In addition to existing crude oil and petrochemical product facilities on the SNWW, one LNG facility began operation in 2008, and construction of a second facility is nearing completion; a third has received regulatory approval. It is anticipated that oil and gas production would continue to be a major employer and industry within the study area. The Preferred Alternative would provide the necessary transportation improvements that would continue to support the export of petroleum commodities as well as support predicted crude oil imports.

#### 4.15.2.10 Public Finance

No impacts to public finance are anticipated from the Preferred Alternative.

#### 4.15.2.11 Land Use

All proposed channel improvements for the Preferred Alternative occur in open-water locations (they would not affect any shoreline land uses). The only land use implications for the Preferred Alternative relate to upland PAs and indirect future land development, which may occur as a result of the proposed project.

Approximately 1,900 square miles of the study area includes portions of Jefferson, Hardin, and Orange counties, Texas, and Calcasieu and Cameron parishes, Louisiana. The study area includes nine municipalities: Beaumont, Port Neches, Nederland, Groves, Port Arthur, Bridge City, Vidor, Orange, and West Orange.

The greatest long-term land use consequence of the proposed project would likely be a change in future land uses that would occur in response to the improvements to the channel. These future land uses are not considered part of the proposed project but would be less likely to occur without it. When the Preferred Alternative is complete, the ports would have a deeper ship channel providing an incentive for new industrial development at all of the ports' properties, based on navigation cost savings. Future industrial development may include oil and gas refineries or upgrades, petrochemical plants or upgrades, LNG

plants, and bulk grain facilities. The long-term land use effects of these industrial facilities are largely unknown; however, given recent trends in the area, they would not likely lead to a substantial increase in demand for new housing development, new roads, commercial services, schools, or other services within Hardin, Jefferson, and Orange counties in Texas or Calcasieu and Cameron parishes in Louisiana.

Proposed land uses for the Preferred Alternative were evaluated to determine if they could increase wildlife hazards to aircraft using public use airports in the study area: the Beaumont Municipal Airport, the Southeast Texas Regional Airport, and the Orange County Airport (see figures 3.14-4a–d). All three airports sell Jet-A fuel, and it was therefore assumed that a separation distance of 10,000 feet for any of the hazardous wildlife attractants would apply, in addition to the 5-mile range to protect approach, departure, and circling airspace. Certain land use practices such as waste disposal facilities, water management facilities, gold courses, agricultural cropland, and dredged material placement areas can act as attractants to wildlife that pose a strike hazard. Some natural areas such as wetlands may attract wildlife species that are associated with aircraft strikes.

Project features of the Preferred Alternatives that could serve as attractants are PAs, BU marsh restoration areas, and marsh mitigation areas. None of these project features are located within the separation perimeters for the Beaumont Municipal Airport and the Orange County Airport. None of the BU and mitigation areas are located within separation areas for any of the three airports. However, all or portions of four PAs are located between the 10,000-foot and 5-mile perimeters of the Southeast Texas Regional Airport. All of PA 23/23A and PA 21 are located between the 10,000-foot and 5-mile perimeter; PAs 18 and 24 straddle the 5-mile perimeter. All are existing designated placement areas for the SNWW navigation project. Although they are designated PAs, at times during the dredging cycle they provide habitat for birds and wildlife species that pose a strike hazard. However, no new PAs would be constructed within the separation perimeters, and no change in land use is proposed in conjunction with the Preferred Alternative.

#### 4.15.2.12 Recreation/Tourism

Among sport-related activities, recreational fishing, wildlife watching, and hunting continue to be major parts of the outdoor recreational activities in the study area. Sabine Lake, numerous wetlands, and the Gulf are sources of recreational fishing and wildlife watching. The construction of the Preferred Alternative would have minimal negative effects on recreation within the study area, and the proposed BU and mitigation marsh restoration areas are expected to have beneficial impacts to recreational activities in the area by providing additional habitat. The Neches River BU Feature will create 2,853 acres of emergent marsh, restore 871 acres of shallow-water habitat, and nourish 1,234 acres of existing marsh. Mitigation in Louisiana's Black Bayou and Willow Bayou watersheds would restore 2,783 acres of emergent marsh, 957 acres of shallow-water habitat, and nourish 4,355 acres of existing marsh. The Gulf Shore BU Feature at Texas Point and Louisiana Point would nourish 6.0 miles of Gulf shoreline. All of these locations would provide new habitat for native fish and wildlife species, providing more fishing and wildlife watching for this area, thus enhancing the life for recreational use.

#### 4.15.2.13 Aesthetics

The Preferred Alternative would have a minimal effect on the overall visual quality within the study area. There would be no negative effect to the appearance of the shorelines that are adjacent to the proposed channel improvements except for temporary turbidity. The study area includes a variety of land uses, including residential neighborhoods, commercial or CBD, transportation systems (highways and railways), civic uses, parks, schools, port facilities, and heavy industrial areas. Some regions in the study area already show moderated human development. Generally speaking, the study area is not particularly distinguished in aesthetic quality from other adjacent areas within the region. The landscape exhibits a generally moderate to high level of impact from human development and alteration. The study area is not considered scenic as defined by Federal regulations by view or by roadway.

## 4.16 CUMULATIVE IMPACTS

### 4.16.1 Introduction

The President's Council on Environmental Quality (CEQ) defines cumulative impacts as those impacts "*on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.*" Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. Impacts include both direct effects (caused by an action, occurring at the same time and place as the action) and indirect effects (caused by the action, but removed in distance or later in time, and reasonably foreseeable). Ecological effects are those on natural resources and on the components, structures, and functioning of affected ecosystems, whether direct, indirect, or cumulative.

### 4.16.2 Method and Evaluation Criteria

The SNWW CIP FEIS follows a traditional cumulative assessment method as typically addressed under NEPA. To define the evaluation criteria and provide additional resource input to the USACE, SNND, and other project staff, an ICT comprised of resource agency representatives was established. The ICT, USACE, and SNND defined the cumulative impacts study area and evaluation criteria considered in this cumulative impacts assessment. This assessment is limited to the SNWW project area for the Preferred Alternative as defined in the Affected Environment section.

The ICT defined criteria and a project list of key past, present, and reasonably foreseeable actions. Criteria used to select projects identified as "reasonably foreseeable" for the purpose of this cumulative assessment are as follows:

a) a Congressionally mandated study or project authorized by and specifically included in a Water Resources Development Act within the last 20 years, for which there is a readily available report that documents environmental consequences, or;

b) a current or recently initiated Federal study for which there is a readily available report that documents environmental consequences, or;

c) a specific proposed or permitted, private (non-Federal, non-State, non-local government) Section 404 action or any aggregate of individual private Section 404 actions where the private action or actions required an environmental assessment (EA) or EIS for authorization and for which there is a readily available report that documents environmental consequences of the action or actions(s), or;

d) an existing or updated regional water plan or reservoir operating plan specifically related to the project area.

Projects that qualified as past, present, or reasonably foreseeable include several LNG and pipeline projects, regional water planning efforts, maintenance and operating plans and projects, habitat restoration and protection activities, and port improvements from the Gulf to the Port of Beaumont, along the SNWW. Project impacts are determined from the best publicly available information in existing documents. Not all projects are included in the impacts summary table and/or resource impact discussions because publicly available environmental documentation is insufficient to quantify and compare impacts; however, these project-specific influences may in time have additive impacts or benefits to resources in the area.

Using the above-defined criteria, the ICT defined the following projects as relevant past or present actions or existing conditions:

- SNWW 40-foot Project (maintenance dredging);
- GIWW –Texas Section, Main Channel and Tributaries, Maintenance Dredging;
- GIWW – Louisiana Section, Sabine Lake to Lake Charles;
- Neches River Saltwater Barrier Operating Plan;
- Toledo Bend Reservoir Operating Plan;
- Beneficial Uses of Dredged Material for Marsh Preservation, GIWW Port Arthur to High Island, Texas;
- Salt Bayou – McFaddin Ranch Wetlands Salt Water Control Project;
- SNWW Marine Organism Access between PA No. 11 and Sabine Lake, Texas;
- Several CWPPRA habitat protection and restoration projects;
- Sabine Pass LNG and Pipeline;
- Golden Pass LNG and Pipeline;
- Kinder Morgan Louisiana Pipeline; and
- Jefferson County Drainage District No. 6 (Diversion Channel from South Fork of Taylor Bayou, south to the GIWW).

Additionally, the ICT defined the following projects as reasonably foreseeable future actions:

- Port Arthur LNG and Pipeline;
- East Texas Regional Water (ETRW) Plan (as part of the approved Texas 2007 State Water Plan);
- Port of Beaumont Intermodal Improvements Projects, Northside and Southside;
- Keith Lake Section 1135 CAP;
- Sabine Pass to Galveston Bay Shoreline Erosion Feasibility Study; and
- Toledo Bend Reservoir relicensing.

Ongoing regional activities, initiatives, and programs may also affect local and regional drainage, navigation, flood control, and erosion control in the SNWW project area, but these actions/programs occur outside of the study area and/or effects are not project-related and cannot be quantified in this document. Programs under which such activities and initiatives may occur include the following:

- the GLO's Coastal Management Program (CMP), including "Coastal Texas 2020" (a long-term, statewide initiative to promote Texas coastal environmental and economic health);
- Louisiana's CMP;
- the USACE Galveston District navigation, flood control, and hurricane-flood protection programs, and regulatory efforts to protect wetlands and navigation channels;
- Jefferson County Drainage Districts (other than No. 6); and
- the Trinity Bay Conservation District.

Resource evaluation criteria include biological, ecological, physical, chemical, cultural, and socioeconomic resources for projects within the SNWW study area. The following resource parameters are addressed:

| Physical Environment | Biological Attributes | Socioeconomic Attributes |
|---|---|---|
| Air Quality and Noise | Wetlands | Recreational Facilities/Areas |
| Topography and Bathymetry | Bottomland Habitat | Commercial/Recreational Fisheries |
| Soils | Terrestrial Vegetation | Ship Accidents/Spills |
| Sediment Quality | Submerged Aquatic Vegetation | Oil/Gas Production on Submerged Lands |
| Water Quality | Plankton/Benthos | Cultural Resources |
| Nutrients | Finfish/Shellfish | Public Health |
| Salinity | Mammals | Safety |
| Turbidity | Reptiles/Amphibians | Land Use |
| Contaminants | Threatened and Endangered Sp. | |
| Freshwater Inflow | Essential Fish Habitat | |
| Circulation/Residence | Migratory Birds | |
| Tidal Influence | | |

All impacts in the above categories that can be quantified from existing documents are displayed in Table 4.16-1. If an impact cannot be quantified, a qualification sourced from available documents (i.e., "benefit," "net benefit," No Impact, or Not Applicable) is presented in most instances for comparison. Project descriptions and cumulative impact assessment results follow.

Table 4.16-1
Impact Summary for Past, Present, and Reasonably Foreseeable Projects with Publicly Available Information

| | Past and Present Actions[1] | | | | | | | | | | Reasonably Foreseeable Actions[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Existing SNWW 40-foot Channel** | **Neches River Saltwater Barrier** | **Salt Bayou/ McFaddin Ranch** | **SNWW Marine Organism Access** | **Beneficial Uses: Port Arthur – High Island** | **Sabine Pass LNG and Pipeline** | **Golden Pass LNG and Pipeline** | **Kinder Morgan Louisiana Pipeline** | **Habitat Restoration Projects** | **Taylor Bayou Flood Reduction** | **Port Arthur LNG and Pipeline** | **Proposed SNWW CIP** |
| **Physical Environment** | | | | | | | | | | | | |
| Air Quality | NA | NI | UN | UN | NI | $NO_x$ and CO emissions | NI[2] | $NO_x$ and VOC emissions | NA | NI | NI[2] | $NO_x$ emissions; anticipate SIP conformance |
| Noise | NI | NI | UN | UN | NI | NI | NI[2] | UN | NA | UN | NI | NI |
| Topography, Bathymetry, Soils, Sediment Quality | NI | Net Benefit | NA | NI[2] | Net Benefit | NI[2] | 2.8 ac prime farmland; other impact NI[2] | NI[2] | Benefit emergent marsh acres created | 51,000 ac removed from 100 year floodplain | 1 ac prime farmland loss; other impact NI[2] | NI[2] |
| Water Quality | NI | Net Benefit | Benefit | NI[2] | NI[2] | NI[2] | NI[2] | NI[2] | Benefit | NI | NI[2] | Net Benefit |
| Freshwater Inflow | NI | Net Benefit | NA | UN | NA | NI | UN | NA | NA | NI | UN | NA |
| Circulation, Tides, Salinity | I | UN | NA | Benefit | Benefit | NI | UN | NA | Benefit | NA | UN | Increased salinity, NI[2] |
| **Biological Attributes** | | | | | | | | | | | | |
| Wetlands (permanent loss) | I | 48.4 ac | NA | NI | NI | 79 ac[3] | 173 ac | 0.8 acres | NA | 629 ac of jurisdictional waters directly impacted | 679 ac | 86 ac offset by DMMP; 691 ac NI[2] |
| Wetlands (mitigation) and DMMP restoration | NA | 5 ac (plug) + 8.5 ac (in fee) | NA | NA | NA | 135 ac[3] | 500 ac | 2.53 acres | Restored 3,695 acres emergent marsh | 246 ac preserved; 44 ac created | 583 ac | Mitigation-restores 2,783 ac emergent marsh, nourishes 4,355 ac existing marsh; DMMP creates 2,853 ac emergent marsh |
| Terrestrial Vegetation (conversion and loss) | NI | 60.4 ac | Limited Benefit | UN | NI | 239 ac | 205 ac | NA | NA | Preservation of 1,000+ ac | 972 ac | NI[2] |

Table 4.16-1
Impact Summary for Past, Present, and Reasonably Foreseeable Projects with Publicly Available Information

| | Past and Present Actions[1] | | | | | | | | | | Reasonably Foreseeable Actions[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Existing SNWW 40-foot Channel** | **Neches River Saltwater Barrier** | **Salt Bayou/ McFaddin Ranch** | **SNWW Marine Organism Access** | **Beneficial Uses: Port Arthur – High Island** | **Sabine Pass LNG and Pipeline** | **Golden Pass LNG and Pipeline** | **Kinder Morgan Louisiana Pipeline** | **Habitat Restoration Projects** | **Taylor Bayou Flood Reduction** | **Port Arthur LNG and Pipeline** | **Proposed SNWW CIP** |
| Submerged Aquatic Vegetation | NI | NA | Benefit | UN | Net Benefit | NI[2] | UN | NA | Benefit | NA | UN | Net Benefit |
| Plankton and Benthos | NI | NI[2] | NA | Benefit | Net Benefit | NI | Minimal[2] | NI[2] | Benefit | UN | NI | NI[2] (net benefit) |
| Finfish and Shellfish | NI | NI[2] | NA | Benefit | Net Benefit | NI | NA | NI[2] | Benefit | UN | NI | NI[2] (net benefit) |
| Essential Fish Habitat (permanent) | NI | NA | NA | UN | NI | 55 ac | 6.3 ac | NI[2] | Benefit | NI | NI2 | NI[2] |
| Essential Fish Habitat (mitigation and/or creation) | NA | NA | NA | UN | NA | 28 ac | NA | NA | NA | NI | UN *mitigation plan pending* | 13,053 ac restored/nourished marsh and shallow water |
| Wildlife Habitat | I | NI | Benefit | Benefit | NI | 236.6 ac | 2,007 ac | NI[2] | Benefit | 8,900+ ac protected | 1,497 ac | NI[2] (net benefit) |
| Migratory Birds | NI | Net Benefit | Benefit | UN | NA | NI | Minimal[2] | NI[2] | Benefit | UN | NI[2] | NI[2] (net benefit) |
| Threatened or Endangered Species | NA | NI | NI | NI | NI | NI | Determina-tion pending | NA | NA | NI | NI | Benefit |
| **Socioeconomic Attributes** | | | | | | | | | | | | |
| Land Use Change | NA | Benefit to agriculture | NA | UN | NA | 341 ac | 911 ac | 67 ac | NA | 246 ac converted to protected status; change in land use to flood control for >9,000 ac | 461 ac | May induce industrial development |
| Economy | Benefit | Benefit | UN | UN | NA | Benefit | Benefit | Benefit | NA | Benefit | Benefit | Benefit |
| Recreational Facilities/Areas | NA | Net Benefit | UN | Benefit | Benefit | NI | Minimal[2] (16.1 miles) | Viewshed alteration | Benefit | UN | Minimal to recreational boating | Net Benefit |

Table 4.16-1
Impact Summary for Past, Present, and Reasonably Foreseeable Projects with Publicly Available Information

| | Past and Present Actions[1] | | | | | | | | | | Reasonably Foreseeable Actions[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Existing SNWW 40-foot Channel** | **Neches River Saltwater Barrier** | **Salt Bayou/ McFaddin Ranch** | **SNWW Marine Organism Access** | **Beneficial Uses: Port Arthur – High Island** | **Sabine Pass LNG and Pipeline** | **Golden Pass LNG and Pipeline** | **Kinder Morgan Louisiana Pipeline** | **Habitat Restoration Projects** | **Taylor Bayou Flood Reduction** | **Port Arthur LNG and Pipeline** | **Proposed SNWW CIP** |
| Commercial and Recreational Fisheries | NI | Net Benefit | NI | Benefit | Benefit | NI | NI | NI[2] | Benefit | NA | Minimal | Net Benefit |
| Ship Accidents/Spills | UN | NA | NA | NA | NA | NI[2] | NI[2] | Potential | NA | NA | NI[2] | Net benefit *probability will decline* |
| Oil/Gas Production on Submerged Lands | NA | NA | NA | NA | NA | UN | UN | NI[2] | NA | NA | UN | NA |
| Public Health & Safety | NA | Net Benefit | NA | NI | NI | NI[2] | NI | NI[2] | NI | Benefit | NI[2] | NI[2] |
| Cultural Resources | NI[2] | NI | NI | NI | NI | NI | Determina-tion pending | NI | NI | NI | UN | I[2] |

Benefit or Net Benefit = Results which have an overall positive effect when compared to the FWOP (baseline, existing) conditions of the resource.

NI = no long-term impacts; NA = not available; UN = unavailable; I = impact.

[1] Although not included in the table, several other projects are included in Section 4.16 Cumulative Impacts.

[2] Offset by engineering design, mitigation, data recovery, adaptive management plans/activities based on monitoring, procedures, and project controls.

[3] Includes acreage from permit amendment applications.

### 4.16.3 Past or Present Actions

Petroleum-related industries, most prominently refining and crude oil terminal operations, dominate the area. These and other shipping-dependent industries, alongside commercial and recreational fisheries, agricultural production, and recreation and conservation areas (NWRs, State Parks, State Historic Sites, and WMAs), have influenced this area's land use history, navigation channel development and maintenance, coastal transportation trends, and regional economic and ecological importance to both Texas and Louisiana. The discussion of baseline conditions discussed in Section 3 of this FEIS presents conditions in the study area resulting from these past actions. Past projects considered in this cumulative impacts analysis include the current SNWW 40-foot Project maintenance and other related activities, which may influence or be influenced by natural and socioeconomic resources of the area.

#### 4.16.3.1 Sabine-Neches Waterway 40-foot Channel (past and current condition)

Two of three major area seaports are included in the SNWW project area: Port Arthur and Beaumont. The Ports of Port Arthur and Beaumont rely on a series of artificially widened and/or deepened channels that were dredged from offshore in the Gulf, through Sabine Pass, around the western shore of Sabine Lake, and up the Neches River. Channel and port improvements began in 1885 when Army Engineers completed construction of the east and west jetties (Alperin, 1977). When the jetties produced a channel depth of 25 feet through Sabine Pass, the Kansas City, Pittsburg, and Gulf Railroad and the Port Arthur Channel and Dock Company dredged a 25-foot-deep by 75-foot-wide channel from Sabine Pass to Port Arthur in 1897. Located near the seminal 1901 Spindletop oil discovery, the cities of Beaumont and Port Arthur underwent rapid and substantial growth to accommodate the new petroleum industry. The Port Arthur International Public Port was established in 1899, and a 9-foot-deep canal was dug in the Neches River from the Port Arthur Ship Channel to Beaumont in 1908. The channel was deepened to 25 feet in 1916, and a turning basin was dredged in a bend of the Neches River. By this time, dock facilities had been developed along the Neches River waterfront, creating an inland port for the City of Beaumont. Beaumont's status as a shipping center was heightened in 1922 when the channel was deepened to 30 feet. In the 1940s, the channel was deepened to 36 feet and finally to 40 feet in the 1960s (Alperin, 1977). In 1912, a 25-foot navigation channel was constructed from the mouth of the Neches River, across the northern edge of Sabine Lake, and up the Sabine River to near the city of Orange, Texas. Called the Sabine River Channel, it was deepened to 30 feet in 1922 and remains that depth today. These deep-draft navigation channels are collectively known as the Sabine-Neches Waterway.

The shallow-draft GIWW coincides with portions of the SNWW in the study area. Construction of the GIWW between the Sabine River and Galveston Bay began in 1925. Originally 9 feet deep by 100 feet wide, it was later enlarged to its current dimensions of 12 feet by 125 feet. The segment of the GIWW from the Sabine River eastward 25 miles to the Calcasieu River in Lake Charles, Louisiana, was deepened to 30 feet by local interests and authorized as a Federal project in 1935 (USACE, 1998c). It provided a deepwater navigation channel to the Port of Lake Charles through the SNWW until the 30-foot depth was abandoned upon completion of the deep-draft Channel to Calcasieu in 1941; it is presently maintained at authorized GIWW dimensions of 12 feet by 125 feet.

The existing 40-foot SNWW project is a federally authorized and maintained waterway approximately 77 miles long, located in Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana. Currently, SNWW maintenance dredged material, approximately 8 mcy annually, is placed in 16 upland confined PAs and 4 ODMDSs in the Gulf (see Appendix D). There was no NEPA-process document for construction of the SNWW 40-foot project, which would provide information about impacts related to construction activities; however, the operational and maintenance impacts were addressed in an EIS in 1972. The Ecological Modeling Report (Appendix C) also discusses impacts of the current condition and FWOP. From these two sources, effects for this cumulative impacts analysis include the conversion and loss of wetlands, terrestrial vegetation, SAV, and wildlife habitats from the creation of PAs and saltwater intrusion. Relative to other Past and Present Actions, SNWW 40-foot Project impacts are presented in Table 4.16-1.

#### 4.16.3.2 GIWW – Texas Section, Main Channel and Tributaries

The USACE, Galveston District published "Maintenance Dredging, Gulf Intracoastal Waterway, Texas Section – Main Channel and Tributary Channels" (an EIS) in October 1975. This document identified and evaluated the environmental impacts of continued maintenance dredging of the GIWW Texas Section and tributary channels. The proposed action was continued maintenance by periodic dredging of shoal deposits. The main channel was authorized at a 12-foot depth and a 125-foot bottom width. The typical means of dredging is by hydraulic pipeline dredge, with the exception of the Port Mansfield Channel that can be maintained by either pipeline or hopper dredge. At the time of the 1975 EIS, the environmental impact and adverse environmental effects of the proposed action were addressed based on the best available information (USACE, 1975a, 2004c).

As it leaves Louisiana, the GIWW connects with the SNWW approximately 3 miles below Orange, Texas. The GIWW then follows the Sabine River Channel and the Sabine-Neches Canal to the head of the Port Arthur Canal where it exits the SNWW and continues westward to Galveston Bay. Portions of GIWW Reach I (Sabine River to the Matagorda Ship Channel) and tributaries are within the SNWW project area. Specific impacts for the GIWW segments within the SNWW project area are not distinguishable in existing documents, which present impacts of larger reaches of the GIWW. Potential impact presentation of the entire GIWW in this document would not be comparable to other projects presented here; therefore, GIWW impacts are not included in Table 4.16-1.

#### 4.16.3.3 Neches River Saltwater Barrier Operating Plan

From 1975 through 1997, the USACE, Galveston District, with cooperation from the LNVA, pursued a project to prevent saltwater contamination of surface water supplies while maintaining free and reasonable unobstructed use of the Neches River for existing and future navigation (USACE, 1997a). Temporary steel-sheetpile barriers installed and controlled by the local sponsor at two locations downstream from their freshwater intakes were environmentally and navigationally unacceptable. Environmental impacts were described in a 1975 FEIS and updated in a 1981 Supplement and 1997 EA; however, changes in environmental conditions and requirements necessitated an additional supplement.

The proposed project was revised in 1997 and relocated around river mile 29.7, downstream from the confluence of the Neches River and Pine Island Bayou, adjacent to the Big Thicket National Preserve. Installations and construction in approximately 60.4 acres include:

- an overflow dam with crown width of 300 feet in the Neches River;
- a sector gated 1,260-foot-long navigation bypass channel west of the river;
- a tainter gated 2,700-foot-long barrier structure in a diversion channel west of the navigation channel;
- an access levee road; and
- a service area west of the diversion channel.

Approximately 48.4 acres of the 60.4-acre project area involved vegetation removal and wetlands conversion, primarily in the form of cypress-tupelo swamp and bottomland hardwood habitats. The project identified the following environmental beneficial effects:

- set aside and protect 8.5 acres of cypress-tupelo swamp and additional modified mitigation strategy approved by the USFWS and USACE;
- prevent annual erosion and shoreline loss on the Big Thicket National Preserve;
- create 5 wetland acres around the "plug";
- conserve groundwater; and
- protect an additional 10 miles of river and bayou wetlands from saltwater intrusion and downstream pollutant contamination.

Additional net benefits were found through additional studies (USACE, 1997a): agricultural (primarily rice, cattle, turf grass, and crawfish); recreation (bird-watching, hunting, fishing); industrial (cooling and processing); and municipal uses.

No long-term permanent effects to wildlife, aquatic life, threatened or endangered species, water quality, air quality, noise, floodplains, cultural resources, or prime farmlands were expected (USACE, 2003c). An FEIS supplement was prepared in July 1981. A draft Environmental Assessment (EA), contained in the December 1997 General Reevaluation Report, concluded that the recommended plan would not have significant adverse environmental effects. The final EA was completed in October 1998. Construction of the Saltwater Barrier Project was completed in 2003. Current operational impacts are not known at the time of this document's production; however, impacts from the FEIS and the General Reevaluation Report are included in Table 4.16-1.

#### 4.16.3.4 Salt Bayou – McFaddin Ranch Wetlands Salt Water Control Project

In 1992, the USACE, Galveston District, proposed modification of the GIWW by construction of a water control structure to improve fish and wildlife habitat on 60,000 acres of the wetlands of the McFaddin NWR, Sea Rim State Park, and J.D. Murphree WMA in Jefferson County, Texas (USACE, 1992). Prior

to construction of the GIWW, the SNWW, and the Keith Lake cut, the area contained fresh to brackish marshlands drained by bayous and lakes to Sabine Lake. Disrupted natural drainage patterns and introduced salt water from the Gulf increased salinity in these marshlands causing loss of SAV, erosion, conversion to open water, and reduced wildlife habitat values. Actions to repair these conditions included installation of a concrete water control structure with five gated culverts on the GIWW at Salt Bayou; new channel excavation; training levee construction with stone riprap; and damming the outlet channel. It was determined that this project would have no significant impact on water quality, federally listed threatened or endangered species, National Register eligible properties, or floodplains (USACE, 1992). The project was intended to have a beneficial effect on approximately 60,000 acres of publicly owned wetlands and migratory waterfowl habitat. Although the barrier is functioning as intended, rainwater runoff exiting through the single remaining tidal exchange point at the Keith Lake Fish Pass has been insufficient to block significant saltwater intrusion, and marsh loss is still occurring.

#### 4.16.3.5 Beneficial Uses of Dredged Material for Marsh Preservation, GIWW – Port Arthur to High Island, Texas

In 2003, the USACE Galveston District proposed BU of routine periodic maintenance dredged material along part of the Port Arthur to High Island reach of the GIWW, a 17-mile reach, which crosses the McFaddin NWR and J.D. Murphree WMA in Jefferson County, Texas. For this project, BU included berm creation and restoration along the channel to restrict saltwater intrusion into adjacent freshwater to intermediate marshes. Additionally, dredged material in existing PA No. 4 was allowed to flow over the rear levee into adjoining marsh to offset effects of subsidence. PA No. 4 is located in both the McFaddin NWR and J.D. Murphree WMA; new PAs as a result of this project were located within the McFaddin NWR and consist of narrow discharge corridors along the southern bank of the GIWW (USACE, 2003d). This plan was developed with the USFWS and TPWD, stewards of the NWR and WMA, respectively.

Overall, dredged material discharge impacts to marsh elevation and temporary salinity impacts to vegetation were considered minor relative to preserving and restoring adjacent marshlands. Wildlife disturbance was short term and localized during dredged material discharge operations. It was anticipated that some species of freshwater fish would benefit from the action, and the action would not affect EFH. No federally listed or proposed species were likely to occur at the project site and several State-listed species may have benefited from habitat loss prevention, restoration, and preservation. No historic properties were affected.

The project actions have no significant effect on maritime traffic along this reach of the GIWW. Vehicular traffic to an adjacent hunting lodge was blocked for 1 to 2 weeks, outside of the hunting season, to accommodate the discharge pipe. During dredging, the area immediately around the dredge and pipeline are hazardous (presence of equipment, increase in service boat traffic); however, these impacts to public safety are minor.

The Port Arthur – High Island Beneficial Use of Dredged Material impacts summary is presented in Table 4.16-1 for comparison to the SNWW CIP and other past, present, and reasonably foreseeable projects.

#### 4.16.3.6 Sabine-Neches Waterway: Marine Organism Access between Placement Area No. 11 and Sabine Lake

In 1997, the USACE, Galveston District, proposed relocation of two drop-outlet structures, which allow clarified decanted water to exit PA No. 11 during dredged-material discharge operations. The relocation intended to enhance estuarine connectivity between PA No. 11 and Sabine Lake Estuary System and productivity within PA No. 11, between dredging cycles, by opening PA No. 11 to tidal exchange with Sabine Lake. Additionally, the work included removal of two existing spillways and closure of the connection between the drainage ditches and the Sabine-Neches Canal. The project was determined to have no significant adverse effect on human environment, fish, wildlife, water quality, threatened or endangered species, or historical resources (USACE, 1997b).

#### 4.16.3.7 TxDOT Emergency Action Permit for Fill Along the Sabine River

TxDOT held an emergency permit valid through 2008 to conduct shoreline stabilization activities, as needed. The permit was valid for approximately 9 miles along the east and west shorelines of the Port Arthur Ship Channel, along SH 87 from south of the GIWW to northeast of Keith Lake, and along SH 82 from east of the GIWW to east of Keith Lake, south of Port Arthur in Jefferson County, Texas.

#### 4.16.3.8 Habitat Protection and Restoration Projects

CWPPRA (PL 101-646), also known as the Breaux Act, provides Federal funding through the USACE to five Federal agencies cooperating with local funding-match sponsors to preserve and restore wetlands in Louisiana (LCWCR, 1998). The Breaux Act also established the Coastal Wetlands Conservation Grant Program to help preserve and restore other coastal wetlands with matching Federal funding in the U.S. and to assist programs under the North American Wetlands Conservation Act, passed in 1989. The Breaux Act designates that 70 percent of its authorized funds go to Louisiana restoration projects, 15 percent to the Coastal Wetlands Conservation Grant Program, and 15 percent to North American Wetlands Conservation Act projects. The Breaux Act Louisiana projects typically have a 20-year or less "lifespan" from planning through implementation and monitoring. As of 2004, approximately 129 projects were active from 13 Priority Project Lists (USACE, 2005c). Four recent projects within the SNWW study area were considered for the cumulative impacts assessment. The effects of these projects on land loss were considered in the WVA model analysis of each hydro-unit (Appendix C); they are combined in Table 4.16-1 under "Habitat Restoration Projects" as they are similar in location, type, action, and effect. A brief description of each project included in this analysis follows.

##### *4.16.3.8.1 East Sabine Lake Hydrologic Restoration Project*

The USFWS, NRCS, and LDNR designed and implemented a restoration strategy to prevent elevated salinity in freshwater areas of the western Sabine NWR, from Pool 3 to the eastern shoreline of Sabine Lake in Cameron Parish, Louisiana (LCWCR, 2003). Two construction phases started in 2004 and included shoreline armoring, revegetation, terracing, dike and levee systems, and other water control

structure installations. Project actions are designed to prevent or restore events that affect the integrity and function of freshwater marsh areas in the refuge:

- prevent saltwater intrusion from the SNWW and the GIWW;
- restore natural water circulation;
- prevent rapid freshwater runoff;
- reduce marsh loss and subsidence, and
- reduce potential increased salinity from the Texas Water Plan (Senate Bill 1), the SNWW enlargement project, and the Neches River saltwater barrier north of IH 10.

The East Sabine Lake Hydrologic Restoration project area contains identified EFH for postlarval, juvenile, and subadult life stages of white shrimp, brown shrimp, and red drum (USFWS, 2004). The project area also provides important habitat for a number of economically important fishery species and migratory birds. The protected brown pelican may use the project area for feeding and/or loafing but is not known to nest in this area. The USFWS completed an intraservice Section 7 ESA consultation prior to issuing the Finding of No Significant Impact (FONSI) and Final EA and determined that the project would not adversely affect any threatened or endangered species within or adjacent to the project area. No cultural resources were identified within the work area. Habitat for fishery resources including EFH, migratory and resident waterfowl, wading birds, alligators, game mammals, furbearers, and brown pelican would be enhanced. Water quality and salinity are expected to show continual improvement. The total project effects/benefits include the following:

- 101.4 acres converted from shallow water to marsh, 1.4 acres filled by rock dike, and 163 acres of shallow water deepened for a total of 265.8 acres of shallow water filled or deepened; and
- 127.4 wetland acres protected and restored (USFWS, 2004).

#### *4.16.3.8.2 Black Bayou Hydrologic Restoration Project*

NOAA, NMFS, and LDNR sponsored and implemented a strategy to restore coastal marsh habitat and slow the conversion of wetlands to shallow, open water within a 25,529-acre wetland in Cameron and Calcasieu parishes, Louisiana (LCWCR, 2002a). The project area includes approximately 6,516 acres of fresh/intermediate marsh, 7,353 acres of brackish marsh, and 11,660 acres of open water (LDNR, 2003a). Tidally influenced intermediate and brackish marshes were threatened by saltwater intrusion and wave action amplified by the GIWW. Several actions were implemented:

- 22,600-foot rock dike constructed on the southern spoil bank of the GIWW;
- 70-foot bottom width barge bay weir in Black Bayou Cutoff Canal;
- 10-foot bottom width weirs with boat bays in Burton Canal and Block’s Creek;
- old, collapsed weir replacement with fixed crest steel sheet-pile weir including a self-regulating tidegate; and
- in situ terracing in open-water areas to create elevated marsh and marsh plantings.

Construction activities were completed in December 2001, and marsh planting began in April 2002. Monitoring was conducted in 2003 under a revised plan (LDNR, 2003a). Mean salinity calculated from continuous recorders and discrete data did not show any large differences between project and reference areas or between preconstruction and postconstruction conditions. However, discrete salinities were monitored from June 1999 through March 2004, and data suggest that the impounded hydrologic area 1 was minimally effective in reducing mean salinity and sharp salinity increases compared to the areas outside the influence of the project structures (LDNR, 2007). California bulrush plantings installed in 2002 were variably successful. No significant change in the shoreline location over 3 years was evident from the 2003 data. SAV coverage was very high in most of the ponds sampled in 1999 and remained high in 2003. Dominant species found at both sampling times include Eurasian watermilfoil, southern naiad (*Najas guadalupensis*), and the algae *Nitella* sp. An annual inspection conducted in October 2005 by the LDNR indicated that the project was in good condition and functioning as intended and that features survived Hurricane Rita basically intact (LDNR, 2005a). As of December 2006, an inspection field trip with the LDNR and NMFS detected two small breeches: one on the rock dike along the GIWW and one on a plug along the GIWW. As a result, discussions are underway to develop a plan for corrective actions (LCWCR, 2006). The project created a total of 2,960 acres of wetlands, protected 634 acres for a net total of 3,594 acres; 2,812 AAHUs are expected for this project (LCWCR, 2002a).

#### *4.16.3.8.3 Perry Ridge Shoreline Protection Project*

In February 1999, the NRCS and LDNR completed a limestone riprap dike within a 4.3-mile reach of the GIWW north bank and the Vinton Drainage Canal (LCWCR, 2002b). This dike (12,000 linear feet) is offset from the vegetated shoreline by 60 feet and is designed to break navigation-induced wave action, prevent further shoreline erosion, and reduce salinity spikes by maintaining a freshwater pool behind the rocks. The dike protects approximately 1,203 acres of vegetated shoreline, which, in turn, benefits approximately 5,945 acres of intermediate marsh north of the shoreline. The original monitoring plan was implemented following construction and has been revised in 1998 and 2003 to conform to similar monitoring projects (LDNR, 2003b). Approximately 624 acres of AAHUs are expected (LCWCR, 2002b). Results of the 2005 Operations, Maintenance, and Monitoring Report (LDNR, 2005a) indicate that the average rate of shoreline accretion was 1.6 feet/year at project stations, while reference stations showed a continued rate of shoreline erosion at 0.8 foot/year.

#### *4.16.3.8.4 GIWW – Perry Ridge West Bank Stabilization*

In 2002, the NRCS and LDNR completed installation of approximately 34,652 linear feet of rock riprap and terraces along the northern bank of the GIWW between Perry Ridge and the Sabine River in Calcasieu Parish, Louisiana (LCWCR, 2002c). This section of the GIWW was dredged to allow the use of doublewide barges, and consequently, wake erosion intensified. In addition, the construction of the Calcasieu Ship Channel and the deepening of Sabine Pass have increased salinity and water currents within the GIWW. These activities have caused the GIWW shoreline to breach, thus impacting the interior marsh of the Perry Ridge West Bank project area. The shoreline protection was accomplished in three phases:

- 9,500 feet of rock riprap along the northern bank of the GIWW from Perry Ridge to its intersection with the Sabine River;
- 2,200 feet of rock riprap from the Sabine/GIWW intersection north along the Sabine River; and
- 22,952 linear feet of terraces in the shallow, open-water areas north of the GIWW to reduce fetch (distance a wave can travel) and allow recovery of the interior marshes. Terraces were vegetated with 9,400 trade-gallon-sized plantings of California bulrush.

The net benefit in the 1,132-acre project area would be protection and restoration of approximately 83 wetland acres over 20 years (LCWCR, 2002c). This project (CS-30) is directly west of the Perry Ridge Shoreline Protection Project (CS-24) discussed above. According to the 2005 Operations, Maintenance, and Monitoring Report (LDNR, 2005b), visual observations indicate an increase in the SAV species in the project area and potential for accretion.

#### 4.16.3.9 Sabine Pass LNG and Pipeline Project

The Federal Energy Regulatory Commission (FERC) issued an Order on December 21, 2004, granting approval under Section 3(a) of the Natural Gas Act (NGA) for Sabine Pass LNG, L.P.'s proposal (FERC Docket No. CP04-47-000) to construct and operate Phase I facilities at the LNG import terminal and granting approval under Section 7(c) of the NGA for 16 miles of 42-inch-diameter pipeline and associated facilities (called the Sabine Pass Pipeline). This order was based on, among other analyses, the FEIS, Sabine Pass LNG, and Pipeline Project (Phase I Project FEIS) published in November 2004 (FERC, 2004). Sabine Pass LNG, L.P., has subsequently applied for, and the FERC issued, an EA in May 2006 to expand facilities at the terminal (Phase II) (FERC, 2006a). The Sabine Pass LNG Terminal received its first shipment of LNG in April 2008.

The Sabine Pass LNG import terminal in Cameron Parish, Louisiana, includes the following:

- LNG ship unloading berths;
- LNG transfer, storage, and vaporization;
- packaged natural gas turbine/generator sets;
- ancillary utilities, buildings, and service facilities; and
- a new 16-mile, 42-inch-diameter pipeline system to deliver natural gas to existing pipeline infrastructure (FERC, 2004).

As documented in the FEIS, the Sabine Pass LNG project was expected to affect approximately 540 acres of open land, consisting of coastal prairie and grasslands, wetlands, and a Dredged Material Placement Area (DMPA). Approximately 35 acres were converted to open water, 36 acres were converted from shallow water to deep water, and 341 acres were affected by operational facilities. Construction and operation were anticipated to have minimal effects to geological and soil resources; no prime farmland soils were affected. No significant effects were anticipated to groundwater resources or public or private water supply wells. Surface water impacts included dredging approximately 4.5 mcy from the berth area

and 69,000 cy from the construction dock area. Materials were moved to an unconfined BU area near Louisiana Point. Maintenance dredging is expected to occur every 4 to 7 years. Protective measures would be implemented to minimize impacts to surface waters. Although project actions resulted in temporary decreased water quality during and following dredge placement, potential future dredging benefits may include the following:

- Creation of a wave barrier to decrease wave energy along the shoreline, resulting in decreased shoreline erosion;
- Accretion of shoreline from redeposition of dredged material;
- Increased shallow-water habitat for marine and bird species that use shallow-water areas for foraging;
- Reoxygenation of sediments;
- Increase in wetland vegetation at water/shoreline interface due to increased shallow water and decreased wave energy; and
- Accretion of wetland habitats as high tide or storm events carry sediments into wetland areas

Approximately 156 acres of wetlands were expected to be affected by the LNG terminal development. Permanent wetland impacts included conversion of 17.4 acres of emergent wetland and 30 acres of DMPA to LNG terminal facility and 3.8 acres emergent wetland for a mainline valve on the pipeline. Less than 1 acre of forested wetland was converted to emergent wetland for pipeline operation. Additional wetlands impacts (approximately 27 acres) and mitigation (62 acres) were proposed when the USACE and LDEQ approved a permit amendment for Phase II (USACE, 2006d).

Wetlands in the Sabine Pass LNG and Pipeline project areas are designated as EFH for brown and white shrimp, red drum, and Spanish mackerel. Temporary EFH impacts during construction of the LNG terminal and pipeline totaled approximately 83 acres. Operation of the LNG and pipeline facilities was expected to permanently impact 15 acres of brackish marsh and mudflat wetlands and convert 36 acres of shallow open-water EFH to deep-water habitat. Wetland and EFH mitigation was proposed to enhance or create 73-wetland acres onsite, concurrent with the start of construction.

Of the 12 potentially occurring Federal- and State-listed threatened and endangered species, only the piping plover and brown pelican potentially occurred within the LNG project area. Critical habitat for the piping plover is designated at Louisiana Point, near the BU area for this project. With protective measures, construction and operation of the LNG terminal and pipeline facility were not expected to likely adversely affect either species or designated critical habitat. LNG ship encounters in the open water of the Gulf during transport create potential adverse effects to sperm whales, Kemp's ridley sea turtles, loggerhead sea turtles, green sea turtles, and leatherback sea turtles. As with the terrestrial species, protective measures and reporting procedures minimize these impacts.

At the time of construction, there were no residences within 1 mile of the LNG terminal location, and no residences within 50 feet of the pipeline work areas. No visual impacts were expected. No recreational

facilities were directly impacted by construction or operation. It was anticipated that areas along the LNG ship route and around the terminal slip would be exposed to a potential temporary hazard during ship transit and while at the berth.

No prehistoric or historic cultural resources were located in the area of potential effect at the time of the FEIS publication; however, additional deep-water archeological testing and some remaining testing along the proposed pipeline route were conducted following the issuance of the FEIS. No known archeological sites or historic properties were affected by use of the Louisiana Point BU dredge disposal area. Construction air emissions were expected to be short term without adverse effect to regional air quality. Operational air quality was anticipated to exceed $NO_2$ and CO thresholds and was subject to State air permitting requirements.

The following plans were implemented to minimize impacts to potentially affected resources:

- Upland Erosion Control, Revegetation, and Maintenance Plan;
- Wetland and Waterbody Construction and Mitigation Procedures;
- Spill Prevention, Containment, and Countermeasures Plan;
- Aquatic Resources Mitigation Plan;
- Environmental Construction Plan and Procedures; and
- NOAA Vessel Strike Avoidance and Injured/Dead Protected Species Reporting (Strike Avoidance Policy).

The Sabine Pass LNG and Pipeline impacts summary is presented in Table 4.16-1, in comparison to the SNWW CIP and other past, present, and reasonably foreseeable projects.

#### 4.16.3.10 Golden Pass LNG and Pipeline

In July 2005, FERC authorized (with conditions) Golden Pass LNG Terminal LP and Golden Pass Pipeline LP construction and operation of an LNG receiving and transportation facility northeast of Sabine Pass, Texas, adjacent to the Port Arthur Canal in Jefferson County, Texas (FERC, 2005). The project was designed to import, store, and deliver foreign-source LNG to natural gas markets and includes a marine ship berthing area, LNG storage tanks and vaporization facilities, and a natural gas pipeline. The 122.4-mile natural gas pipeline was completed in April 2009, 1 year ahead of schedule (FERC, 2006b). The pipeline would cross Jefferson, Orange, and Newton counties, Texas, and Calcasieu Parish, Louisiana. Although the facility was expected to open in mid 2009, damage caused by Hurricane Ike pushed the anticipated opening into 2010 (*Wall Street Journal*, 2008).

Measures would be taken to minimize impacts to soil and geological resources. Approximately 2.8 acres of prime farmland would be permanently affected. No impacts are anticipated to groundwater resources. Primary impacts to surface waters would be from construction, including dredging 6.3 mcy for the LNG terminal; this action would create approximately 63.9 acres of open water and convert 43 acres of shallow water to deep water. Maintenance dredging is expected to occur every 2 years and would result in an

average of 410,000 cy per year. Dredged material would be pumped to PA 8 or PA 9, and approximately 1.2 mcy would be beneficially used for wetland restoration in the J.D. Murphree WMA. The proposed pipeline would cross the J.D. Murphree WMA. Approximately 0.5 acre of eroded shoreline would be reclaimed by filling the shallow-water area adjacent to the canal. Pipeline construction would minimize impacts to surface waters in 19 crossings using 31 horizontal directional drills.

It is anticipated that clearing and construction would affect approximately 2,007 acres of palustrine wetlands, estuarine emergent marsh, upland prairie, forest, agriculture and pastureland, and open-water/channel shoreline habitat. Approximately 239 acres of forested uplands and wetlands would be converted to herbaceous cover. Permanent vegetation effects would be approximately 227 acres for the LNG terminal and access road and 712 acres for the pipeline easement, aboveground facilities, and access roads (FERC, 2006b).

Golden Pass would affect approximately 399 wetland acres: 109 acres lost to LNG terminal facility development; 64 acres converted from forested to herbaceous or lost for aboveground facilities and access roads; and 226 acres affected by pipeline construction. Approximately 83 acres of forested wetlands would be cleared for pipeline right-of-way (ROW); of this, 40 acres would be maintained as herbaceous wetland within the ROW and the remaining 43 acres would eventually return to forested wetland areas. Pipeline construction would cross 14.9 miles of the J.D. Murphree WMA and nearly 1 mile of the Sabine Island WMA. The impacts to the forested wetland areas are considered permanent because of the time required for those wetlands to naturally recover to preproject conditions. Three years of invasive species control would be performed along the pipeline route to facilitate native species' success. Routing would minimize wetlands impacts on J.D. Murphree WMA, and directional drilling would minimize impacts to the Sabine Island WMA. Permanent impacts to wetlands would be mitigated through the following actions:

- creation of approximately 244 acres of vegetated wetland within the J.D. Murphree WMA;
- purchase of an 829-acre tract (195.5 acres forested wetlands, 7.6 acres emergent and scrub shrub wetlands, 18.8 acres forested riparian corridor, and 603.2 acres upland mixed-age pine stands) adjacent to the Big Thicket National Preserve; and
- purchase of 50 acres from The Nature Conservancy's Southwest Louisiana Pine Wetland Mitigation Bank to compensate for the forested wetland impacts within the Calcasieu River watershed.

The Golden Pass projects would affect just over six marshland acres designated as EFH for several life stages of red drum, Spanish mackerel, and white and brown shrimp. Deep, open-water EFH may be created by berth and marine basin dredging, providing habitat for some lifestages of some species. Of 15 potentially occurring federally and State-listed threatened and endangered species, the projects may affect only the red-cockaded woodpecker.

Thirty-three residences are within 1 mile of the proposed LNG terminal. Visual and land use impacts would occur in limited areas; however, Golden Pass would implement special construction techniques to

minimize land use impacts to affected residences. The Texas State Historic Preservation Officer (SHPO) has concurred that no historic properties would be affected by the LNG terminal; however, the pipeline system consultation is not complete. Investigations and consultation indicate that buried cultural resources and the viewshed and cultural landscape of historic structures may be affected by the pipeline system.

The following plans would be implemented to minimize impacts to potentially affected resources:

- Spill Prevention, Containment, and Countermeasures Plans;
- Storm Water Pollution Prevention Plan;
- Upland Erosion Control Plan;
- Revegetation and Maintenance Plan;
- Wetland and Waterbody Construction and Mitigation Procedures; and
- Aquatic Resources Mitigation Plan.

The Golden Pass LNG and Pipeline impacts summary is presented in Table 4.16-1, in comparison to the SNWW CIP and other past, present, and reasonably foreseeable projects.

#### 4.16.3.11 Kinder Morgan Louisiana Pipeline

Kinder Morgan Louisiana Pipeline LLC has obtained authorization to construct and operate a 140-mile pipeline system in Cameron, Calcasieu, Jefferson Davis, Acadia, and Evangeline parishes, Louisiana (FERC, 2006a; 2007). The proposed Kinder Morgan Louisiana Pipeline is designed to transport regasified natural gas from the Sabine Pass LNG Terminal to various intrastate and interstate natural gas pipeline systems, delivering a peak day capacity of not less than 3,395,000 decatherms.

The pipeline system would consist of three pipelines and associated pipeline support facilities, including pig launchers and receivers and metering equipment. Leg 1 of the pipeline consists of approximately 130 miles of 42-inch-diameter pipeline originating at a receipt point within the Sabine Pass LNG Terminal and terminating at an interconnection with an existing Columbia Gulf Transmission interstate pipeline in Evangeline Parish, Louisiana. Leg 2 is an approximately 0.4 mile of 36-inch-diameter pipeline originating at a receipt point in the Sabine Pass LNG Terminal and terminating at an interconnection with the existing Natural Gas Pipeline Company of America north of the LNG terminal. The third pipeline originates at the termination point of Leg 1 and would not have impacts within the SNWW study area. Fifteen new lateral pipelines from the proposed pipeline interconnecting sites to existing interstate pipelines are expected to be constructed by separate entities.

The FEIS was issued in April 2007 (FERC, 2007). Specific resource impact information for the Kinder Morgan Louisiana Pipeline is included in Table 4.16-1. The corridor for Leg 1 is located in the SNWW study area; it commences from the Sabine Pass LNG terminal, proceeds north across Sabine Lake, up the Sabine River, and then turns eastward along the GIWW. The corridor in Sabine Lake was designed to avoid impacts to the extensive oyster reefs near Blue Buck Point and does not impact other oyster reef or habitat. Pipeline construction was expected to result in permanent impacts to 0.8 acre of brackish marsh in

the SNWW study area. Compensatory mitigation for these wetland impacts consisted of marsh restoration and preservation through the creation of 5,511 linear feet (2.53 acres) of wave-dampening terraces.

#### 4.16.3.12 Jefferson County Drainage District No. 6 Taylor Bayou Flood Reduction Project

The Jefferson County Drainage District No. 6 (JCDD6) received a Department of Army permit in 2007 to construct flood control improvements to Green Pond Gully, Willow Slough, and Taylor Bayou, southwest of the city of Beaumont, in Jefferson County, Texas (USACE, 2006e, 2007c). Actions will include regional detention and levee construction, channel improvements, and the construction of a diversion channel (known as the Needmore Diversion Channel) from near the confluence of the North and South Forks of Taylor Bayou south to the GIWW. The Green Pond Detention Basin, levee construction, channel modifications, and Needmore Diversion Channel will be undertaken as part of flood reduction measures for the Taylor Bayou watershed. The Green Pond Detention Basin will be a 9,000-acre, aboveground detention facility located between Lawhorn Road, Farm-to-Market Road 365, South China Road, and Gallier Canal, with a maximum storage capacity of 15,000 acre-feet. The Needmore Diversion Channel is a 63,000-foot-long, 14-foot-deep, 200-foot-wide bottom channel within a 1,000-foot-wide ROW extending from near the confluence of the North and South forks of Taylor Bayou to the GIWW. Rectification of several man-made channel restrictions are included along portions of the North Fork of Taylor Bayou at Craigen Road, SH 124, IH 10, between Crystal Lakes, and between IH 10 and Green Pond Gully to restore and improve the flood flow characteristics of the waterway. The project will result in the direct impact to 692.4 acres of jurisdictional wetlands and 337.2 acres of nonjurisdictional low-to-high-quality forested and medium-to-high-quality herbaceous wetlands.

To offset impacts for the project, the JCDD6 has agreed to preserve 538 acres of wetlands adjacent to Spindletop Bayou and an additional 1,926 acres of forested wetlands and uplands within the Green Pond facility. An additional 7,000 acres will have restricted land use to preserve the area from development. A total of 44 acres of wetlands and riparian forest within or adjacent to the Needmore Diversion (40 acres of wetland shelf within the channel and 4 acres of riparian wooded corridor along the east border of the channel from Taylor Bayou south to Willow Slough) will also be created. In total, mitigation will consist of the preservation of approximately 2,464 acres of wetlands and wetland forests and the creation of 44 acres of wetlands and riparian forest to compensate for impacts to approximately 692 acres of jurisdictional waters and wetlands. To ensure that impacts to water quality in Taylor Bayou are minimized, the project design includes a flap gate structure at the Needmore Diversion Channel's south end to eliminate the possibility of saltwater intrusion in periods of reduced freshwater inflows and during storm surge events. In addition, the diversion channel's input from the South Fork of Taylor Bayou will be controlled to take only floodwaters above elevation 5.2 feet mean sea level ensuring that normal flows of Taylor Bayou are not impacted and only severe flood events are reduced in size and duration by the proposed diversion channel. At issuance, all required Federal, State, and/or local authorization or certifications had been obtained except for water quality certification and coastal zone consistency certification. JCDD6 stated that the project is consistent with the Texas CMP goals and policies and would be conducted in a manner consistent with that program and that water quality certification would be obtained from TCEQ.

A historic properties investigation has been conducted within the permit area, and no sites determined eligible for or listed on the NRHP are within the permit area or affected area. No known threatened and/or endangered species or their critical habitats are likely to be adversely affected by the proposed work. The action is not anticipated to have a substantial adverse impact on EFH or federally managed fisheries in the Gulf. Specific resource impact information for the Taylor Bayou Flood Reduction Project is included in Table 4.16-1.

## 4.16.4 Reasonably Foreseeable Future Actions

### 4.16.4.1 Port Arthur LNG and Pipeline

Port Arthur LNG, L.P., and Port Arthur Pipeline, L.P., proposed construction of a new LNG import terminal and pipeline system in Jefferson County, Texas (FERC, 2006c). The facility includes LNG ship unloading berths, LNG storage and vaporization, and a new 73-mile, 36-inch-diameter natural gas pipeline system to deliver the natural gas to existing interstate and intrastate pipeline systems. The project was authorized by FERC in 2006 and would be constructed in two phases over approximately 10 years.

Geological resources would be minimally affected. Erosion control devices and plans would reduce shoreline erosion and flooding effects from storm events. Adverse effects to groundwater and water supplies are not anticipated. Impacts to surface waters would be primarily from the 6.7 mcy of material dredged for the LNG ship berths and turning basin, pumped to an existing DMPA onsite for beneficial reuse. Approximately 82 acres of land would be converted to open water. Fourteen areas would be horizontally directionally drilled to minimize potential adverse water quality effects from the pipeline crossing several major waterbodies.

Clearing and construction would impact 1,497 acres of palustrine, scrub-shrub, and forested wetlands; estuarine emergent marsh; coastal prairie/grasslands; coastal woodlands/upland forests; agriculture and pastureland; disturbed lands; and, open-water/channel shoreline habitats. Operational (permanent) vegetation impacts would include approximately 198 acres for the LNG terminal and 87 acres (forest to herbaceous conversion) for the pipeline. Construction of the proposed LNG facility and pipeline would result in impacts to approximately 391 acres of wetlands, of which 96 acres would be permanent (83 acres for LNG terminal facility and 13 acres for the pipeline). Approximately 13 acres of the pipeline system permanently impacted wetlands would be converted from forested to herbaceous cover. The remaining 295 acres of impacted wetlands would be restored and allowed to revegetate to preconstruction conditions.

The Port Arthur LNG terminal and pipeline projects would affect a total of 456 acres of estuarine and deep-water habitats designated as EFH for several life stages of red drum, Spanish mackerel, white and brown shrimp, and bonnethead shark (*Sphyrna tiburo*). Eighty-two acres of deep, open-water EFH may be created by berth and marine basin dredging, providing habitat for some lifestages of some species. Of 22 potentially occurring Federal- and State-listed threatened and endangered species, the projects are not likely to adversely affect any of these species or their designated critical habitats.

No residences occur within 1 mile of the proposed LNG terminal and three residences occur within 50 feet of the proposed pipeline work area. Land use and visual impacts are likely. Site-specific construction plans would be implemented to minimize effects to these residences during construction. No direct effects are anticipated to the private, State, and Federal recreation and conservation areas in the Louisiana or Texas. CZMP consistency determinations have been issued by Louisiana and Texas. Two cultural sites within the terrestrial portion of the proposed construction area have been assessed as potentially eligible for listing in the NRHP. Additionally, seven magnetic and/or acoustic anomalies have been detected where the pipeline would cross Sabine Lake. Studies and avoidance/mitigation measure planning efforts are in progress.

If unmitigated, direct and indirect emissions during the LNG terminal operation would exceed de minimis air quality conformity thresholds. Mitigation measures would be implemented, preventing increase of emissions with respect to future baseline emissions. Operational risks to public health and safety would be none to minimal, depending on the location and activity. The moving safety zone, moored vessel security zone at the terminal, and one-way traffic areas would affect other commercial and recreational traffic using the SNWW.

The following minimization and protection plans would be implemented to address unavoidable impacts:

- Spill Prevention, Containment, and Countermeasures Plans;
- Storm Water Pollution Prevention Plan;
- Upland Erosion Control Plan;
- Revegetation and Maintenance Plan;
- Wetland and Waterbody Construction and Mitigation Procedures;
- Aquatic Resources Mitigation Plan (primarily for wetlands); and
- LNG Vessel Management and Emergency Plan.

The Port Arthur LNG and Pipeline impacts summary is presented in Table 4.16-1, in comparison to the SNWW CIP and other past, present, and reasonably foreseeable projects.

#### 4.16.4.2 East Texas Regional Water Plan

The 2007 Texas State Water Plan is the eighth water plan developed by TWDB as a part of its core mission to ensure that sufficient, clean, and affordable water supplies are available for the citizens of the State of Texas and that those water supplies foster a healthy economy and environment (TWDB, 2007). The plan was developed from May 2005 to August 2006 and approved in November 2006. The state plan includes participation from 16 regional groups (TWDB, 2007).

The ETRW Planning area includes all or part of 20 counties, from Beaumont, Port Arthur, and Orange counties north to Tyler County, spanning from the Texas-Louisiana border east to the Trinity River Basin boundary. Three surface water river basins (Sabine, Trinity, and Neches) and four aquifers (Gulf Coast,

Carrizo-Wilcox, Sparta, and Queen City) serve the water uses in the region. The Neches-Trinity Coastal Basin and approximately 1 square mile of the Cypress Creek Basin are also partially encompassed in the planning area. The 2006 ETRW Plan that was adopted as part of the 2007 Texas State Water Plan seeks to address a projected 41 percent increase in water demand from 2010 to 2060 through several strategies (TWDB, 2007):

- construction of a new reservoir, Lake Columbia (Eastex) on Mud Creek (tributary of the Angelina River) in Cherokee County, Texas (approximately 187,839 acre-feet);
- negotiated use of adjacent Region C surface water supplies, Toledo Bend Reservoir (existing), and Lake Fastrill (not yet constructed on the Neches River);
- expanded groundwater use based on long-term sustainability;
- municipal conservation through plumbing code implementation and public education to save over 20,600 acre-feet of water annually by 2060;
- City of Athens indirect reuse of wastewater discharge, returning a portion of treated wastewater to Lake Athens, the city's primary water supply; and
- policy recommendations.

The ETRW Plan is consistent with protection of agricultural, public, park, oil, gas, and coal production resources. The development of Lake Columbia and Lake Fastrill may affect several resource classes, including timber, State- and Federal-threatened and/or endangered species, water resources, and others; however, these reservoirs would not be within the SNWW project area. Lake Columbia is anticipated to inundate approximately 10,000 acres. Lake Fastrill would inundate approximately 24,950 acres, including a portion of the proposed USFWS North Neches NWR. Site-specific information to identify wetlands, bottomland hardwoods, ecologically significant stream segments, Sabine-Neches estuary freshwater inflow needs, cultural resources, and prime farmland sites is currently not available. Because specific resource impact information is not available at this time, strategies discussed in the ETRW Plan are not included in Table 4.16-1.

#### 4.16.4.3 Port of Beaumont Intermodal Improvement Projects

Both the Southside and Northside intermodal improvements projects have received funding from the H.R. 3 Transportation Bill. The Southside Project would provide infrastructure modifications and facilities expansion for direct intermodal interchange, transfer, and access for the Port of Beaumont to improve access and operation capabilities. The project would include rail holding tracks and loading ramps, and would increase the port's railcar storage capacity by about 75 percent. Operational efficiency and security would be enhanced by relocating the interchange tracks to expanded facilities at the terminal (Port of Beaumont, 2005a).

The Northside Intermodal Improvements Project would fund development and construction of an access road to connect IH 10 to port-owned property on the north bank of the Neches River. Additional funding was received for a rail infrastructure improvement project under a Federal program designed to promote air quality and congestion reduction (Port of Beaumont, 2005b).

These projects, combined, are expected to:

- Enhance the port's capacity for railcars
- Improve the port's ability to handle military cargo
- Enhance security for military and other cargo
- Increase the efficiency of port operations
- Make downtown riverfront property available for commercial development
- Provide significant growth opportunities for development of the port's northbank property in Orange County, Texas

In addition to projects outlined above, additional Port of Beaumont improvements include:

- A general cargo wharf
- A new dock office
- A new building for the port's military customers
- Repairs of bulkheads and upgrades of lots
- New double layberth for military vessels and new 90,000-square-foot transit shed on the Orange County, Texas, side
- Extend main Harbor Island east wharf with new transit shed on Beaumont side – new 680-foot extension to Harbor Island wharf, and linking railroad tracks on the new wharf to existing tracks. Project is meant to relieve berth congestion at the terminal.

Specific resource impact information is not available at this time; therefore, the Port of Beaumont intermodal improvement projects' potential impacts are not included in Table 4.16-1.

#### 4.16.4.4 Keith Lake Fish Pass Ecosystem Restoration Section 1135 CAP

Keith Lake Fish Pass is located in Jefferson County, Texas, approximately 15 miles south of Port Arthur and intersects SH 87. The pass is approximately 0.3 mile south of the GIWW and on the west bank of the Sabine-Neches Ship Channel south of Port Arthur. The pass connects Keith Lake to the Port Arthur Canal and is part of a drainage system that impacts about 60,000 acres of wetlands (10,000 acres of coastal marsh habitat) in McFaddin NWR, Sea Rim State Park, and J.D. Murphree WMA in the Neches River delta. At 10,000 acres, the Keith Lake watershed contains approximately 8 percent of existing Texas coastal estuarine marshes. Assuming no increase in the rate of marsh loss from the most recent estimates, approximately 3,460 acres (or 35 percent) of brackish marsh in the Keith Lake watershed would be lost during the next 50 years (USACE, 2002).

Area marsh has been adversely affected by saltwater intrusion and high-energy inflows resulting from an obsolete and unrefurbishable 1933 USACE structure and the impacts of the 1974 USDA "water exchange pass" project, now known as the Keith Lake Fish Pass. The pass was created to improve water circulation into the Salt Bayou Drainage system and was a 3,600-foot straight-line canal, 155 feet wide and 5 feet

deep with 2:1 side slopes. Higher-than-expected water volume and velocity have eroded the pass to 240 feet wide and 7 feet deep since 1977. The cut has improved the amount and variety of marine species in the area; however, the marsh system has been degraded by high salinity levels and hydraulic energy impacts from the ship channel.

Emergent coastal wetland habitats and wetland soils loss has been accelerated in Jefferson County, Texas. Open water is formed when salt-intolerant vegetation dies and the underlying organic topsoil material erodes away before the succession of salt-tolerant vegetation can take place. The area is vital nesting and brooding habitat for mottled ducks, with an increasing amount of nesting by fulvous whistling duck (*Dendrocygna bicolor*) and black-bellied whistling ducks (*D. autumnalis*). Several species of migratory birds traveling the Central Flyway use the area as a rest stop or staging area.

Jefferson County, Texas, and USACE, Galveston District, with support from the TPWD, GLO, and TWDB, are studying ways to reduce the amount of saltwater intrusion and decrease high-energy inflows entering the marsh, thus slowing marsh habitat loss. The goal of the study and any recommended conservation measure is to sustain and protect over 60,000 acres of brackish coastal marshes within the Saltwater Bayou Watershed, including approximately 2,600 acres in the Keith Lake system. As yet, undetermined measures must assist in achieving the objective presented in the Salt Bayou Project Joint Management Concept Plan for Sea Rim State Park, McFaddin NWR, and J.D. Murphree WMA (August 1990). The TPWD is developing alternatives and potential impact information for the Keith Lake Fish Pass project is not currently available to include in Table 4.16-1.

#### 4.16.4.5 Sabine Pass to Galveston Bay Shoreline Erosion Project

The purpose of the Sabine Pass to Galveston Bay Shoreline Erosion Feasibility Study is to address the severe shoreline erosion occurring along the upper Gulf Coast of Texas between the SNWW (Sabine Pass) and the Galveston Entrance Channel (Galveston Bay) and the entire Gulf shoreline of Galveston Island (USACE, 2004b). The study area consists of approximately 90 miles of Gulf shoreline in Jefferson, Chambers, and Galveston counties along the upper Texas coast from Sabine Pass to San Luis Pass at the western end of Galveston Island. The major problems identified in the reach to the north of Galveston Bay result from shoreline erosion and include the potential destruction of nationally significant wetlands, loss of land and damage to homes and commercial properties, and significant damage to SH 87. The Sabine Pass to Galveston Bay Shoreline Erosion Project is in the planning stages, and no information regarding potential impacts is available for Table 4.16-1.

#### 4.16.4.6 Toledo Bend Reservoir Relicensing

Toledo Bend Reservoir is located on the Sabine River in Texas and Louisiana and forms a portion of the boundary between the two states. The reservoir is approximately 65 miles long and inundates land in Newton, Sabine, Shelby, and Panola counties, Texas, and Sabine and DeSoto parishes, Louisiana. Toledo Bend Reservoir has 1,200 shoreline miles, normally covers an area of 185,000 acres, and has a controlled storage capacity of 4,477,000 acre-feet. The reservoir was constructed by SRA-TX and Sabine River Authority of Louisiana (SRA-LA) for water supply with secondary uses of hydroelectric power

generation and recreation. On December 12, 2002, the SRA-TX approved an application to TCEQ to amend Certificate of Adjudication No. 05-4658 to include the right to divert 293,300 acre-feet per year of the available portion of the stored Texas water from Toledo Bend Reservoir for multiple use (municipal, industrial, agricultural) (SRA-TX and LNVA, 2006). TCEQ is mandated to consider environmental flows (instream and freshwater needs) during permit evaluations for new reservoirs or amended water rights.

The SRA-TX and SRA-LA have initiated the process to renew the FERC license that allows the generation of hydroelectric power. The current FERC license expires October 14. 2013. The intention of SRA-TX and SRA-LA is to continue current operations as a hydropower peaking unit during the summer months. However, as water supply sales increase, hydropower generation may be reduced.

The Authorities submitted a Notice of Intent to file an application for a new license and request designation as non-Federal representatives in September 2008, and a Proposed Study Plan in July 2009 to FERC (SRA, 2009), but specific resource impact information is not available at this time; therefore, the Toledo Bend Reservoir Operating Plan and potential FERC relicensing potential impacts are not included in Table 4.16-1.

#### 4.16.4.7 Cameron Parish Dredge Project

Cameron Parish Gravity Drainage District #7 proposes to dredge 6,970 feet of Johnson's Bayou to remove debris and sediments deposited during Hurricane Ike. Material would be placed into an upland confined PA. No wetland impacts would occur. Also, preliminary coordination determined no substantial effects, and no effects to EFH and threatened or endangered species, respectively. Information available is minimal, and this project is not included in Table 4.16-1.

#### 4.16.4.8 Taylor Bayou Canal Seven Gate Saltwater Barrier

Located at the existing Taylor Bayou Canal Seven Gate Saltwater Barrier at the intersections of the Taylor Bayou Canal and Taylor Bayou, the SNND proposes to construct four additional saltwater gates. This effort would include 137-x-40-foot pile-supported slap and gate walls, 98 feet of concrete wing wall, 3,000 cy of riprap, 6,500 feet of 8-inch conduit, replacement of the control building (which was destroyed by Hurricane Ike), and 50,000 cy of material acquired from dredging. Impacts would involve 2.3 acres of wetland. Information available is minimal, and this project is not included in Table 4.16-1.

#### 4.16.4.9 Study Area Habitat Protection and Restoration Actions

Four projects are currently planned in the study area that target protection and restoration of wetlands and include the Star Bayou/Rose City Mitigation Bank, and three restoration and enhancement projects at McFaddin NWR.

The Star Bayou/Rose City Mitigation Bank would require dredging of Star Bayou (400-x-200-foot area) to acquire 26,000 cy of material. This material would be used to construct, restore, and enhance wetland areas at part of another ongoing mitigation effort in the Rose City Marsh Complex Habitat Restoration

Area. Although temporary impacts may occur from dredging, the project would result in long-term beneficial effects to wetlands in the study area.

The USFWS proposes to rehabilitate earthen levees and install water control structures at two locations on McFaddin NWR. The first project, Big Hill Unit Restoration, would involve acquisition of 534,000 cy of dredged material for 8,900 feet of levee rehabilitation along Lost Bayou. Also, 400 feet of new levee would be created. Water control structures would be used to manipulate freshwater inflows from Willow Slough, and general aquatic habitat management. Although 0.18 acre of wetlands would be filled through these actions, the overall long-term effect of the project would result in net benefits to the study area wetland complexes.

The second project, Clam Lake Restoration Project, would create a 625-square-foot levee with control structures within wetlands. Material for levees would come from immediately adjacent areas. Although the project would fill 2.94 acres of marsh and excavate another 3.67 acres, project goals include saltwater intrusion protection for 1,500 acres of wetlands within the Wild Cow Bayou Unit, restoration of 248 acres of marsh, and enhancement of 730 acres of wetlands adjacent to 10-mile Cut.

The third project on McFaddin NWR would involve the placement of 12,132 linear feet of graded rock serving as a breakwater structure for protection along an eroded shoreline along the north side of the GIWW. The breakwater would be approximately 25 feet wide at the base, 3.5 feet high in the center, 20 to 40 feet from the existing eroded bank, resulting in 43,570 cy of fill below the mean high tide line. No direct wetland impacts would occur, and the breakwater may have beneficial effects to adjacent wetlands.

Information on these four protection and restoration projects was limited and only included wetland impacts (or indirect effects) that would all be beneficial to study area wetland complexes. No other information regarding potential project effects associated with the cumulative impacts analysis was available, and thus these projects are not included in Table 4.16-1.

#### 4.16.4.10 Sabine Lake Oil and Gas Projects

Eight oil and gas projects are planned for Sabine Lake that would impact regulated waters and include four exploration wells (El Paso E&P Co.), three flowlines (El Paso E&P Co.), and one oil and gas drilling, production, and transportation facility (Shoreline Southeast LLC).

Four exploration wells occurring in Sabine Lake would involve minimal discharge of materials into regulated waters. All four projects combined are anticipated to impact a total of 0.14 acre of bay bottom, and no mitigation is proposed. These projects would not cause long-term detriment to the study area's aquatic resources.

The three proposed flowlines in Sabine Lake are 6-inch diameter and would be jetted into place about 3 feet below mudline. All of these projects combine for a total of 0.43 acre of impacts to bay bottom, and no mitigation is proposed. These projects would not cause long-term detriment to the study areas aquatic resources.

Information on these Sabine Lake oil and gas projects was limited and only included regulated waters impacts. No other information regarding potential project effects associated with the cumulative impacts analysis was available, and thus these projects are not included in Table 4.16-1.

## 4.16.5 Cumulative Impacts Results

The following sections provide discussion of the potential cumulative impacts summarized in Table 4.16-1, which may result from the Preferred Alternative combined with past, present, and reasonably foreseeable actions within the Study Area.

### 4.16.5.1 Ecological and Biological Resources

Ecological and biological resources are expected to experience short-term temporary adverse effects resulting from increased turbidity, disturbed bottom, and placement of dredged material during construction and maintenance operations. Some permanent impacts are expected to wetlands; however, these are to be offset by the benefits of BU features and compensatory mitigation for each project considered in this assessment.

#### *4.16.5.1.1 Wetlands*

All projects considered in this analysis have compensatory measures and/or minimization or mitigation plans to address wetland loss and/or impacts. In total, the restoration activities, purchased-and-protected areas, and created wetlands offset impacts within and adjacent to the project area, resulting in a net gain of wetland acres (approximately 10:1). This net gain is not always type-for-type; conversion of forested wetlands is considered permanent loss given the time it takes to recover mature forested wetlands and the high potential for invasive species colonization. Overall, cumulative impacts to wetlands are not expected to be significant with implementation of the Preferred Alternative's Mitigation Plan.

#### *4.16.5.1.2 Bottomland Forest*

The Preferred Alternative causes no loss of forested wetland acreage (either swamp or bottomland hardwood) throughout the study area. Salinity impacts to the forested wetlands on the Neches River are avoided by DMMP hydrologic and marsh restoration on the river. Salinity impacts to swamps on the Sabine River are related to a minor decrease in the function of the ecological system, as conservatively estimated in the WVA model (Appendix C) by comparison to maximum growth under optimal conditions. The loss in function is considered to be negligible since projected salinity levels are within the tolerance levels of the swamps.

#### *4.16.5.1.3 Terrestrial Vegetation*

Terrestrial vegetation impacts occur on most projects considered in this cumulative impacts assessment. Clearing for construction, ROW maintenance (trimming and mowing), prescribed burning, conversion to open water, and dredged material placement may affect terrestrial vegetation. The conversion of forested areas to herbaceous cover or open land or water is the most significant impact as the time to recover forest

vegetation communities is significantly longer than that to recover herbaceous habitats, without active intervention. Additional impacts stem from the invasion of non-native fast-colonizing species in disturbed areas.

Upland vegetation on any PA would be covered by dredged material deposition; however, this vegetation consists of mostly opportunistic species, which would recolonize easily once the site has been dewatered. Herbaceous cover impacted typically recovers in a reasonable timeframe with the implementation of erosion control measures. Several of the projects considered in this assessment have invasive species monitoring and control measures, forest land impact minimization actions, or net beneficial actions (such as native prairie restoration and prescribed burning or replanting disturbed areas), which can reduce the loss of native terrestrial vegetation.

In the Preferred Alternative, a total of 86 acres of marsh would be converted to upland confined PAs. The loss of biological function and acreage is fully compensated by DMMP restoration plans resulting in a net increase in coastal marsh acreage in the project area. Cumulatively, the SNWW does not contribute to terrestrial vegetation loss or impacts.

#### *4.16.5.1.4 Submerged Aquatic Vegetation*

Physical impacts to SAV may result from projects augmenting marshlands, protecting shoreline, and affecting wetlands. Additionally, increased salinity resulting from the Preferred Alternative and other projects included in this analysis could affect submerged vegetation and related habitats. Marsh restoration and DMMP restorations and nourishment measures offset adverse effects associated with the Preferred Alternative. Additionally, the Preferred Alternative would increase the amount of shallow-water areas and reduce wave action in certain areas, making conditions more conducive to SAV recruitment and growth, effectively resulting in a net increase of SAV in the study area.

#### *4.16.5.1.5 Plankton and Benthos*

Placement of dredged material in offshore placement sites would bury benthic organisms incapable of escaping or burrowing up through the dredged material. Only the dredge projects considered in this document would affect benthic organisms in the study area through this method. Recolonization is expected; however, benthic community structure and abundance may be altered as early successional recovery stages are not necessarily the same as those buried by excavated materials. Additionally, repeated localized dredging in one place may prevent full benthic community development and shift community structure since overall benthic impacts affect a very small percentage of water bottom in the study area. It is possible that the new community would still provide adequate food source for the aquatic community. Excavation would increase turbidity levels and may provide cover benefits to certain organisms. In general, all projects considered in this cumulative impacts assessment have the potential for short-term negative impacts; none of the coverage or turbidity impacts are expected to adversely affect benthic organisms or plankton. Minimization and mitigation measures to restore, enhance, and augment estuarine environments and shorelines would likely provide a net benefit to these organisms.

#### *4.16.5.1.6 Essential Fish Habitat*

The Sabine Pass LNG and Pipeline, Golden Pass LNG and Pipeline, and the Preferred Alternative have the potential to affect EFH through excavation and dredged material placement in open-water PAs. These activities could affect food sources in EFH and increase turbidity. Dredged material associated with these projects that would be placed in open-water sites would not contain contaminants, as determined by the EPA and USACE review and permitting. Additionally, loss of shallow-water habitats from some of the projects' activities considered in this analysis may adversely affect EFH for lifestages of several species; however, the Preferred Alternative's proposed actions would result in a net benefit to EFH through marsh creation and reduced impacts to SAV.

#### *4.16.5.1.7 Threatened and Endangered Species*

Most of the projects included in this assessment are not expected to or did not significantly impact federally listed threatened or endangered species. In general, the species potentially most affected are sea turtles during hopper dredging activities and piping plover during dredged material placement. While turtle mortality is a possibility, the USACE-NMFS sea turtle avoidance and documentation procedures established for hopper dredging activities and applied during all projects using hopper dredges significantly reduce the likelihood of adversely affecting protected sea turtles. In relevant projects' assessment documents, piping plover populations and designated Critical Habitat were determined to not be affected. Food species potential impacts are short term and recoverable, based on all assessments.

### 4.16.5.2 Physical and Chemical Resources

#### *4.16.5.2.1 Air Quality*

Objectionable odors (mercaptan, hydrogen sulfide) may result from construction and maintenance excavation and/or dredging of sediments containing high concentrations of organic matter. Several of the projects in this assessment document that $NO_x$ and CO emissions would occur during dredging and/or excavation equipment activities. These activities are considered temporary and intermittent. Most of the projects considered in this analysis lie within or adjacent to the BPA Ozone 8-hour Nonattainment Zone, which includes Jefferson and Orange counties. All projects within the study area with the potential to affect air quality must conform to the TCEQ SIP. Coordination and compliance with the TCEQ and EPA would result in no significant cumulative impacts to air quality within the study area.

#### *4.16.5.2.2 Noise*

Temporary noise impacts would result from construction and maintenance dredging activities, which would change with location, depending on the section being dredged. It is unlikely that dredging would occur for more than one of the reviewed projects at one time.

#### *4.16.5.2.3 Topography, Bathymetry, Soils, Sediment Quality*

Terrestrial and marine contours would be permanently changed in construction and maintenance dredging projects, but not by most of the LNG and pipeline projects (which state that temporarily impacted project areas would be returned to preconstruction contours). Topography and bathymetry would be cumulatively changed (increased) in upland and offshore PAs as a result of dredged material deposition. Most soil impacts in all projects are considered temporary and/or recoverable given best construction and erosion control practices, including protection measures implemented as a result of stormwater permitting and water quality certification. No significant impacts to sediments or from sediments are expected, except that there may be an increased risk of spill during construction of the reasonably foreseeable projects included in this analysis.

#### *4.16.5.2.4 Water Quality*

For those projects that include dredging activities, dredging and placement operations are expected to temporarily degrade water quality in the project vicinity through increased turbidity and nutrient releases from the sediment. Dredging placement is not expected to affect water quality as much of the construction and maintenance material would be used beneficially and the rest would go into PAs. For the most part, salinity increases for the projects considered in this analysis were negligible, within natural fluctuation ranges, or offset by mitigation or protective measures. Increased ship traffic in the study area could increase the risk of a toxic spill; however, that risk is offset by the increased safety in the channel expected from the widening and deepening of the SNWW. LNG and pipeline projects presented in this analysis would implement water quality control measures (soil erosion prevention and control, spill prevention and response plans, and runoff containment).

#### *4.16.5.2.5 Sediment Quality*

None of the projects reviewed for this assessment are expected to impact sediment quality. For projects where contaminant spills or leaks are a potential adverse effect, prevention and response plans would be implemented. None of the sediment analyses conducted for this project identified cause for concern.

#### *4.16.5.2.6 Shoreline/Bank Erosion*

Shoreline fluctuations along the Gulf, natural waterways, and constructed navigation channels within the study area are ongoing. While some of the erosion and change can be attributed to natural causes, these can be exacerbated by unmitigated wave action, destabilized shoreline, loss of vegetation, and other factors. Such factors are generally a result of increased frequency and size of ship traffic (enhancing wave action), conversion of shallow gradual water – shoreline transition areas to deeper, open water, and upland activities and development, which can increase runoff and erosion. The Preferred Alternative is expected to reduce the number of vessel trips when compared to the number of trips expected with the No-Action Alternative, thus reducing the potential for increased wave action. Some of the habitat restoration projects reviewed are expected to decrease shoreline erosion in small, localized areas.

Additionally, beach and shoreline nourishment as part of projects' mitigation measures, slow the rate of erosion and shoreline loss in specific areas.

#### 4.16.5.3 Cultural and Socioeconomic Resources

##### *4.16.5.3.1 Economy*

All of the channel enhancement, maintenance, LNG, and pipeline projects are expected to have a net benefit to the regional economy.

##### *4.16.5.3.2 Recreational Facilities/Areas*

Although some of the projects considered in this analysis create conditions that contribute to shoreline erosion, vegetation loss, and land use impacts throughout their project areas, many public recreation lands owned by the USFWS (Texas Point NWR, McFaddin NWR), TPWD (Tony Houseman WMA, J.D. Murphree WMA, units of the Lower Neches River WMA), TxDOT, and LDWF (Sabine Island WMA) benefit from many of the mitigation and minimization measures. Cumulative and coordinated wetland enhancement and restoration efforts on public lands, increased access to public waters, and habitat creation contribute to habitats, which support recreational activities (bird watching, hunting, fishing). The Preferred Alternative's DMMP restoration measures and marsh mitigation would result in a net benefit to those recreational areas by creating substantial marsh acreage.

##### *4.16.5.3.3 Commercial and Recreational Fisheries*

None of the projects reviewed would adversely impact commercial or recreational fisheries (see also subsection 4.16.5.1.6, Essential Fish Habitat). The Preferred Alternative DMMP and marsh mitigation measures would provide a long-term net benefit to fisheries by the creation of new nursery areas.

##### *4.16.5.3.4 Ship Accidents/Spills*

The LNG and pipeline projects, in combination with this project's Preferred Alternative, are expected to increase the number of large vessels using the area's navigable waterways (i.e., SNWW, GIWW, Neches River). It is anticipated that the deepening of the SNWW under the Preferred Alternative, in combination with the other dredging and port projects reviewed in this analysis, would have a net benefit on shipping safety; therefore, the potential for accidents and spills is likely to decrease.

##### *4.16.5.3.5 Public Health and Safety*

Most of the LNG and pipeline projects, in addition to this project, increase the potential for large ship traffic in inhabited areas along project area waterways. No adverse impacts are anticipated for these projects, although, small recreational craft traffic and other channel users may experience delays and reduced mobility with increases in ship traffic throughout the project area.

#### *4.16.5.3.6 Cultural Resources*

Activities associated with any of the reviewed projects have the potential to adversely affect unknown cultural resources by altering the integrity of the location, design, setting, materials, construction, or association contributing to a resource's significance (related to National Register eligibility criteria). No known sites on the NRHP would be impacted by projects reviewed in this analysis; however, projects that are eligible under NRHP criteria have been identified and could be affected. Discovery of potentially protected features/sites during construction and maintenance activities would require verification and further coordination with the SHPO.

### 4.16.6 Conclusions

Cumulative impacts from past, existing, and reasonably foreseeable future projects, along with the Preferred Alternative, are not expected to have significant adverse effects within the study area. Many of the projects within the study area are part of the continued port and shipping industry development. Some projects considered in this assessment are beneficial to certain natural resources (predominantly wetlands and the species dependent on them) and add to the diversity and health of publicly held recreation and conservation areas, migratory bird habitats, EFH, and other sensitive coastal resources. Impacts associated with the Preferred Alternative have been fully offset by compensatory mitigation measures. In addition, the Preferred Alternative would have net beneficial effects on wetlands, water quality, and SAV with the construction of extensive BU features on the Neches River and the Gulf shoreline.

# 5.0 MITIGATION PLAN

This chapter discusses the evaluation of mitigation measures for the Preferred Alternative, and presents the Recommended Mitigation Plan that has been developed in consultation with the appropriate resource agencies. Mitigation is necessary because unavoidable impacts to nationally significant intertidal wetlands remain after efforts to minimize impacts were exhausted. Net project impacts and benefits after application of DMMP BU feature benefits, are summarized in Table 5.1-1.

Table 5.1-1
Net Project Impacts and Benefits by Average Annual Habitat Units

| | Bottomland Hardwood | Swamp | Fresh Marsh | Intermediate Marsh | Brackish Marsh | Saline Marsh | Totals |
|---|---|---|---|---|---|---|---|
| Preferred Alternative Impacts (negative AAHUs) | | | | | | | |
| Texas | 0 | –2 | –6 | –8 | –31 | – | –12 |
| Louisiana | 0 | 0 | –8 | –571 | –3 | –7 | –709 |
| Total Project Impacts | 0 | –2 | –96 | –619 | –54 | –2 | –121 |
| Preferred Alternative Benefits (positive AAHUs) | | | | | | | |
| Texas | 0 | 0 | 284 | 433 | 235 | 222 | 1,068 |
| Louisiana | 0 | 0 | 0 | 0 | 0 | 210 | 210 |
| Total Project Benefits | 0 | 0 | 178 | 433 | 235 | 432 | 1,278 |
| Net Project Benefits or Impacts (AAHUs) | 0 | –2 | –6 | –186 | 81 | 390 | –43 |

This chapter is divided into six sections: Section 5.1 summarizes Federal policy and regulatory requirements for mitigation plans, and mitigation objectives that were followed in the plan's development. Section 5.2 provides a brief history of the development and coordination of the Recommended Mitigation Plan, including application of the HS and WVA models. Section 5.3 summarizes FWP impacts of the Preferred Alternative after benefits of the DMMP BU features have been applied. Section 5.4 discusses the evaluation of alternatives for compensatory mitigation, and presents the cost effective/incremental cost analysis (CE/ICA) of mitigation alternatives. Section 5.5 describes the Recommended Mitigation Plan that compensates for unavoidable salinity impacts.

## 5.1 SUMMARY OF PROJECT IMPACTS

Unavoidable indirect impacts of the Preferred Alternative in Louisiana remain after all benefits of the DMMP BU features have been applied. Although the SNWW channel is located primarily in Texas, large indirect impacts may occur due to small increases in salinity levels causing an increase in wetland loss and a decrease in biological productivity in aquatic habitats of both Texas and Louisiana. Remaining impacts in Louisiana may affect approximately 182,000 acres (284 square miles) of tidal, emergent marsh habitats, resulting in a total loss of 1,709 AAHUs (a 1.8 percent loss from the FWOP condition). The important ecological functions of the wetlands in the affected area would decline as increases in salinity levels affect marsh communities, and the fish and wildlife that depend upon this habitat. The slightly

higher salinities may lead to the loss of 691 acres of marsh, associated SAV and shallow-water habitat, as stressed emergent marsh converts to open water. Some direct effects of the Preferred Alternative's navigation improvements were not captured and quantified by the WVA modeling. However, a full impact analysis has been performed for these effects, and they have been determined to be minor and temporary. These impacts include (1) impacts to water quality and benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats resulting from dredging to construct the navigation improvements, the creation of new offshore ODMDSs, the borrow area trench for Willow Bayou mitigation areas, and marsh restoration in shallow, open-water areas; (2) potential dredging impacts to bottom-feeding and pelagic organisms such as sea turtles; and (3) potential impacts to shoreline birds and their habitat from the placement of maintenance material on the Gulf shoreline.

Potential adverse affects to threatened and endangered sea turtles during hopper dredging to construct the Entrance Channel would be addressed by the adoption of reasonable and prudent measures to avoid impacts that are established in the BO for the CIP. No other adverse effects to threatened and endangered species have been identified.

## 5.2 MITIGATION PLANNING

In the evaluation of alternatives for the SNWW CIP, ecological impacts of the Preferred Alternative have been avoided and minimized to the greatest extent practicable, as required by national policy (Section 906(d), WRDA 86), national environmental laws and executive orders, and the USACE regulations (ER 1105-2-100). The results of proposed actions to minimize impacts are presented in detail in Chapter 2. Unavoidable impacts to significant resources that remain are compensated to the extent justified as described below.

### 5.2.1 Compliance with Federal Requirements

Implementation guidance for Section 2036(a) of WRDA 07 (Mitigation for Fish and Wildlife and Wetlands Losses), issued August 31, 2009, requires that the Preferred Alternative contain a specific plan to mitigate fish and wildlife losses since it has been determined that the Preferred Alternative would have unavoidable impacts after benefits of the DMMP BU features are applied. Adverse impacts to ecological resources that are caused by a proposed project must be avoided or minimized to the extent practicable, and remaining unavoidable impacts must be compensated to the extent justified. The Preferred Alternative must contain sufficient mitigation to ensure that the CIP would not have more than a negligible adverse impact on significant ecological resources.

Central to this requirement is the determination of significance, as mitigation is required only for impacts to significant resources. Significance must be based upon the contribution of the resource to the Nation's economy and technical, institutional, and/or public recognition of the value of the resource. Criteria for determining significance include, but are not limited to, scarcity or uniqueness of the resource from a national, regional, State, or local perspective. The USFWS Habitat Stewardship Program has identified estuarine intertidal emergent wetlands as one of three nationally recognized "scarce and vulnerable"

wetland habitats. These are the same sensitive wetland habitats (saline, brackish, intermediate, and fresh marsh) addressed by the Mitigation Plan.

These habitats are also considered significant and vulnerable by the CWPPRA, Public Law 101-646 (Title III) and the North American Waterfowl Management Plan (2004). The Texas Land and Water Resources Conservation Plan (TPWD, 2005e) recognizes the Gulf coastal marshes in Tier One of high priority ecoregions and considers these habitats to be the most threatened of the State's two high diversity ecoregions. Significant marsh habitat on the Lower Neches River and along the Texas Point shoreline have been declared "critical erosion areas" by the Texas Coastwide Erosion Response Plan. Furthermore, coastal marshes in the Louisiana portion of the study area are recognized as threatened and vulnerable by the Louisiana Coast 2050 Plan (LCWCR/WCRA, 1998), the LCA Ecosystem Restoration Study (USACE, 2004a), and the Louisiana Comprehensive Master Plan (LCPRA, 2007; USACE, 2008a).

Although mitigation technically includes avoiding and minimizing project impacts to ecological resources, this chapter focuses on actions that are typically considered compensatory mitigation, i.e., rectifying impacts by restoration, preservation, or maintenance activities during the life of the project, or replacing fish and wildlife resources that have been adversely affected. Replacements are generally made "in-kind," but substitutions, or replacements "out-of-kind," are also acceptable mitigation if they are at least equal in value and significance to the resources lost. The purchase of credits from mitigation banks established by others was considered as an option in providing compensatory mitigation for the Preferred Alternative. Only two existing mitigation banks were identified in the lower Sabine and Neches watersheds. Neither was available for use as the credits from one were sold out and the other was developed for the exclusive use of a State agency.

The WVA model (Appendix C) quantifies impacts to all habitats in the study area and provides a means to establish the appropriate amount of compensating mitigation. Recommended mitigation measures must be justified by CE/ICA, which identifies the least-cost mitigation plan by demonstrating that the value of the last increment of losses prevented, reduced, or replaced is at least equal to the costs of the last added increment.

The USACE regulations (ER 1105-2-100) recognize wetland resources for special consideration in mitigation planning, and these are the type of resources that could suffer long-term impacts from the Preferred Alternative. Impacts to wetlands must be fully mitigated, and projects must meet the goal of no net loss of wetlands. The Mitigation Plan described below fulfills the special requirements for wetlands. These plans also contribute to multiagency regional plans (Louisiana Coast 2050; a TPWD regional management plan for J.D. Murphree WMA, Sea Rim State Park, Texas Point, and McFaddin NWR; and the North American Waterfowl Plan) by restoring and preserving scarce and vulnerable wetlands and wildlife habitat, and using dredged material beneficially to the greatest extent possible.

### 5.2.2 Compensatory Mitigation Objectives and Target

The following objectives were established to evaluate mitigation measures considered for the SNWW CIP. The objectives were developed by the USACE in consultation with the ICT.

- Minimize salinity impacts to the SNWW affected area
- Maximize the use of dredged material in marsh restoration measures
- Meet goal of no net loss of wetlands
- Replace lost habitat quality on a one-to-one basis as measured by AAHUs
- Replace habitats in-kind to the extent practicable
- Mitigate losses in the state where they occur
- Share dredged material from Sabine Pass equally between Louisiana and Texas

These objectives reflected the most significant expected impacts of the CIP, widespread interest in potential beneficial uses of dredged material, the national policy objective to prevent wetland loss, and the USACE requirements to fully compensate for unavoidable project adverse effects. The last objective is related to the fact that the CIP affects resources from two states. While this FEIS evaluates impacts on the SNWW coastal and estuarine system without regard to state boundaries, the mitigation plan complies, to the greatest extent practicable, with the CZMP for each state. Under the Coastal Zone Management Act (CZMA), states with approved coastal management programs have jurisdiction within their coastal boundaries to ensure compliance with their programs. The CZMA and its implementing regulations require that Federal activities comply to the maximum extent practicable with these programs. In Louisiana, the Louisiana State and Local Coastal Resources Management Act functions as the state coastal management program for CZMA purposes. Compensatory mitigation is used to offset any net loss of wetland ecological value after efforts have been made to avoid or minimize impacts. Furthermore, the CWPPRA requires Federal agencies to ensure that maintenance or modification of navigation projects be consistent with the purposes of the restoration plan submitted under CWPPRA. Louisiana has adopted a Coastal Wetlands Conservation Plan under this authority with a goal of no net loss of wetlands in coastal areas of Louisiana as a result of development activities. The proposed SNWW mitigation plan would provide additional compensatory mitigation beyond the total project loss of 843 AAHUs so that impacts in Louisiana would be compensated in that state. There is, however, a significant exception to this requirement. Federal lands are excluded from coverage under the CZMA, and this means that compensatory mitigation for impacts to Federal lands may be developed without regard to state boundaries.

Since the CZMA does not apply to Federal lands, excess Texas BU benefits could be used to compensate for impacts to Federal lands in Louisiana. The only lands affected by this exclusion are located in the Sabine NWR. While the Texas Point and McFaddin NWRs in Texas would also be affected by salinity increases associated with the project, two DMMP BU features (the Neches River and the Gulf Shore BU features) provide benefits that offset all project impacts in Texas (including impacts to both NWRs) and provide excess benefits of 656 AAHUs. The DMMP BU features fulfill Texas's CZMP requirements to

avoid and minimize impacts to the coastal zone, such that no compensatory mitigation for Texas state resources is needed.

Total SNWW project impacts to the Sabine NWR are –340 AAHUs. When these are removed from the total project impacts in Louisiana (–1,499 AAHUs), the mitigation target proposed for compliance with Louisiana's CZMP is –1,159 AAHUs. Table 5.1-2 illustrates this calculation. Since all mitigation measures for the SNWW would be located in Louisiana, the new mitigation target would compensate for total project losses of –843 AAHUs by providing 1,159 AAHUs of compensatory mitigation.

Table 5.1-2
FWP Compensatory Mitigation Target for Louisiana

| Units (AAHUs) | Texas | Louisiana | Project |
|---|---|---|---|
| **Net FWP Benefits/Impacts** | | | |
| Total Impacts (negative) | –12 | –709 | –121 |
| Total BU Benefits (positive) | 1,068 | 210 | 1,278 |
| Net FWP Benefits (positive) or Impacts (negative) | 656 | –499 | –43 |
| **Excess Texas Benefits Applied to Federal Lands** (Louisiana) | | | |
| Excess Texas Benefits | 656 | | |
| Sabine National Wildlife Refuge Impacts | –40 | | |
| Net Excess Texas Benefits | 316 | | |
| **Compensatory Mitigation Target** | | | |
| Net Impacts by State and Project | | –499 | –43 |
| Federal Impacts Compensated with Texas Excess Benefits | | 340 | |
| FWP Compensatory Mitigation Target | | –159 | –43 |

## 5.3 RESOURCE AGENCY COORDINATION OF THE RECOMMENDED MITIGATION PLAN

Since the primary environmental concerns are the interrelated issues of saltwater intrusion, marsh loss, and destruction of wildlife habitat and fishery nursery areas, the ICT formed two workgroups to oversee the development and application of models used to evaluate salinity changes and ecological effects of the CIP. The MW participated in the development and review of the HS model, and the HW participated in the selection and application of the ecological model. Both models played an integral role in the development of FWOP and FWP conditions and were used to compare the effectiveness of restoration and mitigation measures.

Any ICT agency interested in participating was invited to attend these workshop meetings. Representatives from the following agencies participated in one or both of the workgroups:

- USFWS Clear Lake (Texas) Field Office
- USFWS – Louisiana Field Office
- USFWS – Chenier Plain NWR complex
- USFWS – Sabine NWR

- NMFS – Galveston, Texas
- NMFS – Baton Rouge, Louisiana
- EPA Region 6
- GLO
- TWDB
- TPWD
- TPWD – J.D. Murphree WMA
- LDNR
- LDWF
- SRA-TX
- USACE (Galveston District and ERDC-CHL)

Concerns that a deeper navigation channel would bring higher salinity in the Sabine Lake estuarine system were addressed with a 3-dimensional HS model that predicts changes in salinity, circulation, and water elevation due to proposed channel improvements. The modeling was performed by the ERDC's CHL worked closely with the MW to calibrate and verify the base model for initial modeling. The modeling was revised in 2009 to incorporate changes resulting from external and USACE reviews. The MW reviewed the ERDC's model calibration and verification process, and the revised modeling results.

The SNWW ICT established the HW to apply the WVA model; representatives from 14 agencies regularly attended and agreed upon data used as inputs for the model. Over 30 ICT and workgroup meetings were conducted from 2001 to 2006, and one meeting was held in 2009. The USFWS-Louisiana Ecological Field Office provided assistance to ensure that WVA methodology (USFWS, 2002b) was followed properly and that WVA model Excel worksheets were being used appropriately. The USACE conducted an in-house quality check for worksheet accuracy. In 2009, changes in the proposed project and HS modeling necessitated that the WVA modeling be revised. Due to schedule constraints, the USACE performed the modeling without ICT involvement, basing it as closely as possible on methods and assumptions used by the ICT in the original modeling. The results of this remodeling were coordinated with the ICT. A quality check was also performed for the revised worksheets.

## 5.4 EVALUATION OF ECOLOGICAL MITIGATION MEASURES

### 5.4.1 Preliminary Screening of Alternatives

A large number of potential mitigation measures were evaluated, but the majority were eliminated during preliminary screening. Measures were generally of two types: measures to reduce or avoid salinity intrusion and measures to restore or protect habitat. Salinity effects for large-scale measures affecting the estuary as a whole were evaluated with the HS model; a desktop model was developed for alternatives affecting smaller, localized drainages (Brown and Stokes, 2009). Ecological benefits were evaluated for most of the measures using the WVA model; some were eliminated early in the process because they

were not feasible or implementable. Screening-level costs were based upon conceptual designs and costs for similar structures that had been constructed recently by the USFWS. Final costs were only developed for mitigation measures ultimately included in the Mitigation Plan.

#### 5.4.1.1 Measures to Reduce Salinity Intrusion

Since impacts of the Preferred Alternative would be related primarily to salinity increases associated with a deeper SNWW navigation channel, extensive efforts were made to identify mitigation measures that could minimize or eliminate the projected increase in salinity intrusion. Measures were formulated that affected the estuary as a whole, or smaller, localized areas within specific wetlands.

**Sabine Pass Lock and Dam**

The construction of a lock and dam at Sabine Pass was considered to address increases in saltwater intrusion from the proposed deepening and widening of the SNWW. The lock and dam were not considered to be a project alternative because the structures would not improve navigation efficiency, but it was believed they could minimize salinity impacts. The existing SNWW navigation channel through Sabine Pass is 40 feet deep and 500 feet wide. Large ocean-going petroleum and chemical product tankers regularly transit the waterway. Placing a lock in the channel would create new transit delays as discussed below.

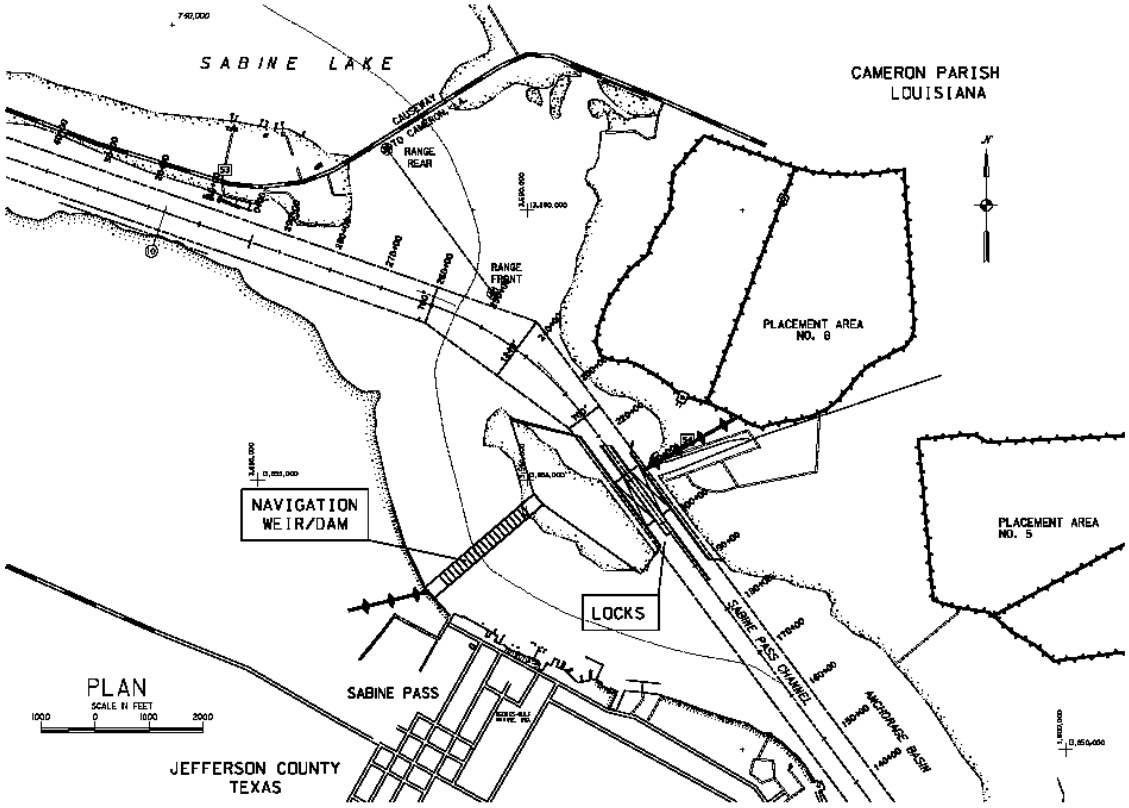
The structures anticipated for salinity control would consist of two navigation locks within the current SNWW navigation channel. Figure 5.4-1 presents a conceptual drawing of the lock and dam alternative. A connecting levee would be required from the east lock wall to the Louisiana side of the pass, and a dam would be required to close the old river channel on the Texas side. This dam would be constructed from the cutoff island to the Texas shoreline immediately upstream of the City of Sabine Pass. It would consist of a reinforced concrete sill positioned at elevation –25 feet mean low tide (MLT), with a set of tainter gates. The tainter gates would be closed under normal conditions, but would open to allow the discharge of upstream floodwaters. A levee would also be required to connect the west end of the dam to higher ground.

The lock and dam would prevent continuous saltwater intrusion from the Gulf by blocking the deeper navigation channel and old river channel, while allowing two-way ship traffic and periodic discharges of upstream floodwaters. The lock and dam structure would create a pool behind the structures with a 3- to 5-foot increase in water elevations over current conditions. The pool is necessary to create the hydraulic head pressures required for the lock to function properly.

There are significant engineering challenges to be met in designing the large locks required to accommodate the large ships, which would use the proposed CIP. The width and depth of the lock chamber would be larger than any other known lock constructed in the U.S., and therefore additional research and data would be needed in order to design and construct the large lock gates and machinery.

**FIGURE 5.4-1**

**CONCEPTUAL DESIGN OF LOCK-DAM STRUCTURE**



With respect to impacts on navigation, the locks would not have a direct effect on the deepening benefits of the proposed project, but would significantly reduce the navigational efficiency of the existing or proposed channel. A preliminary economic analysis estimated that annual delay costs for both inbound and outbound trips would be approximately $7 million. This estimate did not include queuing effects. In reality, slowdowns due to the locks would generate additional delays and queues would form. The vessel delay and personnel cost would need to be treated as added costs for the lock feature. The delays associated with a lock would lead to additional cost and result in a loss of business for the ports of Port Arthur and Beaumont.

From an environmental standpoint, the proposed lock and dam would have both positive and negative environmental impacts on the region. On the positive side, the lock would significantly reduce saltwater intrusion through Sabine Pass into the upriver wetlands systems. Such reduction in saltwater intrusion would ameliorate degradation caused by current saltwater intrusion and permit slow reestablishment of some of the former fluvial freshwater wetlands that existed prior to initial channelization of the river. These freshwater wetlands would likely support increased freshwater sports fishing opportunities, waterfowl, and perhaps some cypress-tupelo swamp acreage.

However, the proposed lock and dam would produce negative environmental impacts as well. Reducing saltwater inputs upstream and flooding existing marshes would significantly decrease productivity of the existing saline and brackish marshes, as the obligate higher-salinity marsh plants are gradually lost in the freshwater conditions. In addition, even before significant loss of marshes upstream of the lock, many largely marine species would be physically precluded from reaching the nursery marsh areas by the lock. Therefore, many commercial, sportfish, and shellfish species would likely decrease in abundance.

The lock alternative was eliminated from further consideration on the basis of navigation economics, environmental, and cost factors. The lock alternative would reduce navigation benefits and result in higher vessel transportation costs. Environmental benefits associated with control salinity intrusion would be partially offset by significant impacts associated with restricting ingress/egress of marine organisms. Finally, significant engineering challenges associated with construction of such a large structure would result in high costs, estimated in excess of $2 billion.

**Sabine Lake Sill**

Three versions of a sill or weir at the mouth of Sabine Lake were modeled with the HS model (Brown and Stokes, 2009): a submerged sill at –10 feet MLT; a stepped, submerged sill ranging from –2.5 feet MLT at the shore to a –10-foot MLT boat bay in the center; and an emergent sill with a –10-foot MLT boat bay in the center of the channel. This alternative was eliminated from further consideration when modeling determined that a sill provided little, if any, salinity mitigation, except for some reduction in salinity at the southwest end of Sabine Lake. This is likely because the principal pathway for salinity transport into the system is via the Sabine-Neches Canal at the northwest corner of Sabine Lake. In addition, the more restrictive versions created unacceptably high velocities through the mouth of Sabine Lake and unacceptably high water elevations in the southern part of Sabine Lake during flood events.

**Structural Water Control**

Nineteen various water-control structures were proposed to control salinity intrusion into the marshes east of Sabine Lake and west of Sabine Pass (see Appendix C). The ERDC developed desktop models to evaluate changes in salinity achieved by these structures (Brown and Stokes, 2009), and the WVA model was applied to evaluate their ecological benefits. Various combinations of a sheet pile wall, a large rock weir, earthen plugs, and channel fill were evaluated for Texas Bayou in the Texas Point NWR. Large, adjustable salinity control structures and large rock weirs were evaluated for Willow Bayou, Three Bayou, Black Bayou, Greens Bayou, and the Right Prong of Black Bayou. Smaller rock weirs and low rock liners were assessed for numerous smaller channels in the Willow Bayou and Black Bayou hydro-units. Earthen plugs in logging canals and submerged pipeline ROWs were suggested as a means of reducing salinities within swamps at Blue Elbow and the Sabine Island WMA. NMFS was concerned that proposed water control structures could adversely affect EFH and other aquatic resources by blocking or reducing marine fishery access to the Louisiana marshes east of Sabine Lake. It is possible that structures could cause salinities to be higher in managed areas during droughts or after storm surges. Ultimately, all of the proposed water control structures were eliminated from further consideration when WVA modeling yielded net negative benefits (i.e., impacts). Salinity reductions were generally modest and could not overcome the adverse effects of restrictions to marine organism access.

**Ensuring Freshwater Inflow**

Purchasing freshwater flows from both the SRA-TX and LNVA was investigated as a potential mitigation measure. Contracts could be negotiated for the 50-year period of analysis that require annual payments for a specific volume of flow, which was determined with the HS model. The alternative was eliminated from further consideration because there is no guarantee that the mitigation flow would be available when it is needed most—during periods of low flows or drought, when the incremental salinity increase associated with the deeper navigation channel would have its greatest adverse effect. The new allocation would be subordinate to preexisting water rights and subject to changes in priorities by State water plans. Ultimately, there is no guarantee that sufficient flows, although contracted and paid for annually, would be provided at the expense of human needs.

**Marsh Creation**

Several measures were considered in which marshes would be used to constrict flows and thereby reduce salinity intrusion from the navigation channel. Marsh creation was evaluated for the following locations: (1) upstream and downstream of the mouth of Sabine Lake, (2) a specific shoreline reach of the Port Arthur Canal, (3) an eroded area at the head of the west jetty, (4) eroding islands between the Sabine-Neches Canal and the northwest corner of Sabine Lake, and (5) the mouths of channels draining Rose City and Bessie Heights. Some of these alternatives were eliminated from further consideration when HS modeling determined they were not effective at reducing salinities. Others were eliminated because they would block access to private property, cause backwater flooding, or create safety problems with navigation.

#### 5.4.1.2 Measures to Restore or Protect Habitat

The HW also evaluated a wide array of measures, which utilized marsh restoration, inshore shoreline protection, and Gulf shore nourishment to compensate for wetland loss or protect from increased erosion. The most effective of these in terms of costs and ecosystem benefits were ultimately selected for inclusion in the Recommended Mitigation Plan; those described below were eliminated during preliminary screening.

**Marsh Restoration Measures**

Thirty-nine combinations of measures and scales of marsh restoration were evaluated. Screening was based upon an informal analysis of benefits determined by the WVA model and costs developed by the USACE. All possible sources of material for marsh restoration were considered (submerged in situ soils, new work and maintenance material from the nearest SNWW channel reaches, sediments from Sabine Lake, Sabine River Channel maintenance material, and accumulated material in the Lake Charles Deepwater Channel/Louisiana GIWW). Locations evaluated for restoration were (1) a degraded marsh area near the head of the West Jetty in the Texas Point NWR; (2) Old River Cove east of the power plant intake canal; (3) the eastern shores of PAs 8 and 11 on Pleasure Island; (4) an old logging canal north of Texas Bayou; (5) a large open-water area south of the Louisiana GIWW and east of Black Bayou Cutoff; and (6) a small, confined open-water area at the northeast corner of the Louisiana GIWW and Black Bayou Cutoff. The large open-water area on the GIWW east of the Black Bayou Cutoff was eliminated because the area was approved for an in situ marsh-terracing project under CWPPRA Project CS-27. Different scales of marsh fill and source material were used within the same footprints in Willow and Black bayous to create different alternatives. Most of the alternatives were eliminated because they produced unacceptably low benefits when compared to costs. Small scales of in situ marsh terracing and marsh creation using dredged material located in the Willow and Black bayou hydro-units were eliminated because of low benefits. Twelve larger scales of the same alternatives were advanced for further screening due to their higher benefits and improved cost effectiveness.

**Inshore Shoreline Protection**

Twenty-one combinations of shoreline protection measures and scales were evaluated in the preliminary screening. Measures were developed for two locations: the eastern shore of Sabine Lake and the north shore of the GIWW in Texas.

For the GIWW shoreline, two separate reaches of rock breakwater (2.4 miles long and 1.5 miles long) were proposed to stabilize areas where low banklines allow higher-salinity waters from the GIWW to enter the large expanse of fresh and intermediate marsh north of the GIWW. Benefits were assessed using the WVA model, based upon an assumed salinity reduction in the marshes protected by the breakwater. The alternative was eliminated because of low benefits in relation to cost. IWR-PLAN comparison revealed it was less cost effective than other alternatives.

For the Sabine Lake shoreline, a foreshore dike was proposed for the Sabine Lake shore between Willow Bayou and the mouth of Black Bayou. This alternative was evaluated in three scales of 3, 4.4, and 8.6 miles in length. Two material types were evaluated for the breakwater: barged-in rock and earthen material obtained from Sabine Lake sediments adjacent to the breakwater. Each of these alternatives was also evaluated at three distances from the Sabine Lake shore: 150, 250, and 500 feet. Finally, marsh restoration behind the dikes was also proposed. Marsh would be created behind the earthen and rock alternatives, 150 feet from the shore using Sabine Lake sediments from the access channel required for construction, and new work material from the SNWW channel was evaluated for the 250- and 500-foot scales. Benefits determined by the WVA were based on the creation of new marsh and the elimination of shoreline retreat. Initially, the rate of shoreline retreat was determined by a GIS analysis of satellite images by the USFWS (Greco and Clark, 2005). However, the rate of shoreline retreat was later revised to incorporate the most likely rate of RSLR, and a forecasted 1.1-foot rise in water surface elevation. Costs of the different measures were estimated by the USACE, including additional costs to raise the dike to accommodate RSLR. All of these alternatives were eliminated because costs were high when compared to benefits.

**Gulf Shore Nourishment**

Eleven measures and scales of Gulf shoreline nourishment were evaluated for Texas and Louisiana Points. The measures were developed in an effort to find the most-cost-effective combination of pumping distance, material type, and length of shoreline nourishment. All of the alternatives were constrained by the requirement that both new work and maintenance material be split evenly between Texas and Louisiana. All but one assumed unconfined placement of dredged material along the current shoreline using a hydraulic pipeline dredge. One alternative envisioned construction of a confined cell along the Texas Point shoreline using new work and maintenance materials. This alternative was eliminated early in the screening because of excessively high costs. Alternatives relying upon unconfined placement of either new work or maintenance material from Sabine Pass sections 5 or 5 and 6 were evaluated for ½-, 2-, and 3-mile-long shoreline reaches. All would begin ½ mile from each jetty, avoiding areas near the jetties where the accretion rate is high. Cost effectiveness analysis determined that the 3-mile-long scale of the maintenance material alternative was the least-cost alternative for the placement of dredged material, and therefore it was adopted as part of the DMMP. One alternative that uses new work material to nourish shoreline at Louisiana Point was advanced for further screening as a potential mitigation alternative.

### 5.4.2 Final Screening of Ecological Mitigation Measures

The Mitigation Plan was selected using the USACE certified version of IWR-PLAN software. IWR-PLAN uses the tools of CE/ICA to weigh the costs of mitigation plans against their nonmonetary output. A mitigation plan is defined as a group of mitigation measures. Cost-effectiveness analysis is used to identify least-cost plans, and incremental cost analysis identifies the subset of cost-effective plans that are superior financial investments, called “best buys plans.” Best buys plans are the most efficient plans at producing the output variable (in this case, AAHUs); they provide the greatest increase in the value of the output variable for the least increase in cost.

Mitigation measures advanced for final screening with IWR-PLAN are listed in Table 5.4-1. For the CE/ICA, the measures were expressed as Solutions A through M, and each solution was evaluated at different scales (Table 5.4-2). Two categories of solutions were evaluated:

1) Marsh restoration in the Willow and Black bayou areas; and
2) Gulf shore nourishment.

The footprint of several marsh restoration solutions is identical; they propose marsh restoration in the same physical area using different sources of sediment (i.e., in situ material, SNWW new work material, and dedicated dredging from Sabine Lake). Solutions with identical footprints are not combinable with other solutions and were identified as such in IWR-PLAN. Other solutions reflect different placement sequences and combinations for the various open-water locales within Willow Bayou or Black Bayou. These were developed in an effort to identify combinations that have more-cost-effective pumping distances. One alternative (LA 2-18C) was duplicated in the IWR-PLAN solutions, with the cost for dredging varied by the size of dredge (i.e., an average size dredge versus the largest, most powerful dredge that could access the area, the *California*). Scales are defined by adding increments of acreage restored, varying the amount of sediment used in the restoration, or the length of shoreline protected or nourished.

Table 5.4-2 contains incremental costs and output for all solutions and scales included in the analysis. The IWR-PLAN code for each solution and the scales of that solution are indicated in the first column, and a brief description of each solution is provided in the second column. For example, the first solution is Willow Bayou in situ terracing (Solution A). This solution has four scales ($A_1$-$A_4$), which increase in acres incrementally through the four scales. Scale $A_1$ restores 38 acres of emergent marsh; Scale $A_2$ creates an additional 26 acres for a cumulative total of 47 acres for both scales $A_1$ and $A_2$. The third column provides a unique identification number for each solution and scale that was used for mapping and tracking through cost estimating and ecological modeling. The fourth column provides the cumulative AAHU output associated with the cumulative acres being restored, and the fifth provides the cumulative average annualized cost.

Variables used in the analysis were nonmonetary ecological benefits established by WVA modeling (expressed in AAHUs) and average annualized costs. These costs include the first cost of construction, costs for marsh plantings, postconstruction monitoring, and 50-year annualized O&M costs. The costs of alternatives that involve the use of maintenance material over one or multiple dredging cycles were amortized over the 50-year period of analysis, using dredging-cycle projections based on historical dredging data and the discount rate in effect at that time.

Table 5.4-1
Mitigation Alternatives Evaluated in Final Screening

| ***Marsh Restoration - In Situ Terracing*** | | | |
|---|---|---|---|
| Description of Alternative | | | |
| "Duck-wing"-shaped earthen terraces built with in situ material using amphibious excavator. Each terrace is 1,000 feet long; 100-foot gap between terraces; approximately 500 feet between each row of terraces. Terraces should have 15-foot-wide tops at +2.0 feet NAVD88 and 4:1 side slopes. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Willow Bayou | LA 2-16(A) | Influence area – 1,831 acres in north part of Greens Lake; located within the same footprint as LA 2-16(B) and LA 2-16(C) | 38 acres |
| | LA 2-17(A) | Influence area – 2,297 acres in southern part of Greens Lake; located within the same footprint as LA 2-17(B) and LA 2-17(C) | 45 acres |
| | LA 2-18(A) | Influence area – 680 acres in area north of Willow Bayou canal; located within the same footprint as LA 2-18(B) and LA 2-18(C) | 11 acres |
| | LA 2-19(A) | Influence area – 1,809 acres in area west of Deep Bayou; located within the same footprint as LA 2-19(B) and LA 2-19(C) | 28 acres |
| ***Marsh Restoration – Sabine Lake Dedicated Dredging*** | | | |
| Description of Alternative | | | |
| Hydraulically dredged material from Sabine Lake (dedicated dredging) to restore marsh and shallow-water habitat in open-water areas of marsh. Borrow trench located 500 feet from shore, excavated approximately 7.5 feet deep; width and length vary for each scale. Assume unconfined flow of maintenance material, frequent movement of pipe, and few training or containment structures. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Willow Bayou | LA 2-16(B) | Influence area – 1,831 acres in north part of Greens Lake; borrow trench approximately 1,000 feet wide x 2 miles long | 822 acres |
| | LA 2-17(B) | Influence area – 2,297 acres in southern part of Greens Lake area; borrow trench approximately 1,250 feet wide x 2 miles long | 1,035 acres |
| | LA 2-18(B) | Influence area – 680 acres in area north of Willow Bayou Canal; borrow trench approximately 700 feet wide x 0.8 mile long | 251 acres |
| | LA 2-19(B) | Influence area – 1,809 acres in area west of Deep Bayou; borrow trench approximately 1,200 feet wide x 1.8 miles long | 719 acres |
| | LA 2 ADD B | Influence area – 1,285 acres in area north of Willow Bayou Canal; borrow trench approximately 1,000 feet wide x 1.25 miles long | 436 acres |

Table 5.4-1, cont'd

| ***Marsh Restoration – SNWW New Work Material*** | | | |
|---|---|---|---|
| Description of Alternative | | | |
| Use new work material from SNWW Section 10 to restore emergent marsh and shallow-water habitat in open water in north part of Greens Lake area. Assume unconfined flow of new work material, frequent movement of pipe, and few training or containment structures. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Willow Bayou | LA 2-16(C) | Influence area – 1,831 acres in north part of Greens Lake area; located within the same footprint as LA 2-16(A) and LA 2-16(B) | 822 acres |
| | LA 2-17(C) | Influence area – 2,297 acres in southern part of Greens Lake area; located within the same footprint as LA 2-17(A) and LA 2-17(B) | 1,035 acres |
| | LA 2-18(C) | Influence area – 680 acres in area north of Willow Bayou Canal; located within the same footprint as LA 2-18(A) and LA 2-18(B) | 251 acres |
| | LA 2-19(C) | Influence area – 1,809 acres in area west of Deep Bayou; located within the same footprint as LA 2-19(A) and LA 2-19(B) | 719 acres |
| | LA 2-ADD C | Influence area – 1,285 acres in area north of Willow Bayou Canal; located within the same footprint as LA 2-ADD B | 436 acres |
| ***Marsh Restoration – Channel to Orange Maintenance Material*** | | | |
| Description of Alternative | | | |
| Hydraulically pump maintenance material from the Channel to Orange (Sabine River) between East Pass and the GIWW into areas north of Black Bayou to restore emergent marsh in degraded marsh and open-water areas. Assume unconfined flow of maintenance material, frequent movement of pipe, and few training or containment structures. Material would come from maintenance dredging of the Sabine River Channel. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Black Bayou | LA 3-10R | Influence area – 2,465 acres; restoring 132 acres every 5 years, TY 5 thru TY 30 (total of 6 cycles, ending TY 30) | 792 acres |

Table 5.4-1, cont'd

| ***Marsh Restoration - GIWW Dedicated Dredging*** | | | |
|---|---|---|---|
| Description of Alternative | | | |
| Dedicated dredging of adjacent GIWW to restore emergent marsh and shallow-water habitat; percent of open water restored to emergent marsh is different in A and B scales. Assume unconfined flow of hydraulically pumped material that has accumulated in GIWW (formerly the 30-foot Deepwater Channel to Lake Charles), frequent movement of pipe, and few training or containment structures. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Black Bayou | LA 3-15(A) | Influence area – 1,788 acres in area west of Black Bayou Cutoff Canal; assume 60 percent of open water restored to emergent marsh | 546 acres |
| | LA 3-18(A) | Influence area – 1,877 acres in large area of open water south of LA 3-15; assume 60 percent of open water restored to emergent marsh | 497 acres |
| | LA 3-15(B) | Influence area – 1,788 acres area west of Black Bayou Cutoff Canal; assume 75 percent of open water restored to emergent marsh | 683 acres |
| | LA 3-18(B) | Influence area – 1,877 acres in large area of open water south of LA 3-15; assume 75 percent of open water restored to emergent marsh | 621 acres |
| ***Gulf Shoreline Nourishment*** | | | |
| Description of Alternative | | | |
| Nourish Gulf shoreline at Louisiana Point; length of nourished shore and number of placement cycles vary. Material pumped along shoreline using hydraulic pipeline dredge. Assume 50:50 split of material between Texas and Louisiana. Assume 60 percent retention of material after initial placement; 50 percent of newly added acres remain at end of 6 years. | | | |
| Hydro-Unit | No. | Size of Influence Area | Length of Shoreline |
| Sabine Lake Ridges | LA 5-3 | Nourish 0.5 to 1.0 mile from east jetty; assume one-time unconfined placement of new work material from SNWW Section 5; all added acres eroded away by TY 51 | 0.5 mile |
| | LA 5-1 and 6-1 | Nourish 0.5 to 3.5 miles from east jetty; assume one-time unconfined placement of new work material from SNWW Section 5; all added acres eroded away by TY 51 | 3.0 miles |
| | LA 5-5 | Nourish 0.5 to 3.5 miles from east jetty; assume one-time unconfined placement of new work material from SNWW sections 5 and 6; all added acres eroded away by TY 51 | 3.0 miles |

Table 5.4-2
Solutions and Scales for Cost Effectiveness/Incremental Cost Analysis

| | Solutions | ID# | Cumulative AAHUs per Solution and Increment | Cumulative Average Annual Cost ($) per Solution and Increment |
|---|---|---|---|---|
| **Marsh Restoration** | | | | |
| $A_1$ | Willow Bayou In Situ Terracing (38 acres) | LA 2-16A | 18 | 145,413 |
| $A_2$ | Willow Bayou In Situ Terracing (83 acres) | LA 2-16A<br>LA 2-17A | 40 | 316,720 |
| $A_3$ | Willow Bayou In Situ Terracing (111 acres) | LA 2-16A<br>LA 2-17A<br>LA 2-19A | 54 | 426,845 |
| $A_4$ | Willow Bayou In Situ Terracing (122 acres) | LA 2-16A<br>LA 2-17A<br>LA 2-19A<br>LA 2-18A | 59 | 472,395 |
| $B_1$ | Willow Bayou Sabine Lake Dedicated Dredging (822 acres) | LA 2-16B | 446 | 2,794,551 |
| $B_2$ | Willow Bayou Sabine Lake Dedicated Dredging (1,857 acres) | LA 2-16B<br>LA 2-17B | 940 | 5,980,573 |
| $B_3$ | Willow Bayou Sabine Lake Dedicated Dredging (2,576 acres) | LA 2-16B<br>LA 2-17B<br>LA 2-19B | 1,360 | 8,183,098 |
| $B_4$ | Willow Bayou Sabine Lake Dedicated Dredging (2,827 acres) | LA 2-16B<br>LA 2-17B<br>LA 2-19B<br>LA 2-18B | 1,512 | 8,806,642 |
| $C_1$ | Willow Bayou Sabine Lake Dedicated Dredging (822 acres) | LA 2-16B | 446 | 2,794,551 |
| $C_2$ | Willow Bayou Sabine Lake Dedicated Dredging (1,857 acres) | LA 2-16B<br>LA 2-17B | 940 | 5,980,573 |
| $D_1$ | Willow Bayou Sabine Lake Dedicated Dredging (251 acres) | LA 2-18B | 152 | 620,877 |
| **$D_2$** | **Willow Bayou Sabine Lake Dedicated Dredging (687 acres)** | **LA 2-18B<br>LA 2-ADD B** | **365** | **1,632,476** |
| $D_3$ | Willow Bayou Sabine Lake Dedicated Dredging (1,406 acres) | LA 2-18B<br>LA 2-ADD B<br>LA 2-19B | 785 | 3,945,394 |
| $E_1$ | Willow Bayou SNWW New Work using the Dredge *California* (2,827 acres) | LA 2-16C<br>LA 2-17C<br>LA 2-19C<br>LA 2-18C | 1,552 | 9,205,547 |
| $F_1$ | Willow Bayou SNWW New Work (822 acres) | LA 2-16C | 446 | 3,692,959 |
| $F_2$ | Willow Bayou SNWW New Work (1,857 acres) | LA 2-16C<br>LA 2-17C | 940 | 7,399,625 |

Table 5.4-2, cont'd

| | Solutions | ID# | Cumulative AAHUs per Solution and Increment | Cumulative Average Annual Cost ($) per Solution and Increment ($1,000) |
|---|---|---|---|---|
| $G_1$ | Willow Bayou SNWW New Work (251 acres) | LA 2-18C | 152 | 1,391,853 |
| $G_2$ | Willow Bayou SNWW New Work (687 acres) | LA 2-18C<br>LA 2-ADD C | 365 | 3,010,940 |
| $G_3$ | Willow Bayou SNWW New Work (1,406 acres) | LA 2-18C<br>LA 2-ADD C<br>LA 2-19C | 785 | 6,336,854 |
| **$H_1$** | **Black Bayou Sabine River Maintenance Dredging (792 acres)** | **LA 3-10R** | **198** | **753,717** |
| $I_1$ | Black Bayou GIWW Dedicated Dredging (546 acres) | LA 3-15A | 231 | 685,753 |
| $I_2$ | Black Bayou GIWW Dedicated Dredging (1,043 acres) | LA 3-15A<br>LA 3-18A | 470 | 1,695,472 |
| $J_1$ | Black Bayou GIWW Dedicated Dredging (497 acres) | LA 3-18A | 239 | 1,009,720 |
| $K_1$ | Black Bayou GIWW Dedicated Dredging (683 acres) | LA 3-15B | 307 | 833,787 |
| **$K_2$** | **Black Bayou GIWW Dedicated Dredging (1,304 acres)** | **LA 3-15B<br>LA 3-18B** | **617** | **2,079,427** |
| $L_1$ | Black Bayou GIWW Dedicated Dredging (621 acres) | LA 3-18B | 310 | 1,245,640 |
| **Gulf Shoreline Nourishment** | | | | |
| $M_1$ | Louisiana Point Gulf Shoreline Nourishment – SNWW new work material – 0.5 mile | LA 5-3 | 5 | 97,144 |
| $M_2$ | Louisiana Point Gulf Shoreline Nourishment – SNWW new work material (Section 5 only) – 3 miles | LA 5-1<br>LA 6-1 | 54 | 370,062 |
| $M_3$ | Louisiana Point Gulf Shoreline Nourishment - SNWW new work material (sections 5 and 6) – 3 miles | LA 5-5 | 90 | 1,087,715 |

### 5.4.3 Selection of the Best Buy Mitigation Plan

The result of the incremental analysis is illustrated on Figure 5.4-2 and in Table 5.4-3. Ten best buy plans were identified, with incremental costs ranging from $2,716 to $19,935 per AAHU. Line 1 is the No-Action Plan, with no cost and no output. The first column numbers the plans in order of cost effectiveness, with the most cost-effective plan (Plan 2) shown on the second line. Column 2 in Table 5.4-3 lists the codes for all solutions included in each best buy plan, as determined by the incremental cost analysis. The mitigation alternatives advanced for final screening (discussed previously) are the solutions evaluated by IWR-PLAN. Refer to Table 5.4-2 for a description of the mitigation measure represented by the codes shown in column 2. Column 3 shows the incremental output (in AAHUs) of the solution, which is added with each new best buy plan. Column 4 shows the average annual cost associated with the incremental output (the last solution added) of each best buy plan.

Figure 5.4-2. Results of CE/ICA Analysis

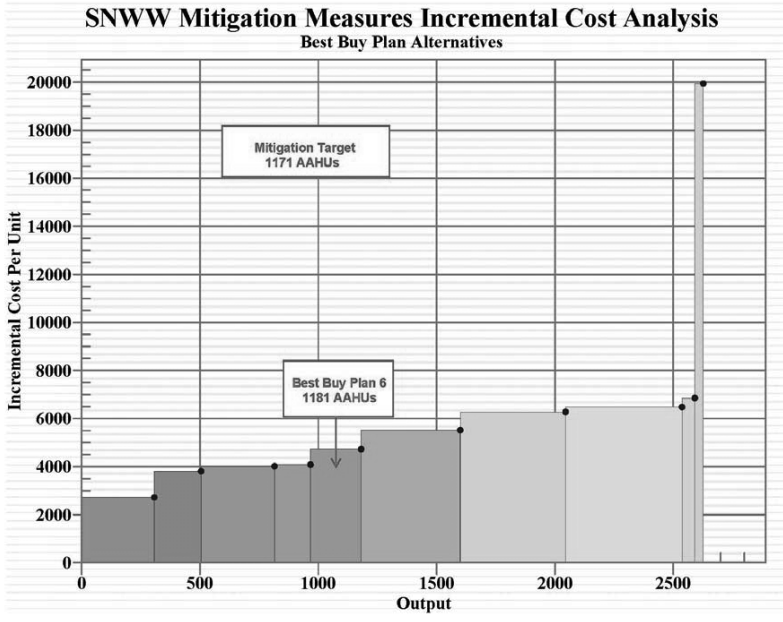



Table 5.4-3
Incremental Cost of Best Buy Plan Combinations (Ordered by Output)

| Counter | Plan Alternative | Output (AAHUs) | Cost ($1.00) | Average Cost ($1.00/AAHU) | Incremental Cost ($1.00/AAHU) | Inc. Output ($1.00) | Inc. Cost Per AAHU |
|---|---|---|---|---|---|---|---|
| 1 | No-Action Plan | 0.00 | 0.00 | | | | |
| 2 | A0B0C0D0E0F0G0H0I0J0K1L0M0 | 307.00 | 833,787.00 | 2,715.9186 | 833,787.0000 | 307.0000 | 2,715.9186 |
| 3 | A0B0C0D0E0F0G0H1I0J0K1L0M0 | 505.00 | 1,587,504.00 | 3,143.5723 | 753,717.0000 | 198.0000 | 3,806.6515 |
| 4 | A0B0C0D0E0F0G0H1I0J0K2L0M0 | 815.00 | 2,833,144.00 | 3,476.2503 | 1,245,640.0000 | 310.0000 | 4,018.1935 |
| 5 | A0B0C0D1E0F0G0H1I0J0K2L0M0 | 967.00 | 3,454,021.00 | 3,571.8935 | 620,877.0000 | 152.0000 | 4,084.7171 |
| **6** | **A0B0C0D2E0F0G0H1I0J0K2L0M0** | **1,181.00** | **4,465,620.00** | **3,781.2193** | **1,011,599.0000** | **214.0000** | **4,727.0981** |
| 7 | A0B0C0D3E0F0G0H1I0J0K2L0M0 | 1,600.00 | 6,778,538.00 | 4,236.5863 | 2,312,918.0000 | 419.0000 | 5,520.0907 |
| 8 | A0B0C1D3E0F0G0H1I0J0K2L0M0 | 2,045.00 | 9,573,089.00 | 4,681.2171 | 2,794,551.0000 | 445.0000 | 6,279.8899 |
| 9 | A0B0C2D3E0F0G0H1I0J0K2L0M0 | 2,537.00 | 12,759,111.00 | 5,029.2121 | 3,186,022.0000 | 492.0000 | 6,475.6545 |
| 10 | A0B0C2D3E0F0G0H1I0J0K2L0M2 | 2,591.00 | 13,129,173.00 | 5,067.2223 | 370,062.0000 | 54.0000 | 6,853.0000 |
| 11 | A0B0C2D3E0F0G0H1I0J0K2L0M3 | 2,627.00 | 13,846,826.00 | 5,270.9654 | 717,653.0000 | 36.0000 | 19,934.8056 |

Best Buy Plan 2, shown on line 2, consists of Solution $K_1$; it has the lowest cost per AAHU ($2,716) of all the best buy plans and consists of only the first scale of that solution, with an output of 307 AAHUs. Best Buy Plan 3 adds Solution $H_1$ to Solution $K_1$, with an incremental output of 198 AAHUs for Solution $H_1$, and a total output of 505 AAHUs for the plan. Best Buy Plan 4 consists of Solutions $H_1$ and $K_2$; in this case, the difference between total output for this plan and Best Buy Plan 3 ($H_1$ and $K_1$) is the incremental output between $K_2$ and $K_1$ (815 – -505 = 310 AAHUs). The cumulative output for each successive group of plans is shown in Column 3. The first plan with the cumulative total that exceeds the mitigation target is generally selected as the Best Buy Mitigation Plan.

The incremental annualized cost per unit of output (Column 5) is calculated by dividing total average annual cost for each incremental solution by the output from that solution. For Best Buy Plan 4, the total annualized cost of $K_2$ (in this case, $1,245,640) is divided by the incremental output (310 AAHUs) to obtain $4,018. Average annual costs were developed for all solutions that were analyzed with IWR-PLAN. These costs include the first cost of construction, marsh plantings, monitoring, and 50-year annualized O&M costs. They are not provided in this document, except as incremental costs per habitat unit, but are available upon request.

Best Buy Plan 6 (Solutions $D_2$, $H_1$, and $K_2$ – shown in bold in tables 5.4-2 and 5.4-3) appears to be an efficient mitigation plan since it reaches the mitigation target of 1,159 AAHUs (Table 5.4-4) by providing a total of 1,181 AAHUs. Best Buy Plan 6 consists of emergent marsh restoration in two Willow Bayou areas (totaling 607 acres) and three areas in the Black Bayou area (totaling 2,096 acres). Best Buy Plan 7 was also evaluated to determine whether its considerable additional benefits were worth the comparatively small incremental cost. Best Buy Plan 7 provides 420 additional AAHUs (719 more acres restored in Willow Bayou) by adding Solution $D_3$ for an additional average annual cost per unit of output of $4,237 (total average annual cost of $2,312,918). Since the estimated total first cost of this increment is $39,275,000 (screening-level cost) and Best Buy Plan 6 meets the mitigation target, Best Buy Plan 7 was deemed not worth the additional investment.

Table 5.4-4
Recommended Mitigation Plan

| Recommended Mitigation Plan | Mitigation AAHUs |
|---|---|
| **Willow Bayou** | |
| LA 2-18 B Marsh Restoration (Sabine Lake dredging) | 152 |
| LA 2-ADD B Marsh Restoration (Sabine Lake dredging) | 214 |
| **Black Bayou West** | |
| LA 3-10R Marsh Restoration (Sabine River Channel maintenance material) | 198 |
| **Black Bayou East** | |
| LA 3-15 B Marsh Restoration (GIWW dredging) | 307 |
| LA 3-18 B Marsh Restoration (GIWW dredging) | 310 |
| Total Compensation | 1,181 |
| FWP Mitigation Target | –1,159 |
| **Net Benefits After Compensation** | **22** |

## 5.5 RECOMMENDED MITIGATION PLAN

The CE/ICA selected Best Buy Plan 6 as the most efficient combination of mitigation measures to compensate for the indirect impacts of the Preferred Alternative. It provides 1,181 AAHUs, which is 10 AAHUs more than the mitigation target. It is important to remember that additional compensatory mitigation would be provided in Louisiana beyond the total 843 AAHUs impacts of the Preferred Alternative. The mitigation plan would result in a net gain of 338 AAHUs for the project as a whole.

Unavoidable impacts of the SNWW CIP remain only in Louisiana; all CIP impacts in Texas are minimized and offset by the DMMP, and no mitigation is required. Therefore, all of the mitigation measures in Best Buy Plan 6 would be located in Louisiana. The mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana (Table 5.5-1, Figure 5.5-1). Each of these alternatives is described in detail below. The recommended Mitigation Plan compensates for the Preferred Alternative's salinity increase and associated losses in marsh and productivity by marsh creation activities that would influence a total of 8,095 acres of Louisiana marshes in the Willow and Black Bayou watersheds. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. The amount of recommended mitigation is based upon the amount of marsh acreage that could be lost as a result of the project, and the additional amount that would need to be restored in order to fully compensate for adverse changes to biological function of the remaining marsh throughout the affected area over the 50-year period of analysis. More than a one-to-one ratio of created marsh to natural marsh is needed to fully compensate for the loss of marsh productivity caused by the CIP. Studies by NMFS (Minello, 2000; Minello and Webb, 1997) have shown that created marshes are not functionally equivalent to natural marshes for all estuarine species for as much as 15 years after the marshes are planted. In total, these measures would produce 1,159 AAHUs and provide full compensation for all impacts of the CIP. The USACE and the ICT would monitor all of the mitigation areas as described by the monitoring plan presented in Appendix I.

Table 5.5-1
Recommended Mitigation Plan – Acreage Analysis

| Mitigation Measure | AAHUs | Total Influence Area (acres) | Nourished Existing Marsh (acres) | Restored Open Water (acres) | Restored Emergent Marsh (acres) |
|---|---|---|---|---|---|
| **Willow Bayou** | | | | | |
| LA 2-18B | 152 | 681 | 367 | 63 | 251 |
| LA 2-ADD B | 214 | 1,285 | 745 | 104 | 436 |
| Subtotal | 366 | 1,966 | 1,112 | 167 | 687 |
| **Black Bayou West** | | | | | |
| LA 3-10R | 198 | 2,465 | 1,317 | 356 | 792 |
| **Black Bayou East** | | | | | |
| LA 3-15B | 307 | 1,788 | 878 | 227 | 683 |
| LA 3-18B | 310 | 1,876 | 1,048 | 207 | 621 |
| Subtotal | 617 | 3,664 | 1,926 | 434 | 1,304 |
| **Total Mitigation** | 1,181 | 8,095 | 4,355 | 957 | 2,783 |

Specific performance criteria for the marsh restoration areas were established in consultation with the ICT: (1) placed material would be 60 to 80 percent vegetated with native, typical, emergent marsh 5 years after each placement of material; (2) marsh would remain intact and 60 to 80 percent vegetated with native, typical, emergent marsh through the 50-year period of analysis; and (3) invasive, noxious, and/or exotic plants would compose less than 4 percent of marsh cover at year 2 and year 5.

### 5.5.1 Willow Bayou Mitigation

Recommended Willow Bayou mitigation measures (LA 2-18B and LA 2-ADD B) are located within the boundaries of the Sabine NWR (see Figure 5.5-1). The USACE has requested that the USFWS prepare a compatibility determination for the proposed activity. See correspondence dated January 24, 2007, in Appendix A1. Material dredged from a borrow trench in Sabine Lake would be used to restore 687 acres of emergent marsh within open-water areas, improve 167 acres of shallow-water habitat, and nourish 1,112 acres of existing marsh within the total influence area of 1,966 acres (see Table 5.5-1). Small ponds and sinuous, interconnected channels would be created to maintain tidal connectivity, increase marsh edge, and create protected areas for SAV. Approximately 1,966 acres of existing marsh in the influence area would also be renourished by winnowing fine-grained suspended solids during placement events. Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. In order to maximize edge in the marsh, topographic relief would be created by varying the final elevation of material placement, and planting with appropriate native flora at each elevation. The varied topography would allow for differences in duration of tidal inundation, create different floral communities, and maximize biodiversity. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled. These would be needed to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

The dedicated dredging would take approximately 3.1 mcy of material from a 1.8-mile-long borrow trench in Sabine Lake. The borrow trench would be located at least 1,000 feet from the Sabine NWR shore and would average 1,030 feet wide by 7.5 feet deep. The borrow trench would be continuous and parallel to the current shoreline, in line with the common longshore circulation pattern in Sabine Lake. The circulation is expected to prevent the development of hypoxic conditions that would be detrimental to aquatic organisms, and would eventually fill the trench with Sabine River sediments. An access channel, approximately 8 miles long, from the GIWW near the mouth of the Sabine River would be needed for the dredge to reach the proposed borrow area. The exact locations of the borrow trench and access channel would be determined in consultation with the ICT after PED bottom surveys of potential locations. The USACE and ICT would monitor these mitigation areas in accordance with the specific success criteria and monitoring plan presented in Appendix J.

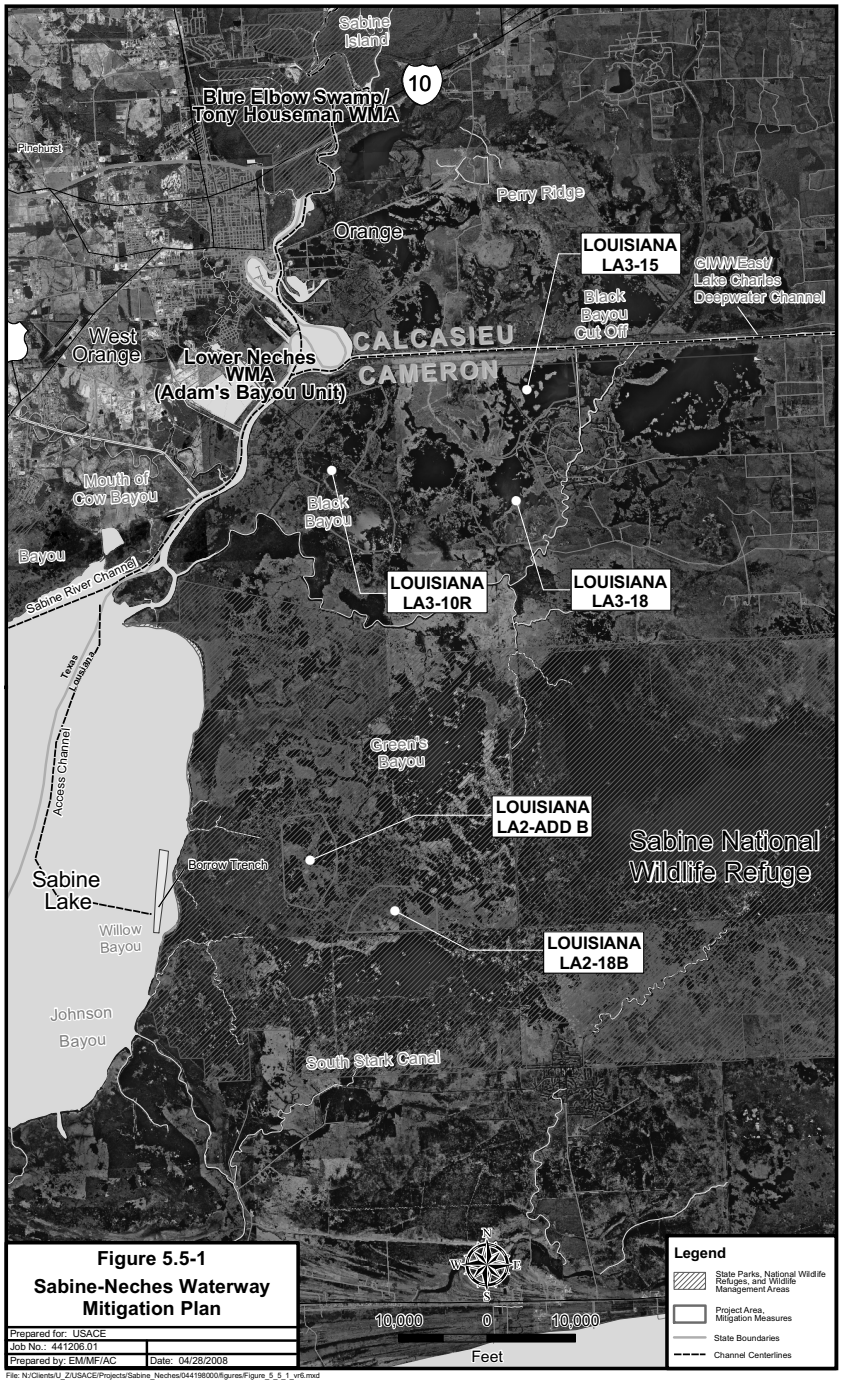



**Figure 5.5-1**
**Sabine-Neches Waterway Mitigation Plan**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 441206.01 | |
| Prepared by: EM/MF/AC | Date: 04/28/2008 |

File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/044198000/figures/Figure_5_5_1_vr6.mxd

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One-time impacts of the borrow trench and access channel dredging would include an increase in water column turbidity during dredging activities; such effects are temporary and local to nekton, phytoplankton, and water quality. A hydraulic pipeline dredge would be used to minimize turbidity. For further information, see subsection 4.11.2.1. No further effects to water quality and related organisms would be expected. Benthic fauna would be removed due to excavation of sediment during dredging activities; however, benthic organisms can rapidly recolonize and no long-term effects are anticipated. Due to low salinity (1 to 6 ppt) in this area of Sabine Lake, live oyster reefs are not likely (Fagerberg, 2003). A study by T. Baker Smith, Inc. (2006) found no live oyster reefs in this area. SAV cover is not likely to be found in this area due to the prevalence of shallow, turbulent, and turbid water.

### 5.5.2 Black Bayou Mitigation

For the Black Bayou West (LA 3-10R) mitigation measure, material from maintenance dredging of the Sabine River Channel between East Pass and the GIWW would be used to restore a large area of marsh north of Black Bayou and west of Rusty Vincent Lake (see Figure 5.5-1 and Table 5.5-1). Maintenance dredging of the Sabine River Channel is considered a separate project within the SNWW system, with a different non-Federal sponsor. It is a without-project condition for the SNWW CIP, and therefore only the incremental cost associated with placing the material in the marsh is included in the cost estimate for the Preferred Alternative. Material removed during regularly scheduled maintenance dredging of this channel would be hydraulically pumped into a large degraded marsh area west of Rusty Vincent Lake. This area is close to the navigation channel, minimizing pumping distance and cost. Marsh restoration in LA 3-10R would be accomplished in six 5-year dredging cycles beginning by the first year of the completion of CIP construction. Each dredging cycle would pump approximately 526,000 cy of material to create 132 acres; a total of 792 acres of emergent marsh would be created over 30 years; 356 acres of shallow-water habitat would be improved, and 1,317 acres of existing marsh would be nourished within the total 2,465 acres influenced by the unconfined flow of dredged material.

For the Black Bayou East (LA 3-15B and LA 3-18B) mitigation measures, marsh restoration would be accomplished in two areas just west of the Black Bayou Cutoff Canal using dedicated dredging of accumulated material in the Lake Charles Deepwater Channel/GIWW (see Figure 5.5-1 and Table 5.5-1). The Lake Charles Deepwater Channel was constructed in 1926 and coincides along its entire 24.9-mile length with the GIWW between the Sabine River and Lake Charles (USACE, 1998c). Communications with the New Orleans District indicate the depth of the 30-foot channel has been reduced to approximately 12 feet due to sedimentation.

Dedicated dredging of the Lake Charles Deepwater Channel for the Black Bayou mitigation efforts would remove and kill benthic organisms; however, constant ship traffic in the shallow channel is an ongoing disturbance to these organisms. Recovery of benthic organisms would be rapid (Sheridan, 1999). No impacts to salinity would be expected because the dredged section would not connect with the Sabine River Channel or the Calcasieu Ship Channel; therefore, there would be no connection with the saltwater wedge in the Calcasieu Ship Channel (there is no Sabine River wedge; Brown and Stokes, 2009) It is

expected that sediment would accumulate over time, refilling the channel to its current depth of approximately –12 feet.

Approximately 10.5 mcy of material would be pumped from a 13-mile stretch of the GIWW approximately 125 feet wide (the width of the GIWW/Deepwater Channel) into the two areas. The first (LA 3-15B) would be located adjacent to the GIWW and would have the shortest pumping distance; the second would be located south of LA 3-15B, and pumping would move to it after the first is complete. A total of 1,304 acres of emergent marsh would be restored, 434 acres of shallow-water habitat would be improved, and 1,926 acres of existing marsh would be nourished within the total 3,664 acres influenced by the unconfined flow of dredged material.

Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. In order to maximize edge in the marsh, topographic relief would be created by varying the final elevation of material placement, and planting with appropriate native flora at each elevation. The varied topography would allow for differences in duration of tidal inundation, create different floral communities, and maximize biodiversity. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled. These would be needed to return the area to the normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area. The USACE and ICT would monitor these mitigation areas in accordance with the specific success criteria and monitoring plan presented in Appendix J.

### 5.5.3 Comparison of Recommended Mitigation Plan to Mitigation Planning Objectives

The net benefits of the Mitigation Plan are shown in tables 5.4-4 and 5.5-1. Compensatory mitigation was considered only after impacts were minimized and offset by DMMP BU features. The DMMP features maximize, to the greatest degree possible, the use of dredged material as a beneficial resource, and share the material from Sabine Pass equally between the states. The mitigation plan (+1,181 AAHUs) fully compensates for AAHU losses to state resources in Louisiana and results in a net gain of 338 AAHUs for the project as a whole. Impacts to East Sabine Lake marshes are replaced in-kind by the marsh mitigation plans in Willow and Black bayous. Minor productivity impacts to cypress-tupelo swamp on the Sabine River near the GIWW are not matched in-kind. The ICT considered this to be acceptable since the loss in function is negligible. Projected FWP salinity levels are within the tolerance levels of these swamps, and the CIP causes no loss of swamp acreage.

### 5.5.4 Performance Criteria for DMMP Restoration/Nourishment and Mitigation Areas

#### 5.5.4.1 Design and Construction

General performance criteria for marsh design and construction for DMMP BU features and Louisiana mitigation measures are presented below. Reference marshes would be located near to mitigation sites so

that vegetation, salinity regime, and hydrology would be directly comparable. Specific criteria would be developed during the PED phase.

**Goals and Objectives**

- To create intertidal marshes compatible with the surrounding natural environment using dredged material.
- To reach consistent and similar intertidal fluctuations that mimic existing nearby marshes to provide habitat suitable for local species to survive and grow.
- To create a sustainable habitat that would withstand environmental conditions and anthropogenic impacts for the period of analysis.

**Methods**

- Build or reinforce existing containment levees adjacent to large canals with mechanically dredged, in situ material. Keep containment levees to the minimum necessary to prevent filling of adjacent navigable canals.
- Place hydraulically dredged material within degraded marsh areas and allow unconfined flow over larger influence areas.
- Frequently move pipe to prevent the accumulation of unsuitably high elevations of material.
- Allow fine-grained sediments to winnow through fringing marsh while material settles at discharge locations.
- Shape the material where required and plant vegetation to sustain the intertidal habitat over time.

**Standards**

- A sustainable marsh habitat maintained.
- Marsh elevations and geotechnical factors shall fall within certain parameters set in the design.
- Marsh water depths, water quality, water temperatures, DO levels, and salinity of the created marsh shall be favorable to expected flora and comparable to those in reference marshes.
- Water displacement over the tidal cycle shall be similar to reference marshes.

**Monitoring and Contingency Plans**

Monitoring and contingency plans for the mitigation measures and DMMP BU features are presented in Appendix J. The monitoring and contingency plans for mitigation measures and BU features have been developed in accordance with recent implementing guidance for sections 2036 (a) and 2039, respectively, of WRDA 07, and the monitoring plans for beneficial use of dredged material in Texas and Louisiana as required by the Section 2039 guidance.

The monitoring plans identify specific ecological success criteria to be used in determining whether the mitigation and BU DMMP features have been successful. Details of the monitoring plan for all of the

mitigation sites in Louisiana and the BU features are presented in tables 3 and 4, respectively, of Appendix J. These tables present the key monitoring parameters, periodicity, costs, and responsible parties.

Periodic monitoring to determine the success of marsh mitigation measures and DMMP BU features would continue until the Division Commander determines that the ecological success criteria of the mitigation and DMMP BU features have been met. This determination would be based upon monitoring results and ICT consultation reports provided by the District Engineer. The ICT would be consulted annually to determine progress in the planning, construction, and postconstruction evaluation of the ecological success of these features.

#### 5.5.4.2 Implementation

Upon authorization of the CIP, the USACE would use its Navigational Servitude to obtain access for construction of the Texas and Louisiana DMMP BU features and the Louisiana mitigation measures, for the purposes of planning, construction, and postconstruction monitoring. Landowners would be advised of the need for access. All restored areas would remain jurisdictional wetlands and continue to be subject to the Servitude; therefore, conservation easements would not be required. Agencies on the ICT have requested the opportunity to provide input to the future engineering, design, construction, and monitoring of the project. The ICT would participate in the detailed planning of the marsh creation areas during the PED phase, monitor construction of the mitigation areas, and participate in planning and conducting postconstruction monitoring.

# 6.0 CONSISTENCY WITH TEXAS AND LOUISIANA COASTAL MANAGEMENT PROGRAMS

In an effort to encourage states to better manage coastal areas, Congress enacted the CZMA in 1972. Texas and Louisiana both have developed and continue to implement federally approved coastal zone management programs and plans (TCMP and LCMP, respectively). States with approved plans have the right to review Federal activities (including private activities that require Federal permits) to determine whether they are consistent to "the maximum extent practicable" with the policies of the state's coastal zone management program. Appendix I addresses the compliance of the Preferred Alternative in this FEIS with the TCMP and LCMP in full detail.

In summary, coastal natural resource areas (CNRAs), would be affected by the Preferred Alternative. The Preferred Alternative is a result of evaluating six project designs, several mitigation approaches, and beneficial uses of dredged material. Evaluations were made by an ICT and involved extensive modeling of ecological functions based on potential impacts, RSLR, and mitigative measures. The alternatives evaluations included attempts to minimize and avoid CNRAs to the maximum extent practicable and provide overall benefits to the ecosystem functions.

No net loss of coastal wetlands was a specific goal of the SNWW CIP ICT and alternatives evaluation. Several components of the DMMP and mitigation plan involve restoration, protection, and enhancement of coastal wetlands. The Neches River BU Feature would restore 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat. Additionally, the mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. This mitigation measure would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing adjacent marsh.

USACE has evaluated the proposed SNWW CIP for consistency with the Texas and Louisiana coastal management programs, and concluded that the Recommended Plan is fully consistent to the maximum extent practicable with the enforceable policies of both state programs. An ICT comprised of Federal and State resource agency representatives from Texas and Louisiana assisted USACE over a nearly 10-year period to perform appropriate scientific studies and modeling needed to ensure that the proposed project avoids and minimizes environmental impacts to the greatest extent practicable. USACE in particular notes that State and Federal agencies including USFWS, NMFS, TPWD, TCEQ, LDEQ, and the EPA have expressed no outstanding concerns with the project. By letter dated March 30, 2010, the Texas Coastal Coordination Council concurred with the USACE consistency determination. By letter dated March 31, 2010, the LDNR Office of Coastal Management (OCM) found that the SNWW CIP is conditionally consistent with their state program. The finding requires that USACE submit an additional consistency determination no later than the time at which draft contract plans and specifications are circulated for internal review. A requirement of the conditional consistency is the submission of additional detailed

information on topics that "would include, but not be limited to, the topics of storm surge, bar channel deepening, salinity, borrow from Sabine Lake, mitigation plans and adequacy, and pipeline relocation." The letter also notes that the USACE letter to LDNR-OCM, dated March 19, 2010, does not constitute an adequate resolution to the issues described. USACE consulted with LDNR (as a member of the ICT) concerning technical issues raised in this letter, and issues originally approved by LDNR as a member of the ICT are now being reopened. USACE maintains that the issues, as summarized below, have been adequately addressed. Since USACE finds that the Recommended Plan is consistent to the maximum extent practicable with the enforceable policies of the LCMP, USACE does not accept conditional consistency as proposed by LDNR-OCM. By letter dated April 26, 2010, USACE notified LDNR of its finding and that it will proceed with the project.

**Storm Surge**

LDNR asserts that the effects of the deeper shipping channel and the borrow of material from the GIWW and Sabine Lake may be significant and have not been modeled thoroughly enough to identify all potential impacts. ERDC-CHL was consulted about the need to model the salinity effect of borrowing material from the GIWW and Sabine Lake relative to salinity impacts. Neither feature was expected to increase salinity impacts, and so they were not included in the HS modeling.

ERDC was also consulted on the potential for ODMDSs to increase wave set-up and erosion on Louisiana shores. ODMDS sites are located too far from shore and in water too deep to affect the Louisiana shore. Waves of any consequence present within a thousand feet of the shoreline are generally depth limited because of the mild nearshore slope and the presence of a soft mud (PIE, 2003). The closest ODMDS (#4) is located between 3.8 and 6 miles from Louisiana in 34 to 43 feet of water. Appendix B discusses previous monitoring of this ODMDS and studies of bottom ocean currents in the region that have determined the dredged material would disperse between placement cycles and not accumulate, and thus would not affect wave set-up or erosion.

ERDC has just completed a sensitivity analysis of potential storm surge impacts from the deeper shipping channel and placement areas (Wamsley, Cialone, and McAlpin, 2010). The analysis is discussed in more detail in subsection 4.6.2.1. The analysis clearly and unequivocally identifies no impact to Louisiana from the deflection of storm surges by the higher PA levees or from the deeper navigation channel. Therefore, further modeling to identify impacts is not necessary.

**Bar Channel Deepening**

Modeling of potential impacts on wave climate has been performed by ERDC-CHL as reported by Gravens and King (2003). The report has been presented on the USACE, Galveston District's SNWW webpage since 2003, and it is reported in here in subsection 4.6.2.2. The modeling addressed the changes in the wave climate that would be produced by a deeper and longer offshore channel, including the Outer Bar Channel. In the first 2 miles east of Sabine Pass, the net eastward transport would be slightly reduced (by a maximum of about 1,400 cy/year), and farther east there would be essentially no change. For a

50-foot project, between ½ mile and 3–4 miles of the east jetty, the accretion would decrease by less than 0.5 foot/year, and farther from the jetties than that, the change in the shoreline would decrease to zero. This small impact would be more than offset by the proposed Gulf Shore BU feature's regular shoreline nourishment at Louisiana Point.

**Salinity**

LDNR asserts that the SNWW salinity modeling used questionable assumptions and boundary conditions, and data collected over a short and nonrepresentative time period. Boundary conditions and assumptions were developed by ERDC and coordinated with the ICT in numerous meetings of the ICT and its MW from 2000 to 2004, and the revised HS modeling presented at the last ICT meeting on August 27, 2009. While LDNR participated in most of the MW meetings, and all prior ICT meetings, no representatives from LDNR attended the last ICT meeting. The ICT presented no objections to the revised modeling at this meeting. The HS modeling for the Preferred Alternative has been subjected to extensive agency technical review (ATR) and independent external peer review (IEPR). ATR identified no significant concerns. The primary IEPR concern related to the need to include the effects of relative sea level rise. This was included as demonstrated in the latest the HS modeling report (Brown and Stokes, 2009). As part of the ICT, LDNR participated in the development of modeling assumptions and reviewed the modeling results. No negative comments were received prior to the consistency determination coordination.

**Borrow Site in Sabine Lake**

LDNR has requested more information on design details regarding the proposed Sabine Lake borrow trench for the Willow Bayou mitigation areas. USACE has agreed to provide all of the information (i.e., geotechnical information on borrow quality, analysis of potential access channels, and disposal plans) needed to develop detailed engineering plans during the PED phase. Designs would minimize impacts to the maximum extent practicable. This FEIS (subsection 5.5.1) fully evaluates potential impacts of the access channels and borrow area and has determined that impacts would be minimal and temporary.

LDNR also requires that mitigation of oyster seed ground impacts must be accomplished to the satisfaction of LDWF. The exact locations of the borrow trench and access channel would be determined in consultation with the ICT after PED bottom surveys of potential locations. The proposed route of the access channel was chosen to keep dredging impacts to a minimum; it takes advantage of deeper water in the center of the lake, thereby minimizing dredging and bottom impacts. Due to low salinity in this area of Sabine Lake, live oyster reefs are not likely (Fagerberg, 2003; T. Baker Smith, 2006). Nevertheless, as stated in subsection 5.5.1 and in the USACE letter dated March 4, 2010, to LDWF, USACE has proposed that a water-bottom survey of the borrow and access channel areas be conducted during the PED phase of the project. In the unlikely event that oyster reef is encountered, plans will be revised to avoid impacts.

LDNR-OCM asserts that royalty payments and license issues over sediment resources must be resolved with LDWF before LDNR-OCM can concur that the final design is consistent, to the maximum extent

practicable, with Louisiana Coastal Resources Program. USACE maintains that the United States is not bound by Louisiana statute (R.S. 56:2011) pursuant to the Supremacy Clause of the United States Constitution, and that Louisiana is not entitled to compensation under the Fifth Amendment, pursuant to the doctrine of Navigation Servitude. This servitude gives the Federal Government the right to use the "Navigable Waters" of the United States without compensation for navigation projects. In a letter dated March 19, 2010, on the issue of payment of royalties, the USACE provided a detailed legal and policy analysis to support the conclusion that no royalty payments are proper or allowable under current Federal law.

**Mitigation Plans and Adequacy**

LDNR asserts that details of the proposed mitigation are insufficient to determine whether all potential losses will be adequately compensated. USACE disagrees—mitigation site locations have been finalized, and conceptual designs are sufficient to support ecological modeling of the compensatory mitigation. USACE has agreed to work with the ICT (which includes LDNR) to obtain all of the information needed to develop detailed engineering plans, including geotechnical data relevant to site design, during PED.

LDNR asserts that the proposed mitigation plan falls at least 318 AAHUs short of replacing the anticipated habitat losses to Louisiana, and that additional mitigation will have to be performed in Louisiana to offset this deficit. USACE maintains that the proposed mitigation plan would more than compensate for all impacts of the proposed SNWW CIP. LDNR has questioned the use of benefits from BU features in Texas to offset impacts in Louisiana (see Table 5.1-2). In Louisiana, the benefits of BU measures offset the loss of 210 AAHUs to private lands along the coast at Louisiana Point, and the loss of 340 AAHUs to Federal land in the SNWR. Exclusion of the Federal SNWR is based upon the definition of “coastal zone” in the Coastal Zone Management Act of 1972, as amended. “Excluded from the coastal zone are lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers or agents (16 USC §1453).” The net impact of the project to non-Federal lands in Louisiana after application of BU benefits is the loss of 1,159 AAHUs, and the proposed mitigation plan would provide 1,181 AAHUs in order to fully and separately compensate losses to these lands. Furthermore, the Louisiana marsh mitigation measures would compensate for the predicted loss of 691 acres in Louisiana over 50 years by the restoration of 2,783 acres of emergent marsh, the improvement of 957 acres of shallow-water habitat, and the nourishment of 4,355 acres of existing marsh. Since the marsh restoration is several times greater than the predicted marsh loss, there would be no net loss of wetlands.

LDNR has also questioned the benefits of the Gulf Shore BU feature at Louisiana Point, and asserts that additional mitigation in Louisiana will be required unless acceptable technical justification of the projected benefits is provided. The benefits of the BU feature in Louisiana were established by WVA modeling accomplished by the ICT, of which LDNR was a part. The technical justification presented in Appendix C, subsection 8.3.1.2 and WVA modeling were reviewed and accepted by the ICT. The monitoring plan (Appendix J) would determine whether benefits are being reached as predicted.

**Pipeline Relocation**

A total of 104 pipelines have been identified crossing the SNWW navigation channels. Of the 104 pipelines, 46 require adjustment to meet the minimum required vertical and horizontal clearances for the SNWW CIP. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. Costs of pipeline relocations have been included in the economic analysis of potential project benefits. Direct and indirect economic benefits of the proposed deepening will accrue to all users of the SNWW, including the energy industries, and to the regional economy in Louisiana as established by an independent economic analysis (Martin Associates, 2006). The economic analysis presented in FFR Section V.F establishes that there would be a net economic benefit to the country from the proposed project. Minimal impacts to Louisiana industries are anticipated because construction would work around pipeline relocations as needed to accommodate all parties for a safe, effective, and minimally disruptive working plan.

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# 7.0 CONSISTENCY WITH OTHER STATE AND FEDERAL PLANS AND REGULATIONS

This FEIS has been prepared to satisfy the requirements of all applicable environmental laws and regulations and has been prepared using the CEQ NEPA regulations (40 CFR Part 1500–1508) and the USACE's regulation ER 200-2-2 (*Environmental Quality: Policy and Procedures for Implementing NEPA*, 33 CFR 230). The USACE will follow provisions of all applicable laws, regulations, and policies related to the proposed actions, including those for which applicability, review, and enforcement are their responsibility. Additionally, the local sponsor may be required to secure local municipal permits as a "Land, Easements, Rights-of-Way, Relocation, and Disposal Areas" requirement. The following sections present brief summaries of Federal environmental laws, regulations, plans, and coordination requirements applicable to this FEIS.

## 7.1 NATIONAL ENVIRONMENTAL POLICY ACT

This FEIS has been prepared in accordance with CEQ regulations in compliance with NEPA provisions. All impacts on terrestrial and aquatic resources have been identified, significant adverse impacts requiring mitigation have been identified, and mitigation has been proposed.

## 7.2 RIVER AND HARBOR ACT OF 1899

Sections 9 (33 USC 401) and 10 (33 USC 403) are related to structural construction and dredge-and/or-fill activities, respectively, within U.S. navigable waterways. The USACE authorizes permits under this statute. While the agency would not issue a permit for its own actions, the USACE would meet and be consistent with all applicable elements of the statute. Additionally, the USACE and ICT determined that dredged material testing was required under the related Regulatory Guidance Letter 06-02 (*Guidance on Dredged Material Testing for Purposes of Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972*, July 6, 2002). Results are presented in sections 3.3 and 3.4.

## 7.3 CLEAN WATER ACT

USACE has received §401 State Water Quality Certification from Texas and Louisiana for this action. Both states have determined that the requirements for water quality certification have been met and have concluded that the placement of fill material will not violate water quality standards of each state. The Preferred Alternative is the least environmentally damaging practicable alternative. A CWA §404(b)(1) evaluation of the proposed action, provided in Appendix E of this FEIS, describes the effects of the proposed discharges. Short-term increases in turbidity may be caused by the unconfined flow of dredged material during construction of BU features and mitigation measures. Proposed channel improvements should decrease the number of vessel trips, thus decreasing the probability of a spill.

Appendix E of this FEIS contains the §401(b)(1) evaluation needed for state water quality certification. All relevant sediment and water quality data for both new work and maintenance dredging material were reviewed by a team of State and Federal resource agencies (the CW of the ICT), including the TCEQ and LDEQ, and they found no cause for concern over water or sediment quality in any channel reach. New work sediments were deemed suitable for use in constructing BU or mitigation sites and upland confined PAs, although excess new work material would have to be placed in upland confined PAs. Maintenance material would be handled according to the DMMP. The DMMP measures maximize, to the greatest degree possible, the use of dredged material as a beneficial resource, and share the material from Sabine Pass equally between the states.

## 7.4 CLEAN AIR ACT of 1970

The CAA is the comprehensive Federal law that regulates air emissions from area, stationary, and mobile sources. An analysis of estimated air contaminant emissions from equipment (including dredges and support equipment such as tugboats, runabouts, and tenders, as well as land based equipment such as bulldozers and employee vehicles) associated with the proposed CIP is expected to result in short-term impacts on air quality in the immediate vicinity of the project area, but no long-term impacts are expected. Emissions of VOC for the project are exempt from a General Conformity Determination because they are below the general conformity threshold of 100 tons per year. However, estimated $NO_x$ emissions for the Preferred Alternative exceed the general conformity threshold; i.e., greater than 100 tpy, for all years of construction.

Pursuant to Section 176 of the CAA Amendments of 1990, the USACE prepared a document entitled, "Draft General Conformity Determination, Sabine-Neches Channel Improvement Project." This document was noticed for public comment and was submitted by the USACE to the TCEQ, the EPA, and other air pollution control agencies, as appropriate, concurrently with this DEIS. As part of the General Conformity process, the USACE made this document available to the public for review and comment for a period of 30 days. The TCEQ has provided written concurrence that emissions from the Preferred Alternative are conformant with the Texas SIP for the BPA (Appendix A1). Based on TCEQ's comments, the USACE has prepared a Final General Conformity Determination for the proposed SNWW CIP (Appendix F).

## 7.5 NATIONAL HISTORIC PRESERVATION ACT OF 1966

Compliance with the NHPA of 1966, as amended, requires identification of all NRHP-listed or NRHP-eligible properties in the project area and development of mitigation measures for those adversely affected in coordination with the Texas and Louisiana SHPOs and the Advisory Council on Historic Preservation. As indicated in Section 3.13, this project would not impact NRHP-listed properties or SALs; however, it may potentially adversely impact terrestrial and marine historic properties eligible for listing in the NRHP. This FEIS has been coordinated with the Texas and Louisiana SHPOs. An HPPA (Appendix H) has been executed among the Texas and Louisiana SHPOs, the SNND and USACE to address subsequent investigations, coordinate surveys of impact areas, test potentially eligible sites, and manage data recovery or avoidance measures as necessary. Tribal coordination, required by the NHPA, has been

conducted. Tribes with historical or cultural ties to the region were contacted early in the study to identify their interests and concerns. The draft Programmatic Agreement has also been coordinated with the Tribes. No Tribes have requested to become consulting parties, and no impacts to Tribal land or traditional cultural properties have been identified.

## 7.6 ENDANGERED SPECIES ACT

Potential impacts to federally listed threatened and endangered species have been assessed by the USACE in a BA. The BA determined that several federally listed species of sea turtles and wintering populations of the piping plover and its Critical Habitat could potentially be affected by project construction or operation. The BA concluded that the Preferred Alternative would not jeopardize the continued existence of piping plovers or result in the adverse modification of its designated Critical Habitat. Potential impacts to sea turtles from hopper dredging were identified, and interagency consultation under Section 7 of the ESA was initiated. NOAA/NMFS responded with a BO as outlined under Section 7(c) of the ESA of 1973, as amended. The BA and BO are presented in Appendix G of this FEIS; other related correspondence is present in Appendix A2. While the project alternative changed, project-related impacts remained the same and therefore the BO conclusions would remain the same.

Potential impacts to the wintering piping plover would be associated with implementation of the Gulf Shore BU Feature. The recurring placement of dredged material for shoreline nourishment would affect areas of designated Critical Habitat. The USFWS has designated the entire shoreline between Constance Beach and Sabine Pass (Unit LA 1, in part) as Critical Habitat for wintering piping plover. Proposed beach nourishment activities at Louisiana Point would occur along approximately 3 miles of this unit, beginning approximately 0.5 mile east of Sabine Pass. No designated Critical Habitat, or even suitable habitat, is present along the Texas portion of the Gulf Shore BU Feature. The USFWS, in letters dated March 20 and March 22, 2007 (Appendix A2), concurred that the Preferred Alternative is not likely to adversely affect the piping plover or its Critical Habitat and the brown pelican. The USFWS Louisiana Field Office stated that no further ESA consultation would be required with its office unless changes are made to the scope or location of the project. The USFWS Clear Lake Field Office letter was silent on the need for further consultation. However, the USACE staff confirmed by telephone that no further ESA consultation would be required unless changes are made to the scope or location of the project. The Clear Lake Field Office did recommend that steps be taken to determine whether bald eagles are nesting within or near the project area since the number of bald eagles in Texas is increasing. Prior to project construction, the USACE would check with the TPWD and local landowners to determine whether there have been recent bald eagle sightings and determine the need for surveys and further coordination at that time.

The USFWS provided further guidance in a letter dated February 5, 2010, and recommended that all activity in Louisiana occurring within 2,000 feet of a brown pelican rookery be restricted to the non-nesting period (i.e., September 15 through March 31). However, because nesting periods vary considerably among Louisiana's colonies, it is possible that this activity window could be altered based upon the dynamics of the individual colony. Prior to project construction, the LDWF Fur and Refuge

Division will be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies. In Texas, the USFWS recommended all activity occurring within 1,000 feet of a rookery be restricted to the non-nesting season.

Loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles may be present in the study area waters during certain times of the year. Construction and postconstruction maintenance activities involving the use of hopper dredges could result in impacts to sea turtles. No critical habitat for sea turtles is present in the study area, and there have been no reports of sea turtles nesting in the study area, as most of the shoreline is an eroding, muddy marsh. The NMFS has concluded that hopper dredging during construction and maintenance is likely to adversely affect but is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, hawksbill, leatherback, or green sea turtles. The Opinion authorizes incidental lethal take of four turtles (three Kemp's ridley sea turtles and one loggerhead or green sea turtle) during the course of the proposed project's hopper dredging. Only incidental takes that occur while the specified reasonable and prudent measures are in full implementation are authorized. These measures specify that (1) dredging should be completed, whenever possible, within specified temperature and date-based dredging windows; (2) NMFS-approved protected species observers must provide 100 percent monitoring during certain date and temperature-determined periods; (3) rigid deflector dragheads must be used on hopper dredges at all times; and (4) relocation trawling is required after the take of one sea turtle during the project. The Opinion authorizes the per-fiscal-year nonlethal noninjurious take, external flipper-tagging, and taking of tissue samples of 32 sea turtles in any combination in association with any relocation trawling conducted during hopper dredging. Maintenance-dredging activities for the proposed project are covered by an existing agreement between the NMFS and USACE regarding the taking of sea turtles with hopper dredges to ensure that significant impacts do not occur (NOAA, 2003).

## 7.7 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

The Migratory Bird Treaty Act of 1918 (as amended) extends Federal protection to migratory bird species; among other activities, nonregulated "take" of migratory birds is prohibited under this Act in a manner similar to the ESA prohibition of "take" of threatened and endangered species. Additionally, EO 13186, "Responsibility of Federal Agencies to Protect Migratory Birds," requires Federal activities to assess and consider potential effects of their actions on migratory birds (including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds). The effect of the Preferred Alternative on migratory bird species has been assessed. The USFWS has concurred that the Preferred Alternative is not likely to affect designated piping plover habitat at Louisiana Point. DMMP marsh restoration and Louisiana marsh mitigation areas would result in a net increase in migratory bird habitat in the project area. Construction contracts would include instructions to avoid impacts to migratory birds and their nests from construction-related activities. The Migratory Bird Conservation Act (16 USC 715–715d, 715e, 715f–715r; 45 Stat. 1222) establishes a Migratory Bird Conservation Commission to approve areas of land or water for acquisition as reservations for migratory birds and is not applicable to the project.

## 7.8 FISH AND WILDLIFE COORDINATION ACT OF 1958

The Fish and Wildlife Coordination Act directs Federal agencies to consult with the USFWS and relevant state wildlife resource agencies regarding potential impacts to wildlife from proposed improvements like the proposed SNWW CIP. The intent of this consultation is to help prevent the loss of and damage to wildlife resources from water development projects. USACE has consulted with the USFWS throughout the ICT process, and as a result, USFWS recommendations have been incorporated into the final impact assessment and the BU and compensatory mitigation plans for the Preferred Alternative. The USFWS submitted a Coordination Act Report (CAR) that affirms the USACE impact assessment and approves the proposed BU and mitigation plans. The CAR, dated March 16, 2010, is presented in Appendix A3.

## 7.9 NATIONAL WILDLIFE REFUGE SYSTEM IMPROVEMENT ACT OF 1997

The National Wildlife Refuge System Improvement Act of 1997 amended the National Wildlife Refuge System Administration Act of 1966 to improve management of the NWR System. An amendment to the 1966 Act requires that each refuge administrator review any proposed new use of a refuge to determine whether its use is compatible with the purposes of the refuge and consistent with public safety. Since the proposed Willow Bayou mitigation measures LA 2-18 and LA 2-ADD B are located in the Sabine NWR, and the proposed Gulf Shore BU Feature at Texas Point is located in the Texas Point NWR, the USACE has requested compatibility determinations from each refuge manager. Each refuge must identify the effects of the proposed use on refuge resources and provide an opportunity for public review and comment.

## 7.10 MARINE MAMMAL PROTECTION ACT OF 1972

The Marine Mammal Protection Act was passed in 1972 and amended through 1997. It is intended to conserve and protect marine mammals and establish the Marine Mammal Commission, the International Dolphin Conservation Program, and a Marine Mammal Health and Stranding Response Program. The Preferred Alternative is in compliance with this Act. No impacts to marine mammals are expected.

## 7.11 FISHERY CONSERVATION AND MANAGEMENT ACT OF 1996

Congress enacted amendments to the MSFCMA (PL 94-265) in 1996 that established procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries. EFH consists of those habitats necessary for spawning, breeding, feeding, or growth to maturity of species managed by Regional Fishery Management Councils in a series of Fishery Management Plans. Rules published by the NMFS (50 CFR sections 600.805–600.930) specify that any Federal agency that authorizes, funds, or undertakes, or proposes to authorize, fund, or undertake an activity that could adversely affect EFH is subject to the consultation provisions of the above-mentioned Act and identifies consultation requirements. Sections 3.10 and 4.11 of this FEIS were prepared to address EFH in the project area and to initiate consultation under the Act. Any detrimental impacts of the Preferred

Alternative on EFH are minor and temporary, but the project would provide indirect benefits since the project, including the DMMP restoration sites, would lead to an overall net gain in marsh habitat. The NMFS, by letter dated March 8, 2010, has concurred with the FEIS assessment of EFH impacts, and concurs that the proposed BU features and mitigation will offset the adverse impacts to EFH and provide a net-benefit to federally managed fisheries. No further consultation under the MSFCMA with NOAA or NMFS is required.

## 7.12 FEDERAL WATER PROJECT RECREATION ACT

The Federal Water Project Recreation Act of 1995 requires consideration of opportunities for outdoor recreation and fish and wildlife enhancement in planning water resource projects. The beneficial uses included in the project for the construction and maintenance material include uses requested by various recreational groups, environmental groups, and State and Federal regulatory agencies. All would benefit one or more of the items listed above.

## 7.13 MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT OF 1972

This Act requires a determination that dredged material placement in the ocean would not reasonably degrade or endanger human health, welfare, or amenities or the marine environment, ecological systems, or economic potential (shellfish beds, fisheries, or recreational areas). Maintenance and construction dredged material proposed for placement at the existing and new ODMDSs, designated by the EPA under Section 102 of Marine Protection, Research, and Sanctuaries Act (MPRSA), is subject to evaluation using the ocean dumping environmental criteria. The proposed new ODMDSs are outlined in Appendix B. The conclusion of the ODMDS Designation FEIS (Appendix B) was that the Preferred ODMDSs met all of the 5 general and 11 specific criteria listed in 40 CFR 228.5 and 228.6 and are therefore acceptable under the MPRSA. All material transported for ocean disposal would be evaluated pursuant to the EPA Ocean Dumping Regulations and Criteria (Section 103). Use of the ODMDSs would be in accordance with an approved Site Monitoring and Management Plan (SMMP).

## 7.14 COASTAL ZONE MANAGEMENT ACT

In an effort to encourage states to better manage coastal areas, Congress enacted the CZMA in 1972. Texas and Louisiana both have developed and continue to implement federally approved coastal zone management programs and plans (TCMP and LCMP, respectively). States with approved plans have the right to review Federal activities (including private activities that require Federal permits) to determine whether they are consistent to “the maximum extent practicable” with the policies of the state’s coastal zone management program. Appendix I addresses the compliance of the Preferred Alternative in this FEIS with the TCMP and LCMP in full detail.

In summary, CNRAs would be affected by the Preferred Alternative. The Preferred Alternative is a result of evaluating six project designs, several mitigation approaches, and beneficial uses of dredged material. Evaluations were made by the ICT and involved extensive modeling of ecological functions based on

potential impacts, RSLR, and mitigative measures. The alternatives evaluations included attempts to minimize and avoid CNRAs to the maximum extent practicable and provide overall benefits to the ecosystems functions.

No net loss of coastal wetlands was a specific goal of the ICT and alternatives evaluation. Several components of the DMMP and mitigation plan involve restoration, protection, and enhancement of coastal wetlands. The Neches River BU Feature would restore 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat. Additionally, the mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. This mitigation measure would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing adjacent marsh.

USACE has evaluated the proposed SNWW CIP for consistency with the Texas and Louisiana coastal management programs, and concluded that the Recommended Plan is fully consistent to the maximum extent practicable with the enforceable policies of both state programs. The Texas Coastal Coordination Council has concurred with the USACE consistency determination. The LDNR-OCM found that the SNWW CIP is conditionally consistent with their state program. Since conditional consistency as proposed by LDNR-OCM is not acceptable, LDNR-OCM has been notified that USACE will proceed with the project. This issue is discussed in further detail in Section 6.0.

## 7.15 COASTAL BARRIER IMPROVEMENT ACT OF 1990

This act is intended to protect fish and wildlife resources and habitat, prevent loss of human life, and preclude the expenditure of Federal funds that may induce development on coastal barrier islands and adjacent nearshore areas. The Coastal Barrier Improvement Act of 1990 was enacted to reauthorize the Coastal Barrier Resources Act (CBRA) of 1982. The Gulf shoreline at the Texas Point NWR is designated as an “otherwise protected area” (unit T01P). The Gulf shoreline in the Louisiana portion of the study area contains no CBRA-designated units. Exceptions to the Federal expenditure restrictions also include maintenance or constructed improvement(s) to existing Federal navigational channels and related structures (e.g., jetties), including the disposal of dredged materials related to maintenance and construction (The Center for Regulatory Effectiveness, n.d.); therefore, the Preferred Alternative is exempt from the prohibitions identified in the act.

## 7.16 FARMLAND PROTECTION POLICY ACT OF 1981 AND THE CEQ MEMORANDUM PRIME AND UNIQUE FARMLANDS

In 1980, the CEQ issued an Environmental Statement Memorandum “Prime and Unique Agricultural Lands” as a supplement to the NEPA procedures. Additionally, the Farmland Protection Policy Act was passed in 1981, requiring consideration of those soils, which the USDA defines as best suited for food, forage, fiber, and oilseed production, with the highest yield relative to the lowest expenditure of energy

and economic resources. The NRCS concurred that the "prime farmland if drained" soil mapped in PA 24A is not Important Farmland, and provided the Farmland Conversion Impact Rating Form indicating an exemption.

## 7.17 EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

The Preferred Alternative includes the development of two new PAs (PA18A and PA24) and the Neches River BU Feature within the floodplain of the Neches River. Alternatives to avoid the adverse effects of developing the two new PAs in the floodplain were evaluated, and it has been determined that this is the only practicable alternative. The Neches River BU Feature would construct marsh in areas of open water within the floodplain that formerly were emergent marsh; they would remain jurisdictional wetlands after construction. Development in the BU areas would be controlled by Section 404 regulations, and their construction would not be expected to induce growth in the floodplain. BU alternatives were evaluated in consideration of existing drainages to ensure that restored wetland areas would not induce flooding. This FEIS fulfills public notification requirements as it provides an explanation of why these project features are proposed to be located in the floodplain and provides an opportunity for the public to comment on these plans.

## 7.18 EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

This EO directs Federal Agencies to avoid undertaking or assisting in new construction in wetlands, unless no practical alternative is available. One of the two new PAs proposed for development (PA 24A) would result in the conversion of 86 acres of wetlands to a confined PA. Alternatives to avoid the loss of 86 acres of wetlands were evaluated, and it has been determined that this is the only practicable alternative. The Preferred Alternative's Neches River BU Feature would result in a net gain in wetlands along the lower Neches River, and the ecological benefits of this feature would more than offset the loss of 86 wetland acres due to the construction of PA 24A. The Neches River BU Feature would construct marsh in areas of open water within the floodplain that formerly were emergent marsh; they would remain jurisdictional wetlands after construction. The Neches River BU Feature would improve water quality, inhibit erosion and sediment loss, and restore habitat for fish and wildlife species, improving the long-term productivity of the lower Neches River ecosystem.

## 7.19 EXECUTIVE ORDER 13112, INVASIVE SPECIES

Under EO 13112, Federal agencies may not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species unless the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species. Related to project development and implementation, Federal agencies whose action(s) may affect the status of invasive species are required to use relevant programs, information, and authorities to do the following:

- prevent the introduction and/or spread of invasive species;
- accurately monitor invasive species populations related to their area of effects;

- provide restoration for natural vegetation communities adversely affected by invasive species;
- provide environmentally sound control of invasive species; and
- consult with the Invasive Species Council and ensure their actions are consistent with the Invasive Species Management Plan.

Although ship traffic would increase with the Preferred Alternative, the increase would be less than the predicted growth of ship traffic under the No-Action Alternative, and therefore, no additional impacts with respect to ballast water are expected. Furthermore, no changes in foreign ports of call are predicted.

## 7.20 EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE

This EO directs Federal agencies to determine whether the Preferred Alternative would have a disproportionate adverse impact on minority or low-income population groups within the project area. The Preferred Alternative would not significantly affect any low-income or minority population (Section 4.12).

## 7.21 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT AND RESOURCE CONSERVATION AND RECOVERY ACT

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (as amended) was designed to help clean up the nation's inactive hazardous waste sites. There are a variety of different requirements included in this sweeping legislation. CERCLA also requires industries to disclose to their communities what hazardous substances they use and store. CERCLA authorized the EPA to remediate polluted sites; for this purpose it created Superfund to pay for site cleanups when there is no clear-cut responsible party. The EPA can also pursue potentially responsible parties to make them pay for response and remediation activities. Superfund, 40 CFR 302–310, authorized the EPA to respond to and remedy polluted sites and created Superfund to pay for site cleanups when a responsible party could not be identified.

The RCRA of 1976 (as amended) provides for comprehensive cradle-to-grave regulation of hazardous waste and authorizes environmental agencies to order the cleanup of contaminated sites. Since 1984, it has also called for the extensive regulation of underground storage tanks and the cleanup of contamination caused by leaking tanks. In addition, RCRA addresses the environmental problems associated with nonhazardous solid waste and encourages states to develop solid waste management programs, regulate solid waste landfills, and eliminate open dumps. Federal facilities are required to comply with Federal, State, and local regulations and requirements on solid and hazardous waste and underground storage tanks to the same extent as private parties. RCRA contains provisions on a number of other topics, such as resource recovery, used oil management and recycling, small town environmental planning, and plastic ring carriers. While most RCRA provisions focus on the protection of human health, its wide-ranging attempts to prevent, reduce and eliminate pollution have an obvious, if largely unstated, effect on wildlife protection as well.

These acts require the reporting of hazardous, toxic, and radioactive waste and prescribe specific handling and remediation requirements. A records search was performed to identify possible RCRA and CERCLA sites in or near the project area, and these are described in the FEIS. An evaluation of the potential for these sites to impact the proposed project was conducted, and yielded the following concern. Contaminant issues affecting PA 17 must be resolved by the non-Federal sponsor before the PA can be used as part of the preferred alternative. Alternative placement areas are available should this not be resolved in time for use.

## 7.22 FEDERAL AVIATION ADMINISTRATION – HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS

In accordance with FAA AC 150/5200-33 and the Memorandum of Agreement among the FAA, the USACE, and other Federal agencies (July 2003), the Preferred Alternative was evaluated to determine if proposed land uses could increase wildlife hazards to aircraft using public use airports in the study area. Potential attractants (four existing PAs) were found to be located between the 10,000-foot and 5-mile perimeters of the Southeast Texas Regional Airport in Beaumont, Texas. No new PAs would be constructed within the separation perimeters, and no change in land use is proposed in conjunction with the Preferred Alternative. USACE provided this information to the FAA, and concluded that continued use of the four existing PAs does not constitute a change in land-use and is compatible with airport operations.

## 7.23 TEXAS CHENIER PLAIN NATIONAL WILDLIFE REFUGE COMPLEX COMPREHENSIVE CONSERVATION PLAN

The Texas Chenier Plain NWR Complex is four units administered by the USFWS: Anahuac NWR, McFaddin NWR, Texas Point NWR, and Moody NWR. These units are located along the upper Texas Gulf Coast in Chambers, Jefferson, and Galveston counties. Only the Texas Point NWR is located within the SNWW study area. The Refuge Complex's aquatic habitats (open-water and near-shore Gulf habitats), freshwater to saline marshes, riparian habitats, coastal woodlots, rice fields, native prairies, cheniers and coastal beach, and dune habitats harbor over 300 bird species, 75 species of freshwater fish, and 400 species of salt and brackish water finfish and shellfish.

Long-term, large-scale alterations to the region—over 100,000 acres of coastal wetland loss in 25 years; loss and conversion of more than 99 percent of the historic tallgrass prairie along the Louisiana and Texas Gulf Coasts for agriculture, residential, and commercial uses; increases in nonnative plant and animal species; loss or severe restriction of freshwater and sediment inflows and increased saltwater intrusion; and ongoing threats from sea level rise and land subsidence—have prompted the USFWS to act to facilitate the long-term protection of natural resources in the region.

The Texas Chenier Plain National Wildlife Refuge Complex Comprehensive Conservation Plan (CCP) provides a 15-year vision to identify and propose solutions to significant problems that may adversely affect the populations and habitats of fish, wildlife, and plants and the actions necessary to correct or

mitigate such problems (USFWS, 2008a). The CCP has four goals: (1) conserve, enhance and restore the refuge's coastal wetlands to provide habitat for native fish and wildlife; (2) conserve, enhance and restore the refuge's coastal prairies and coastal woodlands to provide habitat for native fish and wildlife; (3) implement a comprehensive biological program to guide and support conservation effort for all native fish, wildlife, and plant species; and (4) work with others on a landscape level to address threats to natural biological diversity, ecological integrity, and environmental health on the Refuge Complex. Specific strategies will include habitat restoration, protection, and land acquisition from willing sellers.

The Preferred Alternative would impact the goals of the CCP by causing small increases in salinity and land loss, and related decreases in productivity within the intermediate, brackish, and saline marshes of the Texas Point NWR. However, losses quantified by the WVA model would be more than offset by gains from the regular beneficial use of dredged material for shoreline nourishment at Texas Point. This BU feature complies with another goal of the CCP—the restoration of sediment supply to the Gulf's nearshore littoral zone at Texas Point NWR through the beneficial use of dredged material. Other CCP goals (restoration of hydrology by reducing saltwater intrusion with rock weirs or earthen plugs in Texas Bayou, and using dredged material to restore mineral sediment to interior marsh) were thoroughly evaluated in the screening of BU and mitigation measures. Construction of rock weirs or earthen plugs at Texas Bayou were determined to be ineffective in reducing saltwater intrusion. The beneficial use of dredged material to restore interior marsh would be feasible, but the cost would exceed the Traditional Placement Plan. The latter goal could be pursued if a non-Federal sponsor offers to pay the incremental cost of construction. The SNWW CIP does not conflict with any of the refuge expansion goals of the Texas Point NWR.

## 7.24 SABINE NATIONAL WILDLIFE REFUGE COMPLEX COMPREHENSIVE CONSERVATION PLAN

The Sabine NWR is part of the Southwest Louisiana National Wildlife Refuge Complex, which also includes Cameron Prairie and Lacassine NWRs to the east within Cameron Parish, and Shell Keys NWR in Iberia Parish. Only the western portion of the Sabine NWR (portions of Unit 5, excluding Pool 3, Unit 6, and Unit 7) is located within the SNWW study area. The refuge contains a diversity of habitat including extensive coastal marshes and open water, wooded ridges and levees, canals, ponds, and bayous. The refuge provides habitat for many species of wildlife, including ducks, geese, alligators, muskrats, nutria, raptors, wading birds, shorebirds, blue crabs, shrimp, and finfish. It is one of the primary overwintering refuges for waterfowl in the Mississippi Flyway.

Overall, the greatest risk to fish, wildlife, plants, and their habitats in the Chenier Plain ecosystem is from extensive wetland habitat degradation and loss that has occurred over the past century. Wetlands in the Chenier Plain declined 16 percent from the mid-1960s to 1990. These habitat losses have led to commensurate impacts on wildlife populations, especially those dependent on wetlands. These losses have prompted the USFWS to implement a 15-year protection plan to facilitate wetland preservation and restoration, a most important wildlife conservation priority of the Gulf Coast ecosystem.

The CCP provides a 15-year vision to identify and propose solutions to significant problems that may adversely affect the populations and habitats of fish, wildlife, and plants and the actions necessary to correct or mitigate such problems (USFWS, 2008b). CCP primary goals include (1) maintaining, restoring, and enhancing unique coastal wetland habitats on the refuge to provide favorable conditions to improve species diversity and richness of migratory birds and native terrestrial and aquatic species; and (2) maintaining healthy and viable wildlife and fish populations on the refuge to contribute to the purpose for which it was established.

The Preferred Alternative would impact the first goal of the CCP by causing small increases in salinity and land loss, and related decreases in productivity within the intermediate, brackish, and saline marshes of the refuge. However, losses as quantified by the WVA model would be more than offset by gains from the regular beneficial use of dredged material for shoreline nourishment at Louisiana Point and other BU features associated with the project in Texas. In addition, it is proposed that two of the compensatory mitigation measures proposed for the SNWW CIP be located within the Sabine NWR. These measures would employ one of the management strategies recommended by the CCP—using dredged material to restore mineral sediment to emergent marsh in degraded areas of the refuge. In the long term, these mitigation areas would contribute to the restoration of habitat and maintenance of healthy fish and wildlife populations in the refuge.

## 7.25 TEXAS COASTWIDE EROSION RESPONSE PLAN

The Texas Coastwide Erosion Response Plan has identified several parts of the study area as “critical erosion areas” because of impacts to habitats and traffic safety from ongoing erosion, and has called for an increase in the beneficial use of dredged material from the SNWW project to help address these issues. The plan was developed as part of the CEPRA (GLO, 2004, 2005). The program has identified the Gulf shoreline between Texas Point and Sea Rim State Park as a critical erosion area. It attributes the erosion, in part, to a lack of sediment coming down the Sabine and Neches rivers, and the interruption of longshore sediment transport by the SNWW jetties. The CEPRA Plan recommends that long-term regional sediment management be utilized, along with highway realignment and beach dune restoration, to protect the important coastal evacuation route of SH 87 in Jefferson County. In Orange County, the CEPRA Plan calls for restoration of 9,400 acres of marsh in the Lower Neches River using dredged material to raise soil elevations in the former marsh areas that have become open water. The Preferred Alternative would address some of the ongoing problems by using maintenance material for shoreline nourishment at Texas Point and by restoring and nourishing approximately 5,000 acres of marsh in the Lower Neches River floodplain.

## 7.26 LOUISIANA COAST 2050

In Louisiana, the Coast 2050 is a comprehensive, ecosystem-based restoration plan, completed in 1998 to address coastal wetland loss throughout southern Louisiana. Planning involved Federal, State, and local entities, landowners, environmentalists, wetland scientists, and others in the development of an integrated,

multiple-use approach to ecosystem management. A major funding source for these projects comes from the Federal CWPPRA. The SNWW is located in Region 4 of this plan.

The goals of Coast 2050 are to:

- Sustain coastal ecosystem with the essential functions and values of the natural ecosystem
- Restore the ecosystem to the highest practicable acreage of productive and diverse wetlands
- Accomplish this restoration through an integrated program that has multiple use benefits

In the Sabine Lake area, Coast 2050 strategies include:

- Maintain Sabine River inflow
- Beneficial use of dredged material for marsh creation
- Seasonally operated locks at the mouths of navigation channels to relieve salinity stress on marshes

Detailed strategies for specific areas are described in the Coast 2050: Toward a Sustainable Coastal Louisiana (LCWCR/WCRA, 1998). The USACE, New Orleans District, and LDNR prepared the *Louisiana Coastal Area Feasibility Study* to provide the necessary technical data required to implement the conceptual plan of the Coast 2050 document (USACE, 2004a). The Preferred Alternative would impact the first goal of the Coast 2050 Plan by causing small increases in salinity and land loss, and small decreases in productivity. However, these losses would be fully compensated by marsh restoration mitigation measures in the Willow and Black bayou watersheds.

## 7.27 LOUISIANA COASTAL AREAS ECOSYSTEM RESTORATION STUDY AND PLAN

The LCA Ecosystem Restoration Study (USACE, 2004a) documented the most critical human and natural needs of the endangered Louisiana coastal area, identified short- and long-term critical priorities, and recommended large-scale, long-term studies that were beyond the scope of that study. The eastern half of the SNWW study area is located in the western part of Region 4, the Chenier Plain. Without any preservation or restoration actions, the report predicted that Sabine Lake wetlands would continue to experience severe wetland deterioration and land loss due to increased salinity levels and marine influences from the SNWW and the GIWW, relative sea level change, tropical storms, oil and gas infrastructure, sediment reduction/vertical accretion deficit, and saltwater intrusion resulting from diminished freshwater inflow.

For Region 4 as a whole, existing rates of habitat loss are predicted to continue, resulting in the loss by 2050 of 9.8 percent of existing fresh marsh, 16.3 percent of intermediate marsh, 100 percent of saline marsh, and 33.3 percent of swamp habitat. Brackish marsh and open water are predicted to increase by 46.5 and 11.4 percent, respectively. This would reduce habitat diversity and result in a long-term loss of an estimated 37 square miles of land loss.

The LCA report did not recommend any near-term critical restoration features for congressional authorization or additional study in Region 4. While beneficial use of dredged material from the Calcasieu Channel is recommended for wetlands adjacent to that channel, no beneficial use projects are identified for the marshes along the eastern shore of Sabine Lake. A long-term, large-scale study of freshwater and sediment management in the Chenier Plain was recommended and this would include the portion of the SNWW study area east of Sabine Lake and the Sabine River. The Preferred Alternative does not include any features that would conflict with future restoration features. Impacts of the proposed project would be fully compensated by the marsh mitigation measures.

## 7.28 LOUISIANA'S COMPREHENSIVE MASTER PLAN

Louisiana has developed a coastal master plan that integrates planning for ecosystem restoration and hurricane protection in planning for a sustainable coast (LCPRA, 2007). The master plan establishes a clear set of priorities for comprehensive coastal protection in Louisiana. In the Chenier Plain, the plan notes that navigation channels and canals have allowed salt water to penetrate inland, destroying fringe marsh and impinging on freshwater lakes. The plan recommends the development of a new plan to develop appropriate measures to address these impacts. Portions of the plan that affect the SNWW study area are as follows. The Chenier Plain Freshwater and Sediment Management and Reallocation Plan suggests managing river and surface fresh water supplies to ensure availability of fresh water throughout the year. This management would also permit the delivery of fresh water to areas exposed to saltwater stress. It is suggested that the GIWW could be used as a conduit to distribute fresh water from the Atchafalaya River toward marshes to the west. The plan also seeks to maintain the integrity of freshwater resources by raising and fortifying selected portions of SH 82, installing segmented offshore breakwaters to protect the barrier shoreline, fortifying dredged material banks along the GIWW, and placing saltwater barriers on the SNWW to manage salinity levels. The plan recognizes that safe and efficient navigation must be maintained when implementing such a project. It suggests that a barrier could be operated periodically to manage saltwater intrusion events. Marsh restoration using dredged material from maintenance dredging of navigation channels is also recommended. In planning hurricane protection structures, the plan emphasizes nonstructural solutions such as flood insurance, elevating and retrofitting structures, and revising building codes. No structural solutions for hurricane protection are recommended for the study area. The State's Annual Plan would be the vehicle for presenting yearly scheduling and cost information about proposed projects. The Preferred Alternative does not include any features that would conflict with restoration priorities of this plan. Impacts of the proposed project would be fully compensated by marsh mitigation measures.

## 7.29 LOUISIANA COASTAL PROTECTION AND RESTORATION

In February 2008, the Louisiana Coastal Protection and Restoration Draft Technical Report was released for public review and comment (USACE, 2008a). The study was conducted as a joint effort of the Federal government and the State of Louisiana to investigate and integrate hurricane risk reduction and coastal restoration for south Louisiana. The purpose of the report is to describe the progress that the USACE has

made in this effort, which is mandated by the Energy and Water Development Appropriation Act of 2006 and the Department of Defense, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico, and Pandemic and Influenza Act, 2006. Additional time would be needed for the USACE to complete the comprehensive hurricane analysis and design for south Louisiana due to engineering, environmental, and economic complexities. The Louisiana Coastal Protection and Restoration effort is closely tied to Louisiana's Comprehensive Master Plan discussed above. The report does not make recommendations for project authorizations, appropriations, or nongovernmental decisions. It describes methodologies used to perform the technical evaluation and the process used to engage stakeholders.

One of the most significant accomplishments is the development and application of numerical models that replicate hurricane surges and determine the statistical frequency of events along the entire Louisiana coast. This effort has vastly improved the ability of the USACE to evaluate hurricane threats along the northern Gulf coast, including storm surge and wave effects. The Louisiana Coastal Protection and Restoration effort also quantified the risk reduction benefits provided by wetlands. The Louisiana coast is divided into planning units that generally correspond to previously defined subregions. Planning Unit 4 corresponds to Region 4, the Chenier Plain.

Hurricane modeling determined that certain areas of the Gulf are more likely to experience higher-intensity storms. Southeastern Louisiana, Mississippi, and western Alabama were shown to have a higher probability of severe-storm occurrence than elsewhere along the Gulf. The probability of a hurricane greater than Category 2 on the Saffer-Simpson Scale hitting the Gulf coastline in the SNWW study area is 2 percent in any 1 year, half that of the highest probability zone (4 percent in any 1 year). Hurricane Rita is a close comparison to a 100-year storm based on size, intensity, and track. It produced a peak storm surge with an approximately 90-year return interval, compared to the 400-year storm surge of Hurricane Katrina. The Louisiana Coastal Protection and Restoration storm surge modeling projects that a water surface height in the SNWW study area (east of Sabine Lake) with a 100-year storm would range from 15 feet near the coast to 11 feet north of the GIWW near Orange, Texas. Storm surge effects would be felt in the Sabine River valley far north of the current study area. For a 400-year storm, water elevations would range from 19 feet near the coast to 12 feet north of the GIWW near Orange, Texas.

Planning Unit 4 Alternatives located within the SNWW study area are limited to two types: (1) construction of a 12-foot-high levee along the entire GIWW alignment, ending at the Sabine River: and (2) marsh restoration in the marshes east of Sabine Lake. The coastal restoration alternative includes marsh restoration in two areas that are proposed as compensatory mitigation measures for the SNWW CIP (LA 3-10R and LA 3-15). Coastal restoration scored relatively highly in minimizing environmental impacts but did not appear to be a cost-effective measure. The potential for channel deepening proposed in the Preferred Alternative was evaluated with HS modeling conducted for this study. The results of this analysis indicated there would be no significant increase in storm surge effects.

## 7.30 NORTH AMERICAN WATERFOWL MANAGEMENT PLAN

The purpose of the North American Waterfowl Management Plan (NAWMP, Plan Committee, 2004) is to sustain abundant waterfowl populations by conserving landscapes through partnerships that are guided by sound science. The 2004 Plan establishes a new 15-year horizon for waterfowl conservation in North America by assessing and defining needs, priorities, and strategies needed to promote waterfowl conservation in the twenty-first century. The SNWW study area is located in the Gulf Coastal Prairie, an area of continental significance to North American ducks, geese, and swans as it lies within the Central Flyway. The plan focuses on habitat conservation at a continental scale and identifies general objectives for habitat conservation in five key priority regions, including the Gulf Coast Prairie Region. The beneficial use of dredged material to restore degraded marshes is specifically identified as a habitat conservation strategy in this plan. The Preferred Alternative would contribute to plan goals with the restoration and nourishment of approximately 5,000 acres of emergent marsh in the Lower Neches River floodplain and regular shoreline nourishment at Texas and Louisiana Points.

# 8.0 ANY ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PREFERRED ALTERNATIVE BE IMPLEMENTED

The Preferred Alternative would result in minor adverse impacts to benthos and fish from dredging and placement of dredged material but these impacts are temporary. Although the SNWW channel is located primarily in Texas, large indirect impacts may occur due to small increases in salinity levels causing an increase in wetland loss and a decrease in biological productivity in aquatic habitats of both Texas and Louisiana. In Texas, 33,500 acres of intertidal marsh and swamp are expected to be indirectly impacted due to the slight salinity increase as a result of the proposed action. Biological productivity may be reduced over approximately 39,000 acres of tidal marsh and swamp in Texas, with the potential loss of 247 acres of emergent marsh, including 86 acres of fresh marsh that would be converted to an upland PA. Impacts in Louisiana may affect approximately 182,000 acres of tidal, emergent marsh, and potentially result in the loss of about 691 additional acres of marsh within the area of tidal influence. This includes 86 acres of wetland habitat that would be converted to an upland PA. The BU features and compensatory mitigation address wetland loss by restoring a total of 5,636 acres of emergent marsh, 1,828 acres of improved shallow-water habitat, and nourishing 5,589 acres of existing marsh, which more than compensates for wetland losses resulting from a small increase in salinity and enhances the long-term productivity of the study area's ecosystem.

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# 9.0 ANY IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES INVOLVED IN THE IMPLEMENTATION OF THE RECOMMENDED PLAN

The primary impact of the Preferred Alternative is an indirect impact associated with a small increase in salinity and an associated reduction in biological productivity over approximately 211,500 acres of intertidal marsh and swamps in Texas and Louisiana, and the potential resultant loss of about 691 acres of marsh within the area of tidal influence of the SNWW. Benefits of the Neches River BU Feature more than offset the direct impact of conversion of 86 acres of fresh marsh to a confined PA (PA 24A) and the indirect impact of the increase in salinity over 39,000 wetland acres in Texas. The Neches River BU Feature restores 2,853 acres of emergent marsh, improves 871 acres of shallow-water habitat, and nourishes 1,234 acres of existing marsh, providing benefits that offset all project impacts in Texas and all but the loss of 843 AAHUs in Louisiana. The indirect effect of a small increase in Gulf shoreline erosion in both states (totaling approximately 15 acres over the period of analysis) is minimized by the Gulf Shore BU Feature. Compensatory mitigation for unavoidable impacts in Louisiana restores 2,783 acres of emergent marsh, improves 957 acres of shallow-water habitat, and nourishes 4,355 acres of existing marsh in the Willow and Black bayou areas. The BU features and compensatory mitigation address wetland loss by restoring 5,636 acres of emergent marsh, 1,828 acres of shallow-water habitat, and nourishing 5,589 acres of existing marsh, which more than compensates for worst-case wetland losses resulting from a small increase in salinity and enhances the long-term sustainability of the study area ecosystem. Since there would be a time lag before the restored marshes become established and ecologically functional, there would be a temporary loss of productivity during the interim period. Benthic organisms in the Gulf that are buried during initial and subsequent use of the ODMDSs would recover quickly after each use. The productivity of expanded PAs on the Neches River and the Sabine Lake bottom taken for borrow material would be temporarily disrupted, but would shortly be transformed into different habitats that would contribute to the long-term productivity of the SNWW estuary.

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# 10.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

BU features and compensatory mitigation provided under the Preferred Alternative address wetland loss by restoring 5,636 acres of emergent marsh, 1,828 acres of shallow-water habitat, and nourishing 5,589 acres of existing marsh, which more than compensates for worst-case wetland losses resulting from a small increase in salinity and enhances the long-term productivity of the study area ecosystem. Since there would be a time lag before the restored marshes become established and ecologically functional, there would be a temporary loss of productivity during the interim period. Benthic organisms in the Gulf that are buried during initial and subsequent use of the ODMDSs would recover quickly after each use. The productivity of expanded PAs on the Neches River and the Sabine Lake bottom taken for borrow material would be temporarily disrupted, but would shortly be transformed into different habitats that would contribute to the long-term productivity of the SNWW estuary.

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# 11.0 ENERGY AND NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL OF VARIOUS ALTERNATIVES AND MITIGATION MEASURES

NEPA regulations in 40 CFR 1502.16(e) and (f) require a discussion of project energy requirements and natural or depletable resource requirements, along with conservation potential of alternatives and mitigation measures in an EIS.

Under the No-Action Alternative, the energy requirements for maintaining the channel would continue as before. However, the navigation requirements for energy (fuel) to transport commercial products is likely to increase in the future as commerce increases and more traffic increases congestion and navigation time into and out of regional ports. Air quality impacts are likely to increase with an increase in navigation traffic congestion and travel time along the SNWW.

The Preferred Alternative is expected to reduce energy (fuel) requirements for transporting products on a ton/mile basis by deepening the channel and providing bend easings:

- ships can be more heavily loaded with cargo; and
- fewer vessel trips would be required in lightering of crude oil from large ships offshore.

Energy (fuel) would be required to deepen the channel, but this is a short-term impact. Energy to maintain the deeper channel is expected to increase by roughly a factor of two, with the increase in shoal material expected for the larger channel. This increase in fuel requirement is expected to be more than offset by fuel savings in ship traffic in the larger channel and should help reduce air quality impacts slightly over the No-Action Alternative, especially since the largest increase in shoaling is offshore. Increased efficiency in moving petroleum and other petroleum-based commodities to the local refineries is expected to help conserve natural or depletable resources in the future. The reduced energy requirements of the more-efficient channel would result in a smaller increase in transportation costs in the future, which reduces overall production costs for the consumer.

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# 12.0 LIST OF AGENCIES AND ORGANIZATIONS TO WHOM COPIES OF THE FINAL STATEMENT ARE SENT

## 12.1 PUBLIC INVOLVEMENT PROGRAM

The USACE and SNND involved the public through public meetings and other outreach throughout the history of this project. A proactive approach was taken to inform and involve the public, resource agencies, industry, local government, and other interested parties about the project and to identify any public concerns.

The first public scoping meeting was held on May 24, 2000, at the John Gray Center Auditorium, Lamar University, Beaumont, Texas. The purpose of this meeting was to inform the public about the initiation of the feasibility study and to solicit comments on navigation concerns, alternatives to be addressed, and environmental issues and concerns.

The second public scoping meetings were held on May 28, 2002, at the Best Western Hotel, Lake Charles, Louisiana, and May 29, 2002, at the John Gray Center Auditorium, Lamar University, Beaumont, Texas. The purpose of these meeting were to inform the public about study progress and to solicit comments on environmental issues such as changes in salinity and circulation, changes in fresh- and saltwater marshes, water and sediment quality, erosion along the channel, threatened and endangered species impacts, and beneficial use of dredged materials.

Other various forms of outreach utilized during this project included early regulatory agency coordination, ICT, RW, MW, CW, OW, and HW meetings, public workshop to obtain ideas for BU of dredged material, media trips down the waterway, presentations at the GMFMC Texas Habitat Protection Advisory Panel, meetings with the Sabine Pilots Association, presentation at the 2007 Southeast Texas Leaders meeting, meetings with SNWW industries, individual contacts, press releases, and comment forms.

DEIS Public Hearings were conducted on January 26, 2010, at the Beaumont Civic Center in Beaumont, Texas, and on January 27, 2010, at the Lake Charles Civic Center in Lake Charles, Louisiana, to solicit comments and information from the public. Approximately 51 people attended the meeting in Beaumont, and 19 in Lake Charles. An open house was conducted prior to the Public Meetings, which included table-top poster presentations and discussions among the USACE, the SNND, USACE consultants, and the public. Formal presentations were made by SNND and USACE during the public meetings, and then oral comments were taken from the public. These comments were considered when finalizing the FEIS. Transcripts of the DEIS public meetings are presented in Appendix K.

## 12.2 REQUIRED COORDINATION

The FEIS is being circulated to all known Federal, State, and local agencies. Interested organizations and individuals are also being sent notice of availability. A list of those who are being sent a copy of this

document, along with a request to review and provide comments on the documents, is provided in Section 12.3.

### 12.2.1 PUBLIC VIEWS AND RESPONSES

Public views and concerns expressed during this study have been considered during the preparation of this FEIS. The views and concerns were used to develop planning objectives, identify significant resources, evaluate impacts of various alternatives, identify potential PAs, and identify a plan that is socially and environmentally acceptable. Important concerns expressed included the beneficial use of dredged material and recreational opportunities.

Development of alternatives is explained in Section 2. The recommended plan takes into consideration the expressed objectives, views, and concerns of the resource agencies and public. Public comments received are addressed Appendix A5.

## 12.3 STATEMENT RECIPIENTS

The following list includes agencies, organizations, and public that were sent a copy of these documents and/or the Notice of Availability with a request to review and provide comments.

**Organizations**

Bill Bass
Coastal Conservation
Association-Acadiana
P.O. Box 3527
Lafayette, LA 70502

David Bezanson
The Nature Conservancy
816 Congress, #920
Austin, TX 78701

Charles Bollich
Texas Archeological
Stewardship Network
5795 Viking Dr.
Beaumont, TX 77706

Lowell Boudreaux
Lamar University
P.O. Box 10025
Beaumont, TX

Winnie Burkett
Houston Audubon Society
919 Layfair Place
Friendswood, TX 77546

Raymond Butler
Gulf Intracoastal Canal
Association
2010 Butler Drive
Friendswood, TX 77546

David Corban
Fulbright & Jaworski, L.L.P.
Fulbright Tower, 1301
McKinney, Suite 5100
Houston, TX 77010-3095

Mark Davis
Coalition to Restore Coastal
Louisiana
6160 Perkins Road, Suite 225
Baton Rouge, LA 70808

Sherri Droddy
Sabine Pass Port Authority
P.O. Box 318
Sabine Pass, TX 77655

Kenneth Duhon
Navigation District
8174 Boyt Rd.
Beaumont, TX 77713

Lee Elliot
Texas Audubon Society
205 N. Carrizo Street
Corpus Christi, TX 78401-3033

Paul Fontenot
Sierra Club - Acadiana Group
120 Rue Du Jardin
Lafayette, LA 70507-4843

Mike Foster
South East Texas Regional
Planning Commission
2210 Eastex Freeway
Beaumont, TX 77703

Cynthia Goldberg
Gulf Restoration Network
P.O. Box 2245
New Orleans, LA 70176

Richard Harrel
Clean Air & Water
750 Wade
Beaumont, TX 77706

Captain Charles Lahaye
Sabine Pilots Association
5148 W. Parkway
Groves, TX 77619

Rick Jacob
Nature Conservancy of Louisiana
3923 Marie Court
Lake Charles, LA 70607

Larry E. Kelly
Toledo Bend Reservoir, Sabine Parish
210 Hillcrest Drive
Anacocco, LA 71403

Jack Lawrence
Clean Air and Water
5570 Winfree
Beaumont, TX 77705

Bruce Lockett
Texas Archaeological Studies Association
P.O. Box 905
Vidor, TX 77602

Brandt Mannchen
Sierra Club-Lone Star Chapter
5431 Carew
Houston, TX 77096

Richard Martin
Nature Conservancy of Louisiana
P.O. Box 4125
Baton Rouge, LA 70821

Charles McGimsey
University of Southwestern Louisiana, Department of Sociology-Anthropology
P.O. Box 40198
Lafayette, LA 70504

Ehab Meselhe
University of Louisiana at Lafayette, Civil Engineering Department
Abdalla Hall, Room 126
Lafayette, LA 70504-2347

Gretchen Mueller
Audubon Society-Houston
440 Wilchester
Houston, TX 77079

Jerry Norris
Sabine Lake Guide Service
3262 Bell Street
Port Arthur, TX 77640

Todd Brindle
Big Thicket National Preserve, Superintendent
6044 FM 420
Kountze, TX 77625

Steven Peyronnin
Coalition to Restore Coastal Louisiana
6160 Perkins Road, Suite 225
Baton Rouge, LA 70808

Lisa F. Regan
Texas Energy Coalition
6207 Inwood Drive
Houston, TX 77057

Denis Calabrese
Texas Energy Coalition
6207 Inwood Drive
Houston, TX 77057

Cynthia Sarthou
Gulf Restoration Network
P.O. Box 2245
New Orleans, LA 70176

Diane Schenke
The Nature Conservancy Texas City Prairie Preserve
4702 Hwy 146 N
Texas City, TX 77590

Harold Schoeffler
Sierra Club-Acadian Group
P.O. Box 2218
Lafayette, LA 70502

Bruce Sieve
Sierra Club-Groves
4949 Main Ave.
Groves, TX 77619

Ryan Smith
Texas Energy Museum
600 Main Street
Beaumont, TX

Wayne Stupka
Gulf Coast Rod Reel and Gun Club
P.O. Box 8057
Lumberton, TX 77657

Melvin Swoboda
East Texas Regional Water Planning Group
P.O. Box 1089
Orange, TX 77631-0579

Ken Sztraky
Audubon Society-Golden Triangle
P.O. Box 1292
Nederland, TX 77627-1292

Carolyn Thibodeaux
Cameron Preservation Alliance-Sabine Lighthouse, Inc.
P. O. Box 773
Cameron, LA 70631

Louis Trahan
Audubon Society-Acadiana Chapter
707 E. Simcoe St
Lafayette, LA 70501-4524

Rebecca Triche
Coalition to Restore Coastal Louisiana
6160 Perkins Road, Suite 225
Baton Rouge, LA 70808

Captain Charles A. Tweedel
Sabine Pilots Association
5148 West Parkway Drive
Groves, TX 77619

John Whittle
Audubon Society - Golden Triangle
3015 Nashville Ave.
Nederland, TX 77627

John Wesley Paul
Golden Triangle Sierra Club, Conservation Chair
13005 Beaverbrook Street
Lumberton, TX 77657

Gina Donovan
Audubon Society-Houston
440 Wilchester
Houston, TX 77079

Captain Michael Egan
Sabine Pilots Association
5148 W. Parkway
Groves, TX 77619

Don Gohmert
Natural Resources Conservation Service
101 S. Main
Temple, TX 76501

Randy Reese
Navigation District
P.O. Box 778
Nederland, TX 77627

Natalie Snider
Coalition to Restore Coastal Louisiana
6160 Perkins Road, Suite 225
Baton Rouge, LA 70808

Patrick Nugent
Texas Pipeline Association, Executive Director
604 West 14th Street
Austin, TX 78701

Coastal Conservation Association-Louisiana Chapter
P.O. Box 373
Baton Rouge, LA 70821-0373

Coastal Conservation Association-Texas Chapter
6919 Portwest, Suite 100
Houston, TX 77024

The Nature Conservance of Texas
P.O. Box 1440
San Antonio, TX 78295-1440

The Nature Conservancy of Louisiana
P.O. Box 4125
Baton Rouge, LA 70821

**Local Government**

Morris Albright
Chamber - Port Arthur
4749 Twin City Hwy. Suite 300
Port Arthur, TX 77642-5839

Everett Alfred
Jefferson County Commissioner Precinct 4
7780 Boyt Road
Beaumont, TX 77713

Becky Ames
Mayor of Beaumont, Texas
801 Main Street
Beaumont, TX 77704

Francis Andrepont
Calcasieu Parish Police Jury
District 13
1302 Fatima
Sulphur, LA 70663

Eddie Arnold
Jefferson County Commissioner Precinct 1
1149 Pearl Street, 4th Floor
Beaumont, TX 77701

Brad Bailey
Mayor of Groves, Texas
3947 Lincoln Ave.
Groves, TX 77619

Nancy Beaulieu
City of Beaumont
P.O. Box 3827
Beaumont, TX 77704

Guy Brame
Calcasieu Parish Police Jury
District 8
1908 Linden Lane
Lake Charles, LA 70605

Kirk Burleigh
Cameron Parish Police Jury
District 6
P.O. Box 576
Cameron, LA 70631

Owen Burton
Orange County Commissioner Precinct 2
123 South 6th Street
Orange, TX 77630

W. Brown Claybar
Mayor of Orange, Texas
803 W. Green Ave.
Orange, TX 77630

Cindy Clifton
Chamber – Nederland
P.O. Box 891
Nederland, TX 77627

Dr. Alan B. Coleman
City of Beaumont
P.O. Box 3827
Beaumont, TX 77704

Calvin Collins
Calcasieu Parish Police Jury
District 2
2035 Woodring Street
Lake Charles, LA 70601

Brad Corley
Chamber – Groves
4399 Main Ave.
Groves, TX 77619

Daniel Cupit
Mayor of Westlake, Louisiana
1001 Mulberry Street
Westlake, LA 70669-4523

Jimmy Dike
Pleasure Island Commission
520 Pleasure Pier Boulevard
Port Arthur, TX 77640

Mark Domingue
Jefferson County Commissioner Precinct 2
7759 Viterbo Road, Suite 1
Beaumont, TX 77705

David Dubose
Orange County Commissioner Precinct 1
123 South 6th Street
Orange, TX 77630

John Dubose
Orange County Commissioner Precinct 3
123 South 6th Street
Orange, TX 77630

Christopher Duque
City of Nederland - City Manager
P.O. Box 967
Nederland, TX 77627-0967

Les Farnum
Calcasieu Parish Police Jury
District 15
312 Oakley Drive
Sulphur, LA 70663

Darryl Farque
Cameron Parish Police Jury
District 7
10690 Hwy. 384
Lake Charles, LA 70607

Steve Fitzgibbons
City of Port Arthur
P.O. Box 1089
Port Arthur, TX 77641

Becky Ford
Mayor Bevil Oaks, Texas
7390 Sweetgum Road
Beaumont, TX 77713

Sabrina Grey
Greater Orange Area Chamber of Commerce
1012 Green Avenue
Orange, TX 77630

Elizabeth Griffin
Calcasieu Parish Police Jury
District 3
903 North Jake Street
Lake Charles, LA 70601

Kevin Guidry
Calcasieu Parish Police Jury
District 9
4045 Briarfield Lane
Lake Charles, LA 70607

Terri Hanks
City of Port Arthur
P.O. Box 1089
Port Arthur, TX 77641-1089

Ellis Hassien
Calcasieu Parish Police Jury
District 12
4349 Pete Seay Road
Sulphur, LA 70665

Kyle Hayes
City of Beaumont - City Manager
801 Main Street, Suite 300
Beaumont, TX 77701

Glenn Johnson
Mayor of Port Neches, Texas
P.O. Box 758
Port Neches, TX 77651

Phil Kelly
Jefferson County Drainage District No. 7
P.O. Box 3244
Port Arthur, TX 77642

Chris Landry
Calcasieu Parish Police Jury
District 7
4336 Oaklawn
Lake Charles, LA 70605

Ronald Lelux
Mayor of Sulphur, Louisiana
101 N. Huntington St.
Sulphur, LA 70663

Dr. Charles Mackey
Calcasieu Parish Police Jury
District 5
1215 9th Street
Lake Charles, LA 70601

Thomas McDaniel
Cameron Parish Police Jury
District 4
P.O. Box 274
Creole, LA 70632

Mangus McGee
Cameron Parish Police Jury
District 1
121 Alvin Lane
Cameron, LA 70631

Hal McMillin
Calcasieu Parish Police Jury
District 14
1423 N. Beech Street
Westlake, LA 70669

S. Mark McMurry
Calcasieu Parish Police Jury
Administrator
1015 Pithon Street, 2nd Floor
Lake Charles, LA 70602

Randy Miller
Imperial Calcasieu Regional Planning & Development Commission
P.O. Box 3164
Lake Charles, LA 70602

Beamon Minton
Orange County Commissioner
Precinct 4
123 South 6th Street
Orange, TX 77630

R.A. "Dick" Nugent
Mayor of Nederland, Texas
P.O. Box 967
Nederland, TX 77627

Shawn Oubre
City of Orange - City Manager
P.O. Box 520
Orange, TX 77630

Jose Pastrana
Jefferson County Engineer
1149 Pearl Street, 5th Floor
Beaumont, TX 77701

W.L. Pate, Jr.
City of Beaumont
P.O. Box 3827
Beaumont, TX 77704

James Porter
Imperial Calcasieu Regional Planning & Development Commission
P.O. Box 3164
Lake Charles, LA 70602

Charles Prect
Cameron Parish Police Jury
District 3
159 W. Precht Rd.
Sweet Lake, LA 70630

Deloris "Bobbie" Prince
Mayor of Port Arthur, Texas
P.O. Box 1089
Port Arthur, TX 77641

Steve Racca
Cameron Parish Police Jury
District 2
478 Myers Rd.
Hackberry, LA 70645

Mary Ann Reid
Chamber - Port Arthur
4749 Twin City Hwy. Suite 300
Port Arthur, TX 77642-5839

Jim Rich
Beaumont Chamber of Commerce
1110 Park Street
Beaumont, TX 77701

Randy Roach
Mayor of Lake Charles, Louisiana
326 Pujo Street, 10th Floor
Lake Charles, LA 70601

Kirk Roccaforte
Mayor of Bridge City, Texas
260 Rachal Drive
Bridge City, TX 77611-0846

Audwin M. Samuel
City of Beaumont
P.O. Box 3827
Beaumont, TX 77704

Dennis Scott
Calcasieu Parish Police Jury
District 6
5733 Bennie Lane
Lake Charles, LA 70605

Michael Sinegal
Jefferson County Commissioner
Precinct 3
525 Lakeshore Dr.
Port Arthur, TX 77640

Jamie D. Smith
City of Beaumont
P.O. Box 3827
Beaumont, TX 77704

Shannon Spell
Calcasieu Parish Police Jury
District 1
2296 Pinon
Lake Charles, LA 70611

Tony Stelly
Calcasieu Parish Police Jury
District 10
Post Office Box 439
Iowa, LA 70647

Kenneth Stinson
Mayor of Vinton, Louisiana
1200 Horridge Street
Vinton, LA 70668

David Studdert
Mayor of Nome, Texas
P.O. Box D
Nome, TX 77629

George Swift
Chamber of Commerce for Southwest Louisiana
P.O. Box 3110
Lake Charles, LA 70602-3110

Claude Syas
Calcasieu Parish Police Jury
District 4
2506 13th Street
Lake Charles, LA 70601

Carl Thibodeaus
Orange County Judge
123 South 6th Street
Orange, TX 77630

Scott Trahan
Cameron Parish Police Jury
District 5
PO Box 235
Creole, LA 70632

Sandra Treme
Calcasieu Parish Police Jury
District 11
920 Overton
DeQuincy, LA 70633

Ronald Walker
Jefferson County Judge
1149 Pearl Street
Beaumont, TX 77701

Fred Jackson
Jefferson County Courthouse
1149 Pearl Street, 4th Floor
Beaumont, TX 77701

John Walker
Mayor of China, Texas
P.O. Box 248
China, TX 77613

Kenneth Williams
City of Nome
P.O. Box D
Nome, TX 77629

Gethrel Williams-Wright
City of Beaumont
P.O. Box 3827
Beaumont, TX 77704

André Wimer
City of Port Neches - City Manager
P.O. Box 758
Port Neches, TX 77651

Cameron Parish Chamber of Commerce
433 Marshall Street
Cameron, LA 70631

Jefferson County
1149 Pearl Street
Beaumont, TX 77701-3619

Nederland Chamber of Commerce
1515 Boston Ave
Nederland, TX 77627

Port Arthur Chamber of Commerce
4749 Twin City Highway, Suite 300
Port Arthur, TX 77642

Port Neches Chamber of Commerce
P.O. Box 445
Port Neches, TX 77651

Myles Hebert
Coastal Zone Administrator, Flood plain Administrator and Chief Building Official
P.O. Box 1280
Cameron, LA 70631

Fred Jackson
Jefferson County Judge's Office
1149 Pearl, 4th Floor
Beaumont, TX 77701

Taylor Shelton
City of Port Neches
P.O. Box 758
Port Neches, TX 77651

**Libraries**

Kun-Woo Choi
Elmo Willard Library
3590 East Lucas
Beaumont, TX 77701

Library Director
City of Orange Public Library
220 N. 5th Street
Orange, TX 77630

Library Director
Marion & Ed Hughes Public Library
2712 Nederland Ave.
Nederland, TX 77627

Jose Martinez
Port Arthur Public Library
4615 9th Avenue (at Highway 73)
Port Arthur, TX 77642

Mary Montgomery
Bridge City Public Library
101 Parkside Drive
Bridge City, TX 77611

Gwendolyn Pierre
Theodore Johns Branch Library
4255 Fannett
Beaumont, TX 77701

Geri Roberts
Beaumont Public Library
801 Pearl
Beaumont, TX 77701

Michael Sawyer
Calcasieu Parish Public Library
301 W. Claude Street
Lake Charles, LA 70605

Jim Shoemaker
R. C. Miller Library
1605 Dowlen
Beaumont, TX 77701

**Consultants**

Chris Claunch
Shiner Moseley & Assoc.
3300 S. Gessner #111
Houston, TX 77063

Ed Fike
Coastal Environments, Inc.
1260 Main St.
Baton Rouge, LA 70802

**General Public**

American Eagle
American Press
Ameripol Synpol Corporation
Chief Michael Amos
Donnie Ancelet
Leslie Appelt
Eddie Arnaud
Lawrence Aten
AtoFina
D. Babin
Greg Baehr
Curtis Baker
Scott Bare
Delores Barnhill
Barbara Batty
Larry Beaulieu
Rodney Begnaud
James Bel
Regina Bell
Braxton Bennett
Deodat Bhagwandin
Gene Bouillion
Thomas Brent
Rickey P. Brouillette
Rene Broussard
Richard Bryan
Hermie Bundick
Ralph Burch
Tom Burger
Dwayne Burton
Marty Byrd
Clifton Cabell
James Cacioppo
Kim Carroll
Steve Carroll
Centana Intrastate Pipeline
Dan Chand
Citgo Pipeline Company
Dickie Colburn
Henry Combs
Todd Connel
David Conner
Bruce Connery
Bobby Cooper
Jayme Cox
Crain Brothers Inc.
Bryan Crismon
Bucky Crisp
Catherine Cunningham
Kelly Cupero
DCP Midstream, LLC
Susan Davenport
Anne Demuth
Byron DePrang
Jere Dial
Don Dodd
William Doré
Gina Dorsey
Keith Dosch
Melvin Douglas
Ducks Unlimited Texas Field Office
Dunan Entergy Partners, L.P.
Eugene E. Durand
John Durkay
E.I. DuPont de Nemours
Econo Rail Corp
Jim Ephraim
FOCC (Refinery)
George Fereday
David Fisher
Chris Fisher
Delbert Fore
Billy Fortier
Johnny Frederick
Grant Freund
Paul Friesema
Ginger Funk
Sherwood Gagliano
Phil Gamble
George Gardner

Floyd Gaspard
James Gentz
Great Lakes Carbon
Glenn Green
Gulf South Pipeline Company, L.P.
Donald Hall
Neil Harrison
Michael Heim
Carl Henderson
Michael Hluza
Donald Hofer
Don Hofer
T. Hooks
George Horton
Cecil Howard
Tim Huffer
I.M. Skaugen SE
Investa, B.V.
Kathleen Jackson
Skip James
David Janwich
Raymond Johnson
Roy Johnson
Stan Johnson
Justin Jones
Raymond Jordan
Ron Joseph
James Kaucher
Lori Keeter
George Kelly
Bill Kimbrough
Gary King
Jim King
John Knippa
James Krohe
Kudu Limited II, Inc.
Mary LaBlanc
Lake Charles American Press
Tom Lassiter
Matt Long
Susan Ludwig
Fred Manhart
Josh Martin
Linda Mathews
Masao Mayorga
Lynn McCall
David McMasters
Karen McMillin
Chris T. McPike
Jake Messina
Military Sealift
Frederic Miller
Ike Mills
Stephen Mills
Julea Mitchell
Mobile Oil Corp
Ronald Moon
Dennis Moon
Motiva Enterprises, LLC
Charles Nelson
C. Newell
Patrick Nwakoby
Richard Osburn
Jerry Outremari
Hubert Oxford
Hubert Oxford, III
Hubert Oxford, IV
Panhandle Eastern Corp
Clay Pelloat
David Petty
Vernon Pierce
Ervin Polnick
Port Arthur News
Port City Petroleum, Inc.
Premcor
Darryl Reed
Miles Resnick
Randy Richard
David Richard
Gordon Ricossa
G. Grant Roane
Captain Robinson
James Robinson
John Roby
Catherine Rourke
Steve Russell
Sherrill Sagrera
Andre' Says
Terry Schwertner
Dick/Bill Scott
Pete Shelton
Linda Sickels
Allen Sims
Bryan Speaght
Ted Springs
Hunt Sproull
Daniel Stahl
Mike Stafford
Bill Stanisfer
Hercel Stracener
Philip Stock
Dave Suter
Stephen Swetish
Joe Sydes
TPC Group, Inc.
Arthur Thomas
Cathy Thornton
Collin Thorp
Dennis Tindall
Gabriel Trevino
Robert Troxell
James Tucker
Keith Tyree
Jim Uncapher
Mark Underhill
Unocal
Chuck Uzzle
Vastar Resources, Inc.
Rusty Vincent
Dan Wallach
Aubrey Webb
Donna Weifenbach
Milton Westbrook
Jim Westgate
Michael Weston
Bernard Wheeler
Sam Whitehead
Wayne Wilbur
Melinda Winn
Rick Williams
Lester Winfree
Albert Zipp
Julia Zolandz

**State Representatives**

Honorable Charles Boustany
United States Senator
1117 Longworth House Office Building
Washington, DC 20515-1807

Charles Boustany
U.S. House of Representatives, 7th District of Louisiana
Capital One Tower, One Lakeshore Drive Ste. 1135
Lake Charles, LA 70629

Kevin Brady
U.S. House of Representatives, 8th District of Texas
301 Cannon House Office Building
Washington, DC 20515

Kevin Brady
U.S. House of Representatives, 8th District of Texas
420 Green Ave,
Orange, TX 77630

Honorable John Cornyn
United States Senator
517 Hart Senate Office Building
Washington, DC 20510

Honorable John Cornyn
United States Senator
5300 Memorial Drive, Suite 980
Houston, TX 77007

Michael Danahay
Louisiana State Representative, District 33
1625 Beglis Parkway
Sulphur, LA 70663

Michael Danahay
Louisiana State Representative, District 33
P.O. Box 44486
Baton Rouge, LA 70804-4486

Michael E. Danahay
Louisiana State Representative, District 33
1625 Beglis Pkwy.
Sulpher, LA 70663

Joseph Deshotel
Texas State Representative District 22
P.O. Box 2910
Austin, TX 78768

Joe Deshotel
Texas State Representative District 23
One Plaza Square, Suite 203
Port Arthur, TX 77642

Brett Geyman
Louisiana State Representative, District 35
P.O. Box 12703
Lake Charles, LA 70612-2703

Brett Geyman
Louisiana State Representative, District 35
P.O. Box 44486
Baton Rouge, LA 70804-4486

Garrett Graves
Governor's Office of Coastal Activities
Capitol Annex 1051 N. 3rd Street, Suite 138
Baton Rouge, LA 70804

Al Green
U.S. House of Representatives, 9th District of Texas
3003 South Loop West, Suite 460
Houston, TX 77054

Mike Hamilton
Texas State House of Representatives District 19
P.O. Box 2910
Austin, TX 78768

Mike Hamilton
Texas State House of Representatives District 19
P.O. Box 119
Mauriceville, TX 77626

Dorthy Sue Hill
Louisiana State Representative, District 32
529 Tramel Rd.
Dry Creek, LA 70637

Joan Huffman
Texas State Senator, District 17
6217 Edloe
Houston, TX 77005

Joan Huffman
Texas State Senator, District 17
P.O. Box 12068, Capitol Station
Austin, TX 78711

Honorable Kay Hutchison
United States Senator
284 Russell Senate Office Building
Washington, DC 20510-4304

Honorable Kay Hutchison
United States Senator
1919 Smith Street, Suite 800
Houston, TX 77002

Chuck Kleckley
Louisiana State Representative, District 36
130 Jamestown Rd.
Lake Charles, LA 70605

Honorable Mary Landrieu
United States Senator
328 Hart Senate Office Building
Washington, DC 20510

Honorable Mary Landrieu
United States Senator
Capital One Tower, One Lakeshore Drive Ste. 1260
Lake Charles, LA 70629

Dan Morrish
Louisiana State Senate, District 25
119 W. Nezpique Street
Jennings, LA 70546

Dan Morrish
Louisiana State Senate, District 25
P.O. Box 94183
Baton Rouge, LA 70804

Ms. Willie Mount
Louisiana State Senate, District 27
P.O. Box 94183
Baton Rouge, LA 70804

Ms. Willie Mount
Louisiana State Senate, District 27
P.O. Box 3004
Lake Charles, LA 70602

Jonathan Perry
Louisiana State Representative, District 47
407 Charity Street, Suite 102
Abbeville, LA 70501

Jonathan Perry
Louisiana State Representative, District 47
P.O. Box 44486
Baton Rouge, LA 70804-4486

Ted Poe
U.S. House of Representatives, 2nd District of Texas
301 Cannon House Office Building
Washington, DC 20515

Ted Poe
U.S. House of Representatives, 2nd District of Texas
505 Orleans Street, Suite 100
Beaumont, TX 77701

Alan Ritter
Texas House of Representatives, District 21
P.O. Box 1265
Nederland, TX 77627

Alan Ritter
Texas House of Representatives, District 21
P.O. Box 2910
Austin, TX 78768

John Smith
Louisiana State Senate, District 30
P. O. Box 94183
Baton Rouge, LA 70804

John Smith
Louisiana State Senate, District 30
611-B South 5th Street
Leesville, LA 71446

Honorable David Vitter
United States Senator
516 Hart Senate Office Building
Washington, DC 20510

Honorable David Vitter
United States Senator
3221 Ryan Street, Suite E
Lake Charles, LA 70601

Tommy Williams
Texas State Senator District 4
P.O. Box 8069
The Woodlands, TX 77387

Tommy Williams
Texas State Senator District 4
P.O. Box 12068, Capitol Station
Austin, TX 78711

**State Agencies**

David Schanbacher
Chief Engineer/Deputy Director, Texas Commission on Environmental Quality
P.O. Box 13087, Mail Code 168
Austin, TX 78711-3087

Glen Shankle
Executive Director, Texas Commission on Environmental Quality
P.O. Box 13087, Mail Code 109
Austin, TX 78711-3087

Mike Rezsutek
J.D. Murphree Wildlife Management Area
10 Parks and Wildlife Drive
Port Arthur, TX 77640

James Sutherlin
J.D. Murphree Wildlife Management Area
10 Parks and Wildlife Drive
Port Arthur, TX 77640

James Brent
Louisiana Department of Environmental Quality
1209 Leesville Avenue
Baton Rouge, LA 70802

Billy Eakin
Louisiana Department of Environmental Quality
1301 Gadwall
Lake Charles, LA 70615

Kevin Natali
Louisiana Department of Environmental Quality, Southwest Regional Office
1301 Gadwall
Lake Charles, LA 70615

Jamie Phillippe
Louisiana Department of Environmental Quality, Water Permits Division
602 N. 5th Street
Baton Rouge, LA 70802

Greg DuCote
Louisiana Department of Natural Resources, Interagency Affairs/Field Services Division
617 North 3rd Street, 10th Floor, Suite 1078
Baton Rouge, LA 70804-4027

Terry Howey
Louisiana Department of Natural Resources, Coastal Management Division
617 North 3rd Street, Suite 1078
Baton Rouge, LA 70804-4027

Brian Marcks
Louisiana Department of Natural Resources, Coastal Management Division, Consistency Section 617 North 3rd Street, Suite 1078
Baton Rouge, LA 70804-4027

Kirk Rhinehart
Louisiana Department of Natural Resources, Office of Coastal Protection and Management
450 Laurel Street, Suite 1501
Baton Rouge, LA 70801

Kyle Balkum
Louisiana Department of Wildlife & Fisheries
2000 Quail Drive
Baton Rouge, LA 70808

Ismail Merhi
Louisiana Dept of Natural Resources, Office of Coastal Protection and Restoration (OCPR)
450 Laurel Street, Suite 1200
Baton Rouge, LA 70804-4027

Rachel Watson
Louisiana Office of Cultural Development, Division of Archeology
P.O. Box 44247
Baton Rouge, LA 70804

Scott Hutcheson
Louisiana State Historic Preservation Officer
State Capital Annex, 1051 North 3rd Street, Suite 405
Baton Rouge, LA 70802

Lonnie Arrington
Lower Neches Valley Authority
P.O. Box 5117
Beaumont, TX 77708

Dr. Brian Babin
Lower Neches Valley Authority
P.O. Box 5117
Beaumont, TX 77708

Jimmie Cooley
Lower Neches Valley Authority
P.O. Box 5117
Beaumont, TX 77708

Scott Hall
Lower Neches Valley Authority
P.O. Box 5117
Beaumont, TX 77708

Steven McReynolds
Lower Neches Valley Authority
P.O. Box 5117
Beaumont, TX 77708

James Webb
Lower Neches Valley Authority
P.O. Box 5117
Beaumont, TX 77708

Koy Howard
Mobile Source Team, Texas Commission on Environmental Quality
P.O. Box 13087, Mail Code 164
Austin, TX 78711-3087

Office of the Governor of Louisiana
P.O. Box 94004
Baton Rouge, LA 70804-9004

Office of the Governor of Texas
P.O. Box 12428
Austin, TX 78711-2428

Donna Phillips
Regional Director, TCEP
5425 Polk Ave, Ste H
Houston, TX 77023-1452

Jerry Clark
Sabine River Authority of Texas
12777 N. Highway 87
Orange, TX 77630

Stanley Mathews
Sabine River Authority of Texas
PO Box 579
Orange, TX 77631

James East
Sabine River Authority
2760 Shadowwood Dr.
Sulphur, LA 70663

Mark Howard
Sabine River Authority
P.O. Box 579
Orange, TX 77631

Jim Brown
Sabine River Authority
P.O. Box 579
Orange, TX 77631

Jack Tatum
Sabine River Authority
P.O. Box 579
Orange, TX 77631

Gerard Sala
Sabine River Authority
P.O. Box 579
Orange, TX 77631

John Payne
Sabine River Authority
P.O. Box 579
Orange, TX 77631

James Pratt
Sabine River Authority, Louisiana
15091 Texas Highway
Many, LA 71449

Jim Washburn
Sabine River Authority-Toledo Bend
Route 1, Box 270
Burkeville, TX 75932

Paul Beard
Sabine-Neches Navigation District
3220 Eugenia Ln.
Groves, TX 77619

Clayton Henderson
Sabine-Neches Navigation District
2348 Highway 69 North
P.O. Box 778
Nederland, TX 77627

Randall Reese
Sabine-Neches Navigation District
P.O. Box 778
Nederland, TX 77627

Mark Fisher
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, TX 78753

Robert Hansen
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, TX 78753

Ron Pedde
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, TX 78753

James Moore
Texas Commission on Environmental Quality
ATTN: Michelle Horrocks, Water Quality Section
12100 Park 35 Circle, MC-150
Austin, TX 78753

Raul Cantu
Texas Department of Transportation
125 East 11th Street
Austin, TX 78701

Paul Smith
Texas Department of Transportation
8350 Eastex Freeway
Beaumont, TX 77708-1701

John V. Moser
Texas Department of Transportation, Port Arthur Area Office
8350 Eastex Freeway
Beaumont, TX 77708-1701

William Grimes
Texas General Land Office
P.O. Box 12873
Austin, TX 78711-2873

Tom Calnan
Texas General Land Office, Coastal Management Division
P.O. Box 12873
Austin, TX 78711-2873

Tammy Brooks
Texas General Land Office, Coastal Management Program
Stephen F. Austin Building, 1700 North Congress Avenue
Austin, TX 78701-1495

James E. Bruseth
Texas Historical Commission
P.O. Box 12276
Austin, TX 78711-2276

Mark Wolfe
Texas Historical Commission, Texas State Historic Preservation Officer
1551 Colorado
Austin, TX 78701

Terry Stelly
Texas Parks & Wildlife - Coastal Fisheries
601 Channelview
Port Arthur, TX 77640

Jerry Mambretti
Texas Parks & Wildlife Dept.
601 Channelview
Port Arthur, TX 77640

William Schubert
Texas Parks and Wildlife
1502 FM 517
Dickinson, TX 77539

Dean Bossert
Texas Point National Wildlife Refuge
6144 Terry Lane
Port Arthur, TX 77640

Carla Guthrie
Texas Water Development Board, Hydrologic and Environmental Monitoring Division
1700 N. Congress Ave.
Austin, TX 78701

Junji Matsumoto
Texas Water Development Board, Hydrologic and Environmental Monitoring Division
1700 N. Congress Ave.
Austin, TX 78701

Jerry Patterson
Texas General Land Office, Commissioner
Stephen F. Austin Building
1700 North Congress Avenue
Austin, TX 78701-1495

Jimmy Anthony
Louisiana Department of Wildlife & Fisheries
2000 Quail Drive
Baton Rouge, LA 70808

**Federal Government**

Steve Bainter
U.S. Environmental Protection Agency, Region 6, Ocean Dumping Coordinator
1445 Ross Ave, Suite 1200
Dallas, TX 75202-2733
Jim Herrington

U.S. Environmental Protection Agency
720 East Blackland Road
Temple, TX 76502

Mike Jansky
U.S. Environmental Protection Agency, Region 6, Office of Planning and Coordination
1445 Ross Ave., Suite 1200
Dallas, TX 75202-2733

Barbara Keeler
Environmental Protection Agency, Region 6
1445 Ross Ave, Suite 1200
Dallas, TX 75202-2733

Robert Lawrence
Environmental Protection Agency, Region 6
1445 Ross Avenue
Dallas, TX 75202-2733

Jeff Riley
Environmental Protection Agency, Region 6
1445 Ross Avenue
Dallas, TX 75202-2733

Donna Anderson
U.S. Fish and Wildlife Service
17629 El Camino Real Road, Suite 211
Houston, TX 77058-3051

David Bernhart
National Marine Fisheries,
ARA, Protected Resources
Division
NMFS-SERO, 263 13th Ave
South
St. Petersburg, FL 33701-5511

Aja Bonner
Centers for Disease Control and
Prevention Current Rotation
4770 Buford Hwy, Bldg 106
Atlanta, GA 30341

Darryl Clark
U.S. Fish & Wildlife Service-
Ecological Services
646 Cajundome Blvd Suite 400
Lafayette, LA 70506

Tim Cooper
Texas Chenier Plain National
Wildlife Refuge Complex
P.O. Box 278
Anahuac, TX 77514

Miles Croom
National Marine Fisheries,
Habitat Conservation Division
263 14th Avenue South
St. Petersburg, FL 33701-5505

Brigette Firmin
U.S. Fish and Wildlife Service
646 Cajundome Blvd Suite 400
Lafayette, LA 70506

Robert Gosnell
Southwest Louisiana National
Wildlife Refuge Complex
Headquarters
1428 Highway 27
Bell City, LA 70630

Richard Hartman
National Marine Fisheries
c/o Louisiana State University
Baton Rouge, LA 70803

David Keys
NOAA Fisheries, NEPA
Coordinator, NMFS-SERO
263 13th Ave South
St. Petersburg, FL 33701-5511

William Klein
USACE, New Orleans District
7400 Leake Ave, Room 137
New Orleans, LA 70118

Ronald Land
Department of Energy Pipeline
850 South Clearview Parkway
New Orleans, LA 70123

Terrie Looney
Sea Grant
1295 Pearl Street
Beaumont, TX 77701

Steve Parris
U.S. Fish and Wildlife Service
17629 El Camino Real Road,
Suite 211
Houston, TX 77058-3051

Capt. J.J. Plunkett
U.S. Coast Guard
2901 Turtle Creek Dr, Suite 200
Port Arthur, TX 77642

Janelle Stokes
USACE, Galveston District
2000 Fort Point Road
Galveston, TX 77550

Rusty Swafford
National Marine Fisheries,
Habitat Conservation Division
4700 Avenue U
Galveston, TX 77551

Don Voros
Southwest Louisiana National
Wildlife Refuge Complex
Headquarters
1428 Highway 27
Bell City, LA 70630

Fort Hood
Headquarters, III Corps Office
of Com. Gen.
Fort Hood, TX 76544

Stephen Spencer
U.S. Department of Interior,
Office of Environmental Policy
and Compliance, Regional
Environmental Officer
1001 Indian School Road NW,
Suite 348
Albuquerque, NM 87104

**Tribal**

Robert Cast
Caddo Indian Tribe of
Oklahoma
Tribal Historic Preservation
Officer
P.O. Box 487
Binge, OK 73009

Carlos Bullock
Alabama-Coushatta Tribe of
Texas
571 State Park Road 56
Livingston, TX 77351

Bryant Celestine
Alabama-Coushatta Tribe of
Texas
571 State Park Road 56
Livingston, TX 77351

Augustine Asbury
Alabama-Quassarte Tribal Town
P.O. Box 187
Wetumka, OK 74883

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# 13.0 LIST OF PREPARERS

| Name/Title | Experience | FEIS Area of Responsibility |
|---|---|---|
| **U.S. Army Corps of Engineers, Galveston District** | | |
| Janelle Stokes, Regional Environmental Specialist | 25 years, Environmental Impact Assessment and Impact Analysis, Cultural Resource Coordination, Archeological Research and Surveys | Project coordination, report preparation, CE/ICA analysis, WVA modeling |
| Carolyn Murphy, Chief, Environmental Section | 27 years, Environmental Impact Assessment and Impact Analysis, Planning and Environmental Resources, Archeological Research and Surveys | Document review |
| Richard Medina, Chief, Planning and Environmental Branch | 35 years, Environmental Impact Assessment and Impact Analysis, Planning and Environmental Resources | Document review |
| Rob Hauch, Physical Scientist | 26 years, Environmental Impact Assessment and Impact Analysis; Dredged Material, Water, and Sediment Quality Analyses | Appendix B preparation assistance, project review |
| Kristy Morten, HTRW Specialist | 28 years, HTRW and Biological Analysis | HTRW, document review |
| Nicole Minnichbach, Staff Archeologist | 7 years, Archeology | Archeology section preparation and review |
| Nancy Young, Civil Engineer | 10 years, Civil Engineer | Engineering design of BU features and mitigation measures |
| John Damm, Geotechnical Engineer | 20 years, Geotechnical Engineer | Engineering design of BU features |
| Ryan Brown, Geotechnical Engineer | 3 years, Geotechnical Engineer | Engineering design of BU features |
| **U.S. Environmental Protection Agency** | | |
| Barbara Keeler | 30 years of coastal environmental science and NEPA experience for EPA, currently serving as the Region 6 Coastal & Wetlands Planning Coordinator. | Served as the EPA Regional lead for technical and policy EIS review. Participated in this effort as the EPA representative on the Habitat Workgroup and the Sabine-Neches Interagency Coordination Team. |
| Stephen Bainter | 30 years environmental related activities experience, to include experiences in positions as the Municipal Whole Effluent Coordinator, Water Quality Permitting Specialist, and Water Quality Standards Coordinator for EPA Region 6. Currently assigned as EPA Region 6's Ocean Dumping Coordinator. | ODMDS EIS and SMMP technical review. |

| Name/Title | Experience | FEIS Area of Responsibility |
|---|---|---|
| **U.S. Environmental Protection Agency, concluded** | | |
| Renee Bellew | 9 years environmental related activities experience, currently serving as a Water Quality Standards Coordinator for EPA Region 6. Participated in this effort while as the EPA Region 6's Ocean Dumping Coordinator. | ODMDS EIS technical and policy review. |
| **PBS&J** | | |
| Martin Arhelger, Vice President, Project Director | 30 years, Environmental Assessment and Impact Analysis | Project Manager, water and sediment quality |
| Angela Bulger | 8 years, NEPA Compliance and Coordination | Assistant Project Manager, document coordination |
| Tony Risko | 18 years, Coastal Engineering | Assistant Project Manager |
| Lisa Vitale, Marine Biologist | 15 years, Marine Biology | Assistant Project Manager, Marine Fisheries/EFH, document coordination and production, quality control |
| Tomas Dixon, Senior Scientist | 8 years, Wildlife and Protected Species | Wildlife and threatened & endangered species, BA and CMP preparation |
| Derek Green, Biologist, Wildlife Specialist | 24 years, Environmental Assessment and Analysis | Wildlife and habitat, threatened and endangered species, sea turtle analysis |
| Erik Huebner, Senior Scientist | 10 years, Wildlife and Protected Species | Wildlife and threatened & endangered species |
| Tommy Ademski, Senior Environmental Planner | 10 years, Planning | Noise analysis |
| Wendy Connally, Ecologist | 4 years, Environmental Assessment and Analysis | Cumulative Impacts and QA/QC |
| Kathy Calnan, Ecology, Botany | 16 years, Vegetation Analysis and Impacts | Vegetation Analysis |
| Dave Buzan, Aquatic Biologist | 30 years, Aquatic Biology, Vegetation Analysis and Impacts | Freshwater Fisheries, Vegetation Analysis |
| Ruben Velasquez, Senior Engineer | 30 years, Air Quality | Air Quality, General Conformity |
| Bob Gearhart, Archeologist, Magnetometer and Side-Scan Sonar Specialist | 22 years, Marine Archeology | Marine archeology |
| Steve McVey, Geologist, HazMat Specialist | 12 years, Environmental Geology | HTRW Analysis |
| Tricia LaRue, Environmental Planner | 5 years, Planning and Socioeconomics | Socioeconomics |
| Michael Hettenhausen, Environmental Planner | 2 years, Planning and Document Review | General ecology, document review |
| Eric Monshaugen, GIS Specialist | 4 years, GIS | GIS data/figures |
| Chris Vidrick, Senior Word Processor | 30 years, Word Processing | Word processing, document formatting and review |
| Bob Bryant, Lead Word Processor | 18 years, Word Processing | Word processing, document formatting and review |
| Linda Nance, Technical Editor | 35 years, Editing | Technical document editing |

| Name/Title | Experience | FEIS Area of Responsibility |
|---|---|---|
| **Independent Technical Review** | | |
| Philip M. Payonk, Chief, Environmental Resources Section, CESAW-TS-PE | 27 years Environmental Impact Assessment and Impact Analysis; Dredged Material, Water, and Sediment Quality Analyses; Ocean Disposal Coordinator | Environmental Impact Review; compliance with environmental laws and regulations |
| Bernard E. Moseby, Economist, CESAM-PD-FE | 21 years Economic Analysis, Deep Draft Navigation | Review of Mitigation Measures CE/ICA |
| Carl E. Dyess, Dredging Project Manager, CESAM-OP | 18 years, Dredging Operations Manager | Review of operations and maintenance plans |
| Wade A. Ross, Supervisory Hydraulic Engineer, CESAM-EN-HH | 16 years, Hydraulic Engineer, Deep Draft Navigation | Review of hydrology and hydraulics issues |
| Dennis E. Mekkers, Hydraulic Engineer, CESAM-EN-HH | 12 years, Structural Hydraulic Design, Tidally Influenced Wetlands Modeling and Restoration | Review of HS models |
| Naomi R. Fraenkel, Civil Engineer, CENAN-PL-F | 5 years, Deep Draft Navigation Planning | Review of plan formulation |
| James A. Wagoner III, Assistance District Counsel, CESAM-OC | 18 years, Real Estate Attorney | Real estate issues review |
| Wallace W. Brassfield, Cost Engineer, CENWW-EC-X | 40 years, Construction Cost Estimating | Project costs review |

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FOR CONTINUATION OF HOUSE DOCUMENT 112-90

SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT

SEE PART 2

# FINAL ENVIRONMENTAL IMPACT STATEMENT
# FOR
# SABINE-NECHES WATERWAY
# CHANNEL IMPROVEMENT PROJECT
# SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

## VOLUME III: APPENDICES A–B

COOPERATING AGENCIES:

U.S. ENVIRONMENTAL PROTECTION AGENCY
U.S. DEPARTMENT OF THE INTERIOR – FISH AND WILDLIFE SERVICE
U.S. DEPARTMENT OF COMMERCE – NATIONAL MARINE FISHERIES SERVICE
TEXAS GENERAL LAND OFFICE
LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

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**Appendices**

**VOLUME III**

A Coordination
- A1 Agency Coordination
- A2 Endangered Species Act Correspondence
- A3 Fish and Wildlife Coordination and Essential Fish Habitat
- A4 Cultural Resources Coordination
- A5 Public Comments
- A6 Tribal Coordination

B Ocean Dredged Material Disposal Sites Final Environmental Impact Statement

# Appendix A

# Coordination

# Appendix A
# Sabine-Neches Waterway Channel Improvement Project Coordination

## 1.0 INTRODUCTION

U.S. Army Corps of Engineers (USACE) and the Sabine Neches Navigation District (SNND) (formerly the Jefferson County Waterway Navigation District [JCWND]) developed a public involvement plan to be used during the feasibility phase for the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). The goal of this public involvement plan was to ensure that USACE and the SNND were responsive to the needs and concerns of all stakeholders and to ensure public involvement through an open, interactive process. Stakeholders include all the various publics that could be affected or are interested in the project. The plan helped USACE and the SNND provide information to, and obtain information from, the stakeholders.

Coordination with resource agencies was conducted primarily through Interagency Coordination Team (ICT) and technical working group meetings. Resource agencies and the study team meet regularly throughout the study process. Over 30 workgroup meetings and 10 ICT meetings were held.

## 1.1 PROGRAM OBJECTIVES

a. Enhance public understanding of the study, the range of alternatives studied, and the recommended plan for the project.
b. Identify all stakeholders and the best ways to communicate with each.
c. Learn the public's desires, needs, and concerns and make them known to decision-makers.
d. Explain the planning process and study progress.
e. Provide for consultation before decisions are reached.
f. Provide information about the results of environmental studies.
g. Obtain views and concerns on proposed beneficial use areas, and mitigation features.
h. Solicit the public's views and comments for consideration in the decision-making process.
i. Disseminate study information and results in a wide variety of formats.

## 1.2 PROGRAM ACTIVITIES

To this end, a pro-active outreach program was initiated to ensure that the public, resource agencies, industry, local government, and other interested parties were informed about the project and that any concerns were identified and addressed.

Each of activities listed here is described individually below. The program included:

- scoping meetings
- public workshops to obtain ideas for ecosystem restoration and the beneficial use of dredged material
- media trips by boat down the waterway

- presentations at the Gulf of Mexico Fisheries Management Council's Texas Habitat Protection Advisory Panel
- presentations at regular meetings of Southeast Texas Waterway Advisory Council (SETWAC)
- meetings with Sabine Pilots
- presentation at the 2007 SETX meeting
- meetings with SNWW industries

## 2.0 PUBLIC SCOPING MEETINGS

### 2.1 PUBLIC SCOPING MEETING IN 2000

#### 2.1.1 Meeting Summary

A public scoping meeting was held May 24, 2000, commencing at 7:00 p.m. The meeting was announced in local newspapers and with a public notice dated April 20, 2000. The location of the meeting was:

John Gray Center Auditorium
Lamar University
855 E. Florida Ave, Beaumont, Texas

The purpose of the meeting was to inform the public about the initiation of the feasibility study and to solicit comments on navigation concerns, alternatives to be addressed, and environmental issues and concerns. The meeting was attended by 43 persons, as well as representatives of SNND and USACE.

The meeting was conducted by Colonel Nicholas Buechler, Commanding Officer, USACE, Galveston District. Paul Beard, Chairman of the SNND, gave the welcoming address. Col. Buechler explained the purpose and procedures of the meeting and introduced the speakers. Tom Jackson, General Manager of SNND, presented an overview of the development of the Sabine-Neches Waterway and explained the navigation needs that gave rise to the feasibility study. Richard Tomlinson, Project Manager with the Galveston District, presented an overview of the study process.

The meeting was then opened to comments from the public and resource agencies. The issues raised by the speakers that they would like to see addressed in the context of the Draft EIS are as follows:

1. Salinity intrusion, particularly into marshes on the east side of Sabine Lake, the Sabine National Wildlife Refuge (NWR), and upstream on the Sabine and Neches Rivers
2. Effects on wildlife and fisheries which are associated with marsh loss
3. Project effects on tidal amplitude
4. Potential increases in inland reach of storm surges
5. Potential increases in erosion along the channel and along the coast

6. Beneficial use of dredged materials to restore marsh
7. Beneficial use of dredged materials to restore beaches and dunes
8. Establishment of a lock at Sabine Pass as an alternative to the project
9. Deepening through to Sabine Pass and then establish a pipeline distribution center at Sabine Pass as an alternative to deep draft channel improvements to Beaumont.
10. Potential decreases in marshes because of increased needs for placement areas.
11. Potential decreases in sports and shrimp fisheries
12. Effects of relocating approximately 70 pipelines
13. Overall cost of project as it relates to benefits, and the potential to increase taxes
14. Potential impacts to facilities on Pleasure Island such as the TPWD Wildlife Coastal Research Facility and the Corps of Engineers Port Arthur Area Office
15. Potential for restoring the historical hydrology and ecological diversity of the Sabine estuarine system
16. Socioeconomic effects of not improving the channel
17. Identify direct and indirect socioeconomic benefits of channel
18. Evaluate need for new turning basins, berthing areas, and passing zones
19. Who will be responsible for the local cost, both for construction and maintenance of channel improvements and placement areas?
20. Effects on navigation safety

The major concern of the participants was the potential for the project to increase salinity intrusion and further accelerate the decline of existing marshes.

The meeting was adjourned at 8:04 p.m.

2.1.2 Post-Meeting Comments

Several written statements were received by USACE in the month following the meetings. Additional issues that were not raised in the meetings include:

1. Salinity intrusion, particularly into Tony Houseman State Park and Wildlife Management Area (WMA), Lower Neches WMA, J. D. Murphree WMA, and Sea Rim State Park and other habitats of concern such as Sabine Lake, intertidal and fresh marshes at Taylor Bayou, along the GIWW, swamps and bottomland hardwoods, and the Sabine and Neches Rivers
2. Potential impacts to the Sabine Pass Battleground
3. Need for 3-dimensional hydrodynamic modeling of potential salinity and circulation changes
4. Mitigative measures should not adversely affect ingress and egress of marine organisms that use the estuary as part of their life cycle.
5. Studies should incorporate anticipated changes in fresh water inflow
6. Potential impacts to oyster reefs and Blue Buck Point
7. Consistency determination with the Louisiana Department of Natural Resources
8. Cumulative and secondary effects of hydrologic alterations to the coastal ecosystem
9. Beneficial uses of dredged material should be considered for the following areas: Bessie Heights marsh, backdune marshes at the Texas Point NWR, beach

nourishment at Holly Beach and Texas Point, marshes in McFaddin NWR, and marshes within the Lower Neches WMA and J.D. Murphree WMA.

10. Impacts to endangered sea turtles
11. Effects on Essential Fish Habitat (EFH) for postlarval, juvenile and adult red drum, brown shrimp, white shrimp, pink shrimp, postlarval and juvenile Spanish mackerel; categories of habitat that could be affected include estuarine emergent wetlands, estuarine water column, and estuarine mud/sand bottoms.
12. Potential effects to nursery and foraging habitat for economically-important marine fishery species such as spotted seatrout, flounder, Atlantic croaker, black drum, Gulf menhaden, striped mullet and blue crab.
13. Consideration of a submerged sill or constriction at the mouth of Sabine Lake, and water control structures in the wetlands east of Sabine Lake
14. Concern that the Sabine-Neches waterway is close to reaching its capacity for vessel traffic movement

## 2.2 PUBLIC SCOPING MEETINGS IN 2003

### 2.2.1 Meeting Summaries

Two public scoping meetings were held in late May 2002. The meetings were announced in the Notice of Intent to Prepare a Draft EIS for Improvements to the Sabine-Neches Ship Channel near Beaumont and Port Arthur, Texas (Federal Register, Volume 67, No. 98, Tuesday, May 21, 2002). A copy of the Notice of Intent is located at the end of this introductory section, before Appendix A-1. The meetings were also announced in local newspapers and with a public notice which was mailed to all persons on the study mailing list.

#### 2.2.1.1 Public Meeting on May 28, 2002

Best Western Hotel
2600 Moeling Street, Lake Charles, LA
Commencing 7:00 pm

The purpose of the meeting was to inform the public about study progress and to solicit comments on environmental issues such as changes in salinity and circulation, changes in fresh and saltwater marshes, water and sediment quality, erosion along the channel, threatened and endangered species impacts, and beneficial use of dredged materials. The meeting was attended by 20 persons, as well as representatives of the non-Federal sponsor (the Jefferson County Waterway and Navigation District or SNND) and USACE.

The meeting was conducted by Dr. Lloyd Saunders, Chief of Planning, Environmental, and Regulatory Division of the Galveston District. Paul Beard, Chairman of SNND, gave the welcoming address. Dr. Lloyd Saunders explained the purpose and procedures of the meeting and introduced the speakers. Tom Jackson, General Manager of SNND, presented an overview of the development of the Sabine-Neches Waterway and explained the navigation needs that gave rise to the feasibility study. Lizette Richardson, Project Manager with the Galveston District, presented an overview of the study process, including the way in which the study is

responding to issues raised in the May 2000 public meeting. Janelle Stokes, Environmental Lead with the Galveston District, explained the Draft EIS as a component of the feasibility study and the ICT that was formed to promote effective teamwork on the EIS among state and federal agencies.

The meeting was then opened to comments from the public. The issues raised by the speakers that they would like to see addressed in the context of the EIS are as follows:

1. Consistency determination with the Louisiana Department of Natural Resources.
2. Coordination with the Louisiana Coastal Restoration program.
3. Coordinated planning with Calcasieu Ship Channel.
4. Greater consideration for Louisiana interests and concerns.
5. Increased participation of private sector on ICT.
6. Additional opportunities for the public to express opinions on the project.
7. Beneficial use of dredged materials for beach restoration.
8. Consideration of beneficial use recommendations from workshops.
9. Marsh preservation and restoration.
10. Shoreline and channel erosion.
11. Saltwater intrusion.
12. Potential for increased storm surges.
13. Impacts to endangered species.
14. Impacts to migrating birdlife.
15. Potential for pollution of water-bearing sands because of increased dredging.
16. Potential toxicity of dredged materials.
17. Effects of dredging on water quality and fisheries.
18. Loss of shallow-water habitat through dredged material disposal; effects of ocean dredged material disposal sites.
19. Expropriation of land in Louisiana for placement areas, particularly land suitable for economic development.
20. Potential for changes in state boundaries because of spoil disposal in Sabine Lake.
21. Consideration of project alternatives such as a pipeline to an offshore oil port.
22. Establishment of a lock at Sabine Pass to stop saltwater intrusion.
23. Effect of a lock at Sabine Pass on ingress and egress of estuarine species.
24. Restoration of access to Sabine Lighthouse.
25. Establishment of a collision control system on the channel.

The major concern of the participants was the potential for the project to further accelerate the decline of the marshes in Louisiana and the smallness of the population in the coastal area to speak for those marshes.

The meeting was adjourned at 8:05 p.m.

2.2.1.2 Public Meeting on May 29, 2002

John Gray Center Auditorium
855 E. Florida Ave, Beaumont, Texas
Commencing 7:00 pm

The purpose of the meeting was to inform the public about study progress and to solicit comments on environmental issues such as changes in salinity and circulation, changes in fresh and saltwater marshes, water and sediment quality, erosion along the channel, threatened and endangered species impacts, and beneficial use of dredged materials. The meeting was attended by 34 persons, as well as representatives of the SNND and USACE.

The meeting was conducted by Lloyd Saunders, Chief of Planning, Environmental, and Regulatory Division of the Galveston District. Paul Beard, Chairman of SNND, gave the welcoming address. Lloyd Saunders explained the purpose and procedures of the meeting and introduced the speakers. Tom Jackson, General Manager of SNND, presented an overview of the development of the Sabine-Neches Waterway and explained the navigation needs that gave rise to the feasibility study. Lizette Richardson, Project Manager with the Galveston District, presented an overview of the study process, including the way in which the study is responding to issues raised in the May 2000 public meeting. Janelle Stokes, Environmental Lead with the Galveston District, explained the Draft EIS as a component of the feasibility study and the ICT that was formed to promote effective teamwork on the Draft EIS among state and federal agencies.

The meeting was then opened to comments from the public. The issues raised by the speakers that they would like to see addressed in the context of the EIS are as follows:

1. Beneficial use of dredged materials to restore marsh.
2. Beneficial use of dredged materials to restore beaches.
3. Beneficial use of dredged materials to create bird islands in Sabine Lake.
4. Salinity intrusion, particularly into freshwater marshes.
5. Potential for increases in storm surges.
6. Potential contaminants in dredged materials.
7. Cumulative impacts of sediments, circulation, and salinity on marshes.
8. Erosion along the channel.
9. Effect of project on operating procedures for the saltwater barrier.
10. Decrease in marshes because of increased needs for placement areas.
11. Maintenance of remaining nursery areas in existing placement areas in Sabine Lake.
12. Establishment of a pipeline at Sabine Pass as an alternative to the project.

The major concern of the participants was the potential for the project to further accelerate the decline of the marshes.

The meeting was adjourned at 7:42 p.m.

### 2.2.2 Post-Meetings Comments

Several written statements were received by USACE in the month following the meetings. Additional issues that were not raised in the meetings include:

1. Potential effect of project on Jefferson County Drainage District No. 7 Hurricane Flood Protection System.
2. Effect of project on human populations, particularly downstream water supplies, air quality, water quality and quantity, wetlands and floodplains, hazardous materials and wastes, non-hazardous solid waste and other materials, noise, occupational health and safety, and land use and housing.
3. Cumulative impacts of all past, present, and proposed projects in the area in relation to the proposed project.
4. Harmful effects of "beneficial use" proposals, particularly the creation of islands in marine or brackish environments.
5. Consideration of mitigation costs in project feasibility assessment.
6. Effect of project on floodplain development.
7. Potential for increased tidal amplitudes.
8. Impacts to neo-tropicals, wading birds, waterfowl, terns, skimmers, brown pelicans, and sandpipers.
9. Impacts on 404B1 areas such as wildlife reserves, management areas, rookeries, wetlands, oyster reefs, mud flats, sandbars, and beaches.
10. Socioeconomic impacts on sport and commercial fisheries, hunting, crabbing, shrimping, tourism, oystering, and other recreational activities.
11. Determine dredging risks to sea turtles.
12. Elevate dredged material disposal areas above sea level and use plantings to create wildlife habitat.
13. Make dredged material disposal areas subject to public servitude.
14. Determine gulf shoreline impacts from possible changes in near-shore currents and wave patterns.
15. Impacts to paddle fish, sea turtles, oyster reefs, Western Sand Darter, and Western Hill Splitter Mussel.
16. Impacts to flora, particularly loss of wetlands from plant community changes.
17. Potential toxicity of dredged materials in beneficial use projects.
18. Potential for introduction of exotic species.
19. Increased national security costs from increased shipping traffic.

## 2.3 PUBLIC MEETING SUMMARIES

Two public meetings were held in late January 2010. The meetings were held in Beaumont, Texas, and Lake Charles, Louisiana. The meetings were noticed as "Notice of Public Meeting and Availability of Draft Environmental Impact Statement (EIS) for Sabine-Neches Waterway Proposed Channel Improvement Project, Draft Environmental Impact Statement for Texas Ocean Dredged Material Disposal Sites Designation and Draft General Conformity Determination" in local newspapers.

A notification mailer was mailed to all persons on the study mailing list. The mailing list contained a wide array of elected officials, environmental organizations, historic resource organizations, commercial groups, recreational groups, public bodies, fishermen, hunters, and landowners. Over 400 notices were sent out.

Additionally, letters of invitation were mailed and emailed to public officials.

2.3.1 Public Meeting on January 26, 2010

The Beaumont Civic Center
701 Main Street
Beaumont, Texas 77701

The purpose of the meeting was to inform the public about the release of the Draft EIS, Draft EIS for Ocean Dredged Material Disposal Sites Designation, and Draft General Conformity Determination, and solicit comments. The meeting was attended by 51 persons. The meeting was hosted by the non-Federal sponsor, the Sabine-Neches Navigation District (SNND) and the U.S. Army Corps of Engineers (USACE) Galveston District.

From 5:30-7:00 P.M., an informal open house was open to the public. Members of the public viewed displays and spoke with the USACE and PBS&J employees who were available at the display stations. There were four display stations:

1. Recommended Plan-Navigation Improvements
2. Alternatives Evaluated
3. Technical Studies
4. Environmental Impacts and Mitigation

All display materials were sourced from the Draft EIS and the Draft Feasibility Report.

The formal public meeting was conducted by Colonel David Weston, Commanding Officer of the Galveston District, and commenced at 7 P.M. Randall Reese, General Manager of SNND, made a brief introduction of SNND members present and then introduced Colonel Weston. Colonel Weston introduced USACE employees and provided a brief overview of the project and the study. Byron Williams, Project Manager with the Galveston District, explained the purpose and procedures of the meeting and introduced the speakers. Clayton Henderson, Assistant General Manager of SNND, presented an overview of the development of the Sabine-Neches Waterway and explained the navigation needs that gave rise to the feasibility study. Sheri Willey, Project Manager with the Galveston District, presented an overview of the study process. Janelle Stokes, Environmental Lead with the Galveston District, presented the environmental portion of the study.

The meeting was then opened to comments from the public. The issues that the speakers would like to see addressed in the context of the Draft EIS are as follows:

1. Potential impacts on pipeline operations and cost estimates for pipeline relocations

2. Request for an extension of the comment period to at least April 26, 2010
3. Request for an extension of the comment period for at least 120-days
4. Potential problems of proposed dredge sites and respective impacts on fisheries
5. Increased salinities and unnatural increased water flow in coastal marshes and wetlands and Sabine Lake, as well as the impacts on the proximate wildlife habitats
6. Increased marketability and accessibility for larger ship traffic and concurrent increased safety margins
7. Increased economic stimulation through job creation
8. Permitting issues for relocation or removal of existing pipelines

The major concerns of the participants were the environmental impacts (increased salinity) and pipeline relocation.

The meeting was adjourned at 8:07 P.M.

2.3.2 Public Meeting on January 27, 2010

The Lake Charles Civic Center
Jean Lafitte Room
900 Lakeshore Drive
Lake Charles, LA 70601

The purpose of the meeting was to inform the public about the release of the Draft EIS, Draft EIS for Ocean Dredged Material Disposal Sites Designation, and Draft General Conformity Determination, and solicit comments. The meeting was attended by 19 persons. The meeting was hosted by the non-Federal sponsor, the SNND and the USACE Galveston District.

From 5:30-7:00 P.M., an informal open house was open to the public. Members of the public viewed displays and spoke with the USACE and PBS&J employees who were available at the display stations. There were four display stations:

1. Recommended Plan-Navigation Improvements
2. Alternatives Evaluated
3. Technical Studies
4. Environmental Impacts and Mitigation

All display materials were sourced from the Draft EIS and the Draft Feasibility Report.
The formal public meeting was conducted by Colonel David Weston, Commanding Officer of the Galveston District, and commenced at 7 P.M. Randall Reese, General Manager of SNND, made a brief introduction of SNND members present and then introduced Colonel Weston. Colonel Weston introduced USACE employees and provided a brief overview of the project and the study. Byron Williams, Project Manager with the Galveston District, explained the purpose and procedures of the meeting and introduced the speakers. Clayton Henderson, Assistant General Manager of SNND, presented an overview of the development of the Sabine-Neches Waterway and explained the navigation needs that gave rise to the feasibility study. Sheri Willey, Project Manager with the Galveston District, presented an overview of the study process. Janelle

Stokes, Environmental Lead with the Galveston District, presented the environmental portion of the study.

The meeting was then opened to comments from the public. The issues that the speakers would like to see addressed in the context of the Draft EIS are as follows:

1. Formation of an ICT for the development of the final Beneficial Use sites and mitigation plan
2. Potential costs of relocating pipelines
3. Potential flooding impacts from storm events if the channel is deepened
4. More spoil used beneficially
5. Potential impacts of problems caused by deepening channels
6. Increased salability of the waterway
7. Compatibility with the world's largest LNG carriers

The major concerns of the participants were the effects of deepening the channel and pipeline relocation.

The meeting was adjourned at 8:00 P.M.

2.3.3 Pre-Meeting Comments

Written comments were received by the USACE in the months leading up to the release of the Draft EIS, Draft EIS for Ocean Dredged Material Disposal Sites Designation, and Draft General Conformity Determination.

1. Louisiana Department of Wildlife and Fisheries (LDWF) will not concur in plans to mitigate in Texas for wetland impacts occurring in Louisiana. Additional mitigation measures should be implemented to offset the current 318 AAHU deficiency.
2. New work material from the Sabine Pass Channel and Sabine Pass Jetty Channel should be used beneficially to create, restore, or nourish emergent marsh in the vicinity of the project.
3. No fill material shall be dredged from state-owned water bottoms in Louisiana without a license issued by LDWF.
4. Adverse impacts to the public oyster area in Sabine Lake from the mitigation areas, including any access channels, must be addressed.
5. Potential creation of hypoxic conditions in dredged water bottoms and increased shoreline erosion rates through increased wave energy or sinking of the shoreline to fill the excavated trench.
6. Further justification of the 'no change' determination for Further Without Project.
7. Commitment of the local sponsor and interagency coordination.
8. Potential negative impact on marine life in the dredge containment compartments used for the dredging in the deepening and widening of the waterways.
9. Identification of location for Natural Resources Conservation Services to evaluate the proposed areas as required by the Farmland Protection Policy Act
10. Potential economic impacts on coastal low-income communities

2.3.4 Post-Meeting Comments

Written comments were received by USACE in the month following the public meetings. They were received as emails, comment forms, and letters.

1. Placement of spoil in relation to jetties in Texas and Louisiana
2. Potential bias in the research because it was conducted by USACE. A nonaffiliated research team should be implemented
3. Need for the project
4. Any deepening or widening will make our waterway more competitive for business that uses larger ships and automatically adds additional safety margins for the existing shipping already present.
5. Potential impacts on pipeline operations, pipeline relocations, and the costs associated
6. Request of an extension of the comment period to April 10, 2010, at the earliest
7. Need for the project
8. Any deepening or widening will make our waterway more competitive for business that uses larger ships and automatically adds additional safety margins for the existing shipping already present.
9. Potential impacts of placement of spoil near the Sabine Jetties
10. Identification and location of the 42 pipelines that may require relocation
11. Potential costs of relocating pipelines and cost sharing between pipeline owners and project sponsor
12. Request of an extension of the comment period to no earlier than April 10, 2010
13. Potential relocation of pipelines and actual costs to a pipeline owner regarding relocation
14. Request of an extension of the comment period to May 10, 2010
15. Potential concerns about modeling for storm surges, bar channel deepening, salinity, the proposed mitigation for unavoidable impacts to wetland habitats, and the potential impacts to extant energy
16. Increased economic shipping efficiency
17. Recommended literature regarding geoarchaeology in the Sabine Lake area
18. Coordination request with pipeline owners and operators
19. The relocation of a significant number of pipelines must be preceded by a comprehensive and coordinated planning process regarding the relocation.
20. The project may impact pipeline operations in other ways besides relocation.
21. Request identification of the pipelines that will be impacted by the project, the owner of each such pipeline, and the costs for removing or relocating each such pipeline
22. Request for additional documents to understand the proposed project's impact on pipeline operations, including a projected timeline from when the relocations may actually be needed
23. Request confirmation of the cost-sharing requirement that half the pipeline relocation costs must be borne by the pipeline owner and the other half by the local sponsor of the project
24. Request a 60 day extension of the comment period
25. Potential costs, safety and environmental risks, and interruption of gas/diesel supplies, as a result of relocation and removal of pipelines

26. Deepening will potentially increase damage done by storm surges
27. The Draft EIS fails to provide: (1) the project's economic value to the State of Louisiana; (2) resolution to conflicting modeling results and how much marsh could/would be lost or adversely affected by the project due to higher salinity levels than projected; (3) full mitigation plan or compensation for projected losses of intertidal marsh in most of the Louisiana portion of the study area including Cameron Meadows; and (4) resolution to the conflict between navigation needs in Texas, the project's acknowledged detrimental impacts to Louisiana marshes, and ongoing publicly supported and funded coastal restoration efforts in Louisiana.
28. Request for the list of the 42 deep-draft utilities designated for relocation
29. Request for a cross-section where a 10-inch diameter hydrogen pipeline crosses the Neches River (292+00). Additionally requests the GPS coordinates of both existing Neches River centerline and the proposed Neches River centerline
30. Request for further description of the hydraulic pipeline dredge process

## 3.0 ENVIRONMENTAL RESTORATION / BENEFICIAL USE WORKSHOPS

### 3.1 PURPOSE

One of the purposes of the study is to maintain and restore the natural environment in the Study Area. A series of public workshops was held in late 2001 and early 2002 to secure suggestions for environmental restoration and beneficial uses of dredged material from interested organizations and individuals. This section will describe the procedures that were used to initiate and conduct the workshops and their outcome.

### 3.2 RESTORATION WORKGROUP

The ICT created a Restoration Workgroup (RW) to gather, evaluate, and recommend ideas for environmental restoration and beneficial use. At its first meeting in June 2001, the RW identified the brainstorming workshops used by the Beneficial Users Group (BUG) in the Houston-Galveston Navigation Project as the appropriate format for the SNWW Workshops.

The RW also identified a number of environmental organizations, historic resource organizations, commercial groups, and recreational groups in Texas and Louisiana that should be invited to participate in the workshop process and stipulated that this list should be expanded. A contact list was developed identifying the addresses and telephone numbers for many of these organizations. Recommendations were given on how various groups should be approached to achieve efficiency in the workshop process. Organizations were not to be mixed in the workshops in recognition of their differing goals and interests.

A draft letter was mailed to organizations which described the study: the purpose, procedures, and restrictions of the workshops, and what would be done with the workshop results. To insure adequate geographic coverage, workshop notifications appeared in newspapers in Baton Rouge and Lake Charles, Louisiana, and in Beaumont, Port Arthur, and Orange, Texas. A draft notice was prepared for newspaper and website use. A number of small communities in Texas and

Louisiana were identified for potential workshops if meetings with organizations did not produce adequate geographic coverage.

The workshops were intended to solicit suggestions for environmental restoration and beneficial use throughout the Study Area, producing recommendations that could be used in the SNWW feasibility planning process, but also providing a database of recommendations that could be used by other studies and organizations. Recommendations were later evaluated for economic and technical feasibility by the Habitat Evaluation Workgroup (HW).

## 3.3 CONSULTING FIRM

Gulf Engineers & Consultants, Inc. (GEC), a Baton Rouge consulting firm experienced in public involvement, USACE procedures, and water resources projects, was secured to organize and conduct the workshops. This was done because of the time-consuming nature of the effort and the short timeframe for completion. GEC secured the services of a local contact in Texas to avoid any possibility of perceived geographic bias. USACE control of contractor activities was secured through the establishment of a close working relationship between the Contracting Officer's Representative and GEC, through continuous reporting by GEC, and through attendance at all of the workshops by Galveston District personnel or their representatives.

## 3.4 PRELIMINARY ACTIVITIES

Preliminary efforts were devoted to document review, an internet search, attendance at a public meeting concerning the Bessie Heights Marsh, and a visit with the SNND. The principal documents reviewed were the plan of action designed by the Restoration Workgroup, the SNWW reconnaissance report, the scoping meeting minutes, the project study plan, correspondence that had been sent to the Galveston District in connection with the feasibility study, and Louisiana's *Coast 2050* report. An internet search was used to check information on the contact list, to identify additional potential participant organizations, and to identify local chapters. The search also produced information on how the two states were approaching coastal planning, on some of the significant issues, and on some of the specific proposals that had already been developed for coastal restoration. The Bessie Heights Marsh public meeting was attended because it was concerned with an environmental restoration project in the study area in Texas and in order to gain a sense of procedural difficulties that might be encountered in the workshops. The visit with the SNND resulted in an extensive tour of the study area's navigation and environmental features, including site visits to some of the existing dredged material disposal areas.

## 3.5 CONTACTS

The initial list of potentially interested parties prepared by the RW included 11 organizations in Texas and 5 in Louisiana. GEC added to this list five organizations and groups in Texas and six in Louisiana, all of which were approved for contact by the USACE. The final list contained a wide array of environmental organizations, historic resource organizations, commercial groups, recreational groups, public bodies, fishermen, hunters, and landowners.

The organizations were contacted by telephone in November. Telephone logs were kept of all contacts. The contacts were used to explain the nature of the workshops and the function of GEC in relation to the Galveston District and to determine whether the organization was interested in participating in the process and wanted more information in the form of a letter from the Galveston District. The response to the telephone contacts was highly favorable.

On receiving confirmation from an organization or group that it would like to have a workshop, information on date, time, place, and composition was transmitted by e-mail from GEC to USACE, which transmitted the information to the Restoration Workgroup members.

## 3.6 NEWSPAPER NOTICES

The RW identified the Beaumont Enterprise, Orange Leader, Port Arthur News, Lake Charles American Free Press, and Baton Rouge Advocate as daily newspapers in which public notices of the workshops should be placed. GEC identified the weekly *Beaumont Examiner* as an additional suitable placement medium. The draft workshop notice that had been prepared by the Restoration Workgroup was placed in these newspapers during the week of November 12, 2001 (one day in the *Baton Rouge Advocate*, two days in the *Beaumont Examiner*, and three days in the others). During its November 16, 2001 meeting, the RW indicated that the notice should also appear in the newspaper of record for Cameron Parish (the *Cameron Pilot*), which was done during the week of November 19, 2001 (3 days). The notices achieved the objective of giving everyone an opportunity to participate in the process.

## 3.7 WORKSHOP ORGANIZATION AND PROCEDURES

Most of the workshops were organized by the responding organizations or groups; that is, GEC did not need to call a number of people to establish attendance at most of the workshops. Most of the workshops were held in conjunction with regular organizational meetings. The Galveston District prepared electronic files of recent aerial photographs of the study area, a constructed hardcopy map showing the study area boundaries and the channel, Mylar-covered hardcopy older topographic maps of the east and west portions of the study area, and four Mylar-covered hardcopy maps of recent aerial photographs of the immediate vicinity of the channel. Suggestions were numbered, beginning with one at the first workshop and continuing sequentially through the last, to avoid the difficulties that participants would have in recording large numbers on the Mylar-covered maps. The suggestions were later compiled by GEC into one master list.

Suggestions were hand recorded and the locations of suggestions were recorded on the Mylar-covered hardcopy maps, of which the two topographic maps proved most useful (with the west portion used in Texas meetings and the east portion used in Louisiana meetings). The electronic maps were used in the workshops to provide greater clarification for specific suggestions and their locations when needed. Tape recorders were not used because of the emphasis on anonymity of suggestions.

In addition to the GEC facilitator, all of the workshops were attended by at least one USACE representative, almost all were attended by at least one RW representative, and some were

attended by the SNND. At each workshop, GEC gave a brief presentation on the project, the purpose of the workshop, how the workshop results would be used, and the ground rules. It was stressed that the workshop was not for expressing opinions on the merits of the project, that the suggestions made by the workshop participants could refer to any place in the study area, that the suggestions did not need to be limited to problems and opportunities related to the SNWW project, that the suggestions should not be limited by concerns of technical or economic feasibility, that all suggestions would remain anonymous with respect to the person making the suggestion and the meeting at which the suggestion was made, and that the suggestions would be used to create a database that would be used in conjunction with the project but also by a wide variety of agencies, organizations, and groups.

## 3.8 WORKSHOP RESULTS

Sixteen workshops were held, attended by a total of 168 persons who participated in the making suggestions. A number of organizations declined to participate; the major reason for nonparticipation in the process was insufficient interest on the part of organization members. Of the 16 workshops, 10 were held in Texas and six in Louisiana. One meeting in Texas and one in Louisiana was attended by participants from both states. The discrepancy between the number of meetings in Texas and Louisiana was the result of organization availability and response. The total number of Louisiana participants was actually about the same as the number of Texas participants.

The participants produced 244 suggestions, which were concerned with marsh restoration, beach and dune restoration, chenier restoration, hydrologic restoration, salinity control, erosion control, island construction, land restoration and development, road restoration, recreation and cultural development, use of sediment sources, use of placement areas, and nonstructural measures. There were a number of repeated suggestions, which provide some idea of the preference for various proposals. The 244 suggestions, listed below, are presented in no particular order. Specific locations related to each suggestion are labeled with the suggestion number on figures 1–3.

1. Deposit dredged materials in open water areas within the marshes (affected by subsidence, erosion, and saltwater intrusion) at Texas Point NWR.
2. Deposit dredged materials at Lafitte's Landing 1 and 2 (south end of Pleasure Island, lakeside, along shoreline and by marina) to provide shoreline erosion control and wetland creation.
3. Deposit dredged materials at Pleasure Island Marina for shoreline erosion control and marsh creation.
4. Construct a salinity control structure at the Keith Lake Fish Pass/SNCC intersection to reduce saltwater intrusion while allowing for unhindered navigation and marine organism ingress/egress.
5. Construct a system (depending on hydrologic model) of berms or levees (terraces) north of Pleasure Island in the gap and restore the island along the Sabine-Neches Canal to protect the lake from higher salinities in the channels.

6. Restore the hydrologic connection (freshwater sheetflow) at Salt Bayou between the marshes north and south of the GIWW.
7. Construct a structure on the east part of Salt Bayou to restore freshwater flow to marshes south of the GIWW.
8. Deposit dredged materials, particularly those with higher sand content, linearly along the shoreline from Texas Point NWR westward through McFaddin NWR.
9. Deposit dredged materials, particularly those with higher sand content, linearly along the shoreline east of the entrance channel.
10. Create gaps in both entrance channel jetties to increase sediment transport to Gulf shorelines.
11. Stabilize the shoreline on the east edge of Texas Point NWR at gaps in the jetty north of pilot station and repair the jetty.
12. Construct a two to six acre bird island or islands, at least five feet high with a sheltered lagoon, in the north part of Sabine Lake near Sidney Island at least one mile offshore.
13. Establish salinity controls, including the restoration of historic flow volumes, in Texas Bayou and associated channels connecting to the SNWW on Texas Point NWR through such things as low-level rock weirs, plugging man-made channels, water control structures, and/or other channel modifications.
14. Deposit dredged materials in open water areas and degraded marshes in the east part of the Salt Bayou watershed north and south of Keith Lake.
15. Stabilize the shoreline in any reaches of the GIWW projected to have increased salinities as a result of the project.
16. Establish erosion control on the Taylor Bayou outfall canal shoreline, primarily on the south bank.
17. Stabilize the banks of the GIWW in Louisiana, particularly the south bank, because the north bank has been largely stabilized through two coastal restoration projects.
18. Protect the cypress swamp area south of the Neches River Saltwater Barrier from possible excessive salinities by installing structures, terraces, or other hydrologic components.
19. Use high sand content dredged materials from offshore, including existing disposal areas, for beach enhancement purposes.
20. Implement the East Sabine Lake Hydrologic Restoration Project to protect approximately 35,000 acres of brackish to intermediate marsh in the west part of the Sabine NWR and adjacent lands from elevated salinities by such things as water control structures at major bayous and canals and earthern terraces in existing shallow-water areas.
21. Construct a gate on the Sabine Pass Channel or a sill offshore to establish hydrologic control.
22. Restore the interior hydrology of Salt Bayou marshes south of the GIWW on TPWD land.
23. Construct a low-level rock weir or similar structure at the causeway to prevent excessive salinities from entering the lake.
24. Construct salinity controls in the brackish marsh regions east of the intersection of Lighthouse Bayou and the Sabine Pass Channel.

25. Deposit dredged materials from the SNWW in large, shallow, open-water areas in the west part of the Sabine NWR north and south of the Willow Bayou Canal and in the Greens Lake area.
26. Deposit dredged materials from the SNWW on the east shoreline of Sabine Lake at the Sabine NWR and adjacent lands.
27. Deposit dredged materials from the SNWW in the open-water areas of the Greens Lake area to create marshes.
28. Establish salinity control between the GIWW and the Sabine River to protect the Louisiana side.
29. Establish salinity control west of the Hwy. 87 bridge and the GIWW to protect the Texas side.
30. Use new work materials one-time offshore that would degrade to feeder berms.
31. Establish topographic relief offshore.
32. Establish nearshore feeder berms for shoreline protection.
33. Protect and stabilize the Middle Marsh Drain Ditch.
34. Restore the saltwater guard lock at the north end of Pleasure Island.
35. Establish salinity control at the mouth of Cow Bayou.
36. Establish salinity control at the mouth of Adams Bayou.
37. Establish salinity control on the Old Ferry Road Borrow Ditch.
38. Establish salinity control at Old River Bayou.
39. Create terraces in the Entergy Power Plant Marsh.
40. Isolate the Entergy outfall canal by recreating the historic canal berms.
41. Use dredged materials to create terraces and mounds and backfill canals in the Bessie Heights Marsh.
42. Restore the natural hydrology of the Bessie Heights Marsh by restoring the natural bayou and closing the two canals.
43. Divert some of the stormflow in Anderson Gully into the Bessie Heights Marsh.
44. Restore the cypress swamps in the Rose City Oilfield through hydrologic restoration, salinity control, and beneficial use of dredged materials.
45. Plug the Hwy. 87 borrow ditch to restore flows to Nig Bayou.
46. Protect the shoreline on the north side of Old River Cove.
47. Use dredged materials to create mounds and terraces in Old River Cove.
48. Use dredged materials in the Old River Unit of the Lower Neches River WMA.
49. Use dredged materials in the open-water areas of the Burton Canal Marsh east of the Sabine River and the Burton Canal.
50. Use dredged materials in the open-water areas of the marsh east of Phoenix Lake.
51. Protect and restore the north shore of Keith Lake.
52. Construct a structure in the Sabine River at Orange to protect the cypress-tupelo swamps upstream if Sabine Compact withdrawals are implemented.
53. Use dredged materials to create a bird island north of the causeway.
54. Use dredged materials to restore marsh elevations in the interior of the Salt Bayou Marsh south of the GIWW.
55. Divert the Neches River through the Bessie Heights Marsh into Sabine Lake by leveeing the channel.
56. Create a substrate for oysters in south Sabine Lake to restrict salinity and flow.

57. Construct a navigation lock at Sabine Pass, which would resolve many of the problems, particularly saltwater intrusion, in the Sabine Lake area.
58. Construct a low-level rock weir constriction at the mouth of Sabine Lake at the causeway to reduce saltwater intrusion.
59. Implement the East Sabine Lake Hydrologic Restoration Project (a CWPPRA project) to provide salinity control on the east shore of Sabine Lake.
60. Implement the NRCS Public Law 566 rock weirs along the length of Black Bayou.
61. Construct a salinity control structure at the mouth of Black Bayou.
62. Use dredged materials between Pleasure Island and Sabine Island to create an earthen barrier that would protect Sabine Lake from saltwater intrusion from the channels.
63. Use dredged materials to restore the marsh in the Old River Unit south of Bridge City.
64. Remove Placement Area 11 at the north end of Pleasure Island to restore the estuarine bottom and reestablish public access to state waterbodies.
65. Remove Placement Area 8 at the south end of Pleasure Island to restore the estuarine bottom and reestablish public access to state waterbodies.
66. Use dredged materials to restore the marshes north and south of Keith Lake.
67. Use dredged materials to restore the marshes in the Greens Bayou area.
68. Use dredged materials to restore the marshes in the Willow Bayou area.
69. Establish an earthen barrier with water control structures along the entire east edge of Sabine Lake to protect the marshes from salinity intrusion and wave action.
70. Use dredged materials to restore the marshes north of Lighthouse Bayou.
71. Construct a structure at the mouth of Lighthouse Bayou to reduce salinity intrusion.
72. Use dredged materials to restore the marshes south of Perry Ridge.
73. Provide greater opportunities for fishing (for example, piers) to compensate for the decline of boater access to Sabine Lake from Louisiana that has been brought about by hydrologic restoration projects.
74. Stabilize the shoreline on the east side of Sabine Lake using boudin bags (geotextile tubes filled with dredged materials).
75. Use dredged materials to restore the marshes northwest of the Black Bayou Oil and Gas Field.
76. Maintain Sabine River freshwater flows into Sabine Lake in keeping with the Coast 2050 strategy.
77. Establish a navigation lock on the GIWW at Gum Cove Ridge to reduce saltwater intrusion to the east.
78. Use dredged materials to enhance the existing marsh strip and refurbish the deteriorated rock barriers on the south side of the GIWW in the Gum Cove Unit 13 area.
79. Use dredged materials to restore the marshes and establish a bird island south of the GIWW in the Gum Cove Unit 13 area.
80. Provide shoreline protection and hydrologic restoration for the fresh marsh east of the Sabine River and between the GIWW on the south and the Sabine Island WMA on the north.
81. Create terraces and use dredged materials to restore marshes between Perry Ridge and the Sabine River.

82. Protect the marshes between the Sabine NWR and Sabine Pass by protecting the shoreline of Sabine Lake and establishing salinity controls on Madame Johnsons Bayou, Forge Bayou, Greens Bayou, and Johnsons Bayou in keeping with the East Sabine Lake Hydrologic Restoration Project.
83. Use dredged materials to restore marsh in all open-water areas east of Sabine Lake where it is feasible to pump them, and construct terraces to restore marsh in all open-water areas east of Sabine Lake where it is not feasible to pump dredged materials (note: not location specific).
84. Use dredged materials and construct terraces in the open-water areas of the Black Bayou Cutoff Canal area.
85. Restore the hydrology and prevent saltwater intrusion at the oil field ditch and lateral ditches running west from the Black Bayou Cutoff Canal.
86. Establish a state park in the area east of Lighthouse Bayou and south of Hwy. 82 (contingent on private property donation and not necessarily including the lighthouse).
87. Use dredged materials to restore eroded beaches in the vicinity of the 15-mile marker from the Louisiana line (that is, in the Dunn Beach and Martin Beach areas).
88. Construct an earthen barrier on the east bank of the Sabine River from the GIWW to Sabine Island to eliminate saltwater intrusion.
89. Use dredged materials to restore the marshes in the area north of the GIWW and west of the Gray and Vinton drainage canals.
90. Use one-time placement of dredged materials in various areas to create coastal forest and chenier habitat (note: not location specific).
91. Use dredged materials to create cheniers on the high marsh from Louisiana Point to Holly Beach.
92. Use dredged materials to restore marshes in the Bessie Heights Marsh area.
93. Provide erosion control along the channel on the north portion of Pleasure Island.
94. Provide erosion control along the channel on the extreme south portion of Pleasure Island.
95. Use dredged materials to restore the north end of Pleasure Island where Sabine Lake is breaking through.
96. Use dredged materials to restore the southern tip of the peninsula north of the northern tip of Pleasure Island.
97. Provide erosion control using concrete revetment on the west side of the Port Arthur Canal across from Placement Area 11 in the vicinity of the vessel repair facility.
98. Use dredged materials to close the gap between the channel and Sabine Lake north of Pleasure Island.
99. Use dredged materials to close the gaps between the islands at the north end of Sabine Lake.
100. Elevate Hwy. 87 with dredged materials near Sabine Pass.
101. Provide erosion control along the channel on the south portion of Pleasure Island in the vicinity of Placement Area 8.
102. Use dredged materials to restore the marsh on the south end of Humble Island.
103. Use dredged materials to restore the marsh on the south side of the GIWW below Taylor Bayou.
104. Use dredged materials to restore the marshes north of the GIWW in Louisiana.

105. Restore access to the Sabine Lighthouse and stop erosion in the immediate area.
106. Use dredged materials to build developable land on the north side of the Neches River from Beaumont downstream.
107. Use dredged materials to build up the area near Hwy. 82 and the causeway so that a bridge can be built over the channel directly linking Hwy. 82 and Hwy. 87.
108. Use dredged materials to restore the eroding beach in the vicinity of Peveto Beach.
109. Breach the levees and use dredged materials to restore the manmade lakes within Sabine NWR to their original marsh condition.
110. Use dredged materials to fill in oilfield service canals wherever they are contributing to salinity intrusion into Louisiana's marshes (note: not location specific).
111. Use dredged materials to build islands offshore on both sides of the channel for migratory birds that would simulate the function of a natural delta.
112. Use dredged materials to build islands for migratory birds in Sabine Lake far enough from shore to protect from predators.
113. Use dredged materials to construct cheniers in Louisiana and Texas, planting them with oaks and other vegetation that occur on natural cheniers.
114. Use dredged materials to restore cheniers in Louisiana and Texas (perhaps by removing the existing top layer of sand and shell, depositing dredged materials, and they relaying the sand and shell on top), with easements to protect them for bird use.
115. Use dredged materials to buffer cheniers in Louisiana and Texas that are in danger of disappearing.
116. After placing dredged materials in new placement areas, shape and contour the areas so that they appear natural, and plant native vegetation to support wildlife (note: not location specific).
117. Shape and contour existing dredged material placement areas so that they appear natural, and plant native vegetation to support wildlife (note: not location specific).
118. Construct recreational amenities, particularly primitive campgrounds, on cheniers and on placement areas that have been filled (note: not location specific).
119. Construct a lock at Sabine Pass to prevent saltwater intrusion into Sabine Lake.
120. Construct a bulkhead on the channel side of Pleasure Island from the intersection of the SNWW and the GIWW to the north end of the island.
121. Mine dredged materials from Placement Area 8 to build up the 43 acres at the south end of Pleasure Island owned by the port and then replace with new dredged materials.
122. Preserve the productive shallow-water areas of the two placement areas on Pleasure Island by depositing dredged materials on top of the existing levees, particularly near the channel, and develop the land for recreational use.
123. Use dredged materials to build up the land on the southern portion of Pleasure Island from Placement Area 8 to the south end of the island on the lakeside and bulkhead the channel side.
124. Provide erosion control for all of Pleasure Island on the channel side.
125. Use dredged materials to rebuild the approximately one-quarter mile of land at the north end of Pleasure Island that has completely eroded away and protect it with erosion control structures.

126. Use dredged materials to build up the land on Pleasure Island directly across from the Taft Avenue Extension to preserve its potential as a location for a second bridge to the island.
127. Construct a new salinity control structure on the north side of the GIWW at the point where Salt Bayou intersects the GIWW.
128. Use dredged materials to restore the beach and create dunes south of McFaddin NWR between Sea Rim State Park and High Island.
129. Use dredged materials to rebuild the island at the McFadden Bend Cutoff (Reserve Fleet area across from Sun Terminal) that was lost to erosion.
130. Use dredged materials to restore Bessie Heights Marsh and construct salinity control structures to protect the marsh.
131. Construct a salinity control structure on the Keith Lake Fish Pass.
132. Limit salinity intrusion into Keith Lake by using dredged materials to fill in the cuts that have been made into the lake on its north side.
133. Build vegetated dunes and institute ongoing erosion control and beach nourishment for the eroded beach in the vicinity of McFaddin NWR.
134. Construct a structure at the channel end of the Pilot Station Cut to limit saltwater intrusion.
135. Construct a structure at the channel end of the Texas Bayou Cut to limit saltwater intrusion.
136. Construct a structure at Keith Lake Fish Pass to limit saltwater intrusion.
137. Investigate the potential for mining existing placement areas for high-quality dredged materials that can be used in various restoration projects (note: not location specific).
138. Use maintenance dredging materials from the GIWW to restore the eroded beach in the vicinity of McFaddin NWR.
139. Use dredged materials from the lower portion of Taylor Bayou for marsh restoration and beach nourishment.
140. Mine the high-quality sediments from behind the dam at Steinhagen Lake (outside of the study area) for use in marsh restoration and beach nourishment projects in the study area.
141. Modify the jetty system to restore the longshore current and deposition of materials along the beach west of the channel.
142. Use the high-quality materials from offshore channel dredging to restore the eroded beach in the vicinity of McFaddin NWR.
143. The beach in the vicinity of McFaddin NWR is being eroded because the longshore current is deflected outward by the jetties and then turns back sharply toward the beach. Build a longshore parallel jetty system to minimize the assault on the beach by the inwardly turning longshore current.
144. Because it is of higher quality, use dredged materials from the GIWW for beach restoration west of the channel rather than for other purposes.
145. Reinforce the shoreline all along the channel to reduce erosion and the need for maintenance dredging.
146. Implement the Drainage District 6 proposed Taylor Bayou Diversion Channel project west of the present diversion channel and from Taylor Bayou to the GIWW to alleviate flooding.

147. Use dredged materials to restore the eroding beach south of McFaddin NWR to protect Hwy. 87.
148. Pump sand from offshore to restore the eroding beach south of McFaddin NWR to protect Hwy. 87.
149. Restore the Rose City Marsh in keeping with the plan of action submitted by TNRCC, which involves breaking the open-water areas into cells with levees and restoring one cell at a time with dredged materials.
150. Preserve the oxbow above the Rose City Marsh, with possible donation or easement and recreation link with mainland.
151. Close the breaks into the marsh on the southeast bank of Keith Lake that are contributing to saltwater intrusion.
152. Resolve the problem of too much fresh water in the Blind Lake area where the TPWD levee and the GIWW are interrupting sheetflow, perhaps by constructing a drainage canal to the GIWW.
153. Reduce saltwater intrusion into Bessie Heights Marsh by separating the marsh from the Neches River by building a levee along the riverbank and rebuilding the levee on the GSU canal.
154. Reduce saltwater intrusion by building a levee across the old dredged material placement area to Bird Island Bayou.
155. Restore the Mires Bayou area by building levees to close the oxbow at both ends, which would limit saltwater intrusion.
156. Protect the Texas Point marshes by constructing a longshore rock jetty and placing dredged materials along the beach behind the jetty.
157. Use dredged materials to restore marshes throughout the study area that have been converted to open-water areas, as seen by comparing historic to contemporary maps (note: not location specific).
158. Constrict the channel to about 250 feet at Sabine Pass to reduce saltwater intrusion into Sabine Lake.
159. Construct a lock at Sabine Pass to eliminate saltwater intrusion into Sabine Lake.
160. Deposit dredged materials southeast of the lighthouse to create a raised area or dunes that would protect the lighthouse from storm surges and assist in erosion control.
161. Place dredged materials southeast of the lighthouse along the mudflats and slightly inshore at an elevation of about three feet to protect the lighthouse.
162. Control coastal erosion west of Johnsons Bayou by the placement of materials from offshore channel dredging.
163. Use every opportunity presented by the present and proposed projects to preserve the lighthouse for future generations (note: not site or recommendation specific).
164. Construct a saltwater barrier at the mouth of Lighthouse Bayou to limit saltwater intrusion into the marsh.
165. Construct an emergent or submerged rock barrier north of the causeway to limit saltwater intrusion into Sabine Lake.
166. Build a levee or separate salinity control structures from Blue Buck Point east to limit saltwater intrusion into the marshes through the numerous small ditches and oilfield canals.

167. Construct an erosion control structure and rebuild the land with dredged materials in the eroding cove on the east side of the lake and north of the causeway.
168. Construct an erosion control structure and rebuild the land with dredged materials in the eroding cove on the east side of the lake and south of the causeway.
169. Construct a lock at the mouth of the channel to eliminate saltwater intrusion into Sabine Lake.
170. Build placement areas to a reasonable level, then move on to other areas, allowing the old placement areas to vegetate or be used for development (note: not location specific).
171. Use dredged materials to restore the eroding beaches from Texas Point to High Island.
172. Use dredged materials for dune restoration south of Hwy. 87 if it is ever rebuilt.
173. Use dredged materials for marsh restoration in the Bessie Heights Marsh.
174. Use dredged materials for marsh restoration in Keith Lake wherever open-water areas are emerging.
175. Use dredged materials for marsh restoration in the Salt Bayou watershed north and south of the GIWW.
176. Use dredged materials to build up low-lying land suitable for development that is not marshland (note: not location specific).
177. Because most dredged materials contain pollutants, continue to put them in placement areas rather than using them for ostensibly beneficial purposes (note: not location specific).
178. Any beach-quality sand that is available should be used to restore the eroding beaches from Texas Point to High Island.
179. Use dredged materials to construct a road to the Sabine Lighthouse.
180. Use dredged materials to restore the beaches east of the channel.
181. Construct a lock at the mouth of the channel to eliminate saltwater intrusion into Sabine Lake.
182. Construct a revetment or levee and fill in back with dredged materials to restore the eroding cove at the mouth of Lighthouse Bayou.
183. Remove Point Hunt Island in the channel to allow a straight passage for vessels so that the land to the east is not subjected to collisions.
184. Use dredged materials to fill in the open-water areas in Sabine NWR.
185. Use dredged materials to further build up the potentially developable land on the east side of the channel and investigate ways to modify present restrictions on development.
186. Constrict the channel at Sabine Pass to reduce saltwater intrusion into Sabine Lake.
187. Construct a weir in the vicinity of the causeway to reduce saltwater intrusion into Sabine Lake.
188. Construct a series of small islands between the north end of Pleasure Island and Sabine Island to reduce saltwater intrusion into Sabine Lake from the channel.
189. Use the higher-quality dredged materials obtained through offshore dredging for marsh and beach restoration.
190. Use dredged materials to restore the shoreline and Hwy. 87 between Texas Point and High Island.

191. Continue to insure freshwater inflow into Sabine Lake from the Neches and Sabine rivers (note: not location specific).
192. Construct a public boat launch on the Louisiana side of the causeway at the site of the present deteriorated boat ramp to provide access to Sabine Lake from Louisiana.
193. Rehabilitate the old boat launch at the burned out bridge on old Hwy. 90.
194. Rebuild the deteriorating islands between the north end of Pleasure Island and Sabine Island to reduce saltwater intrusion into Sabine Lake from the channel.
195. Construct substrates for oysters in Sabine Lake to renew oyster production.
196. Ensure that future restoration and beneficial use projects comply with Louisiana mandates and Louisiana's Coast 2050 plan (note: not location specific).
197. Stabilize the levees of the GIWW throughout its entire extent in the Louisiana portion of the study area.
198. Restore the levees on the Vinton Drainage Canal.
199. Use dredged materials to restore road access to the Sabine Lighthouse.
200. Construct a lock in Sabine Pass to eliminate saltwater intrusion into Sabine Lake.
201. Use dredged materials for erosion control on both sides of the channel from Sabine Pass to the north end of Pleasure Island.
202. Stabilize the shoreline of the entire Neches River channel.
203. Stabilize the lake shoreline and replenish adjacent marshes in the area from Blue Buck Point to Johnsons Bayou, leaving the bayous open.
204. Construct a structure within the causeway to slow tidal flows in and out of the south end of Sabine Lake.
205. Construct a lock at the mouth of the Sabine River to regulate freshwater flows into Sabine Lake from Toledo Bend Reservoir.
206. If the SNWW project is approved, develop a joint Louisiana-Texas plan to deal with any unforeseen problems that might occur (note: not location specific).
207. Use dredged materials for beach restoration from Texas Point to High Island.
208. Construct a fishing pier in connection with the improved boat launch on the Louisiana side of the causeway.
209. Construct a large parking area in connection with the improved boat launch on the Louisiana side of the causeway.
210. Construct a structure at the mouth of Lighthouse Bayou to limit saltwater intrusion.
211. Use dredged materials to restore the beach from Louisiana Point to Constance Beach.
212. Use dredged materials to reinforce the roadbed of Hwy. 82 along the Louisiana coast.
213. Use dredged materials to enhance the beach at Louisiana Point.
214. Use dredged materials to restore Fina Anchorage Island created by the cutoff in the Neches River.
215. Use dredged materials for chenier restoration in Louisiana, including planting of native vegetation to provide habitat for neotropical migratory songbirds.
216. Use dredged materials to restore deteriorating marshes in the chenier plain.
217. Use dredged materials to construct new cheniers in Louisiana.
218. Establish salinity control on the bayous and canals entering Sabine Lake from Louisiana.
219. Use dredged materials to restore cheniers on the Texas side of the channel.

220. Use dredged materials to restore beaches and dunes along the Louisiana coast to provide bird habitat.
221. Move Hwy. 87 one thousand feet inland from the beach from Texas Point to High Island, build a dune structure, and fill in the area with dredged materials to slow erosion.
222. Stockpile dredged materials and mine them for beneficial use when needed (note: not location specific).
223. Use dredged materials (sand and mud) to restore the coastline west of Texas Point.
224. Use dredged materials to restore the marshes north of Keith Lake.
225. Restore the marshes from Bessie Heights Marsh to Rose City Marsh as one marsh system.
226. Fill manmade ditches within the Texas marshes (Sea Rim Pintail Flats Marsh, Lower Neches Marsh, Bessie Heights Marsh, Texas Point Marsh, McFaddin Marsh, Meyers Bayou Marsh, etc.) to restore the historic hydrology and salinity (note: not location specific).
227. Construct a saltwater barrier at Sabine Pass.
228. Construct water control structures at the mouth of every canal and bayou in Texas that connects with the channel (Pilot Station, Texas Bayou, Keith Lake Fish Pass, Bessie Heights, Lower Neches, etc.) to restore the historic hydrology, and use dredged materials to fill the canals after water control is accomplished (note: not location specific).
229. Use dredged materials to raise Hwy. 87 from the GIWW bridge south to Sabine Pass.
230. Reconstruct Hwy. 87 from the GIWW bridge south to Sabine Pass to allow sheetflow under the road.
231. Use dredged materials to build up eroding areas on Pleasure Island while avoiding any damages to the lake.
232. Develop a comprehensive study of the best possible restoration of the marsh system from Bessie Heights Marsh to Rose City Marsh.
233. Transport dredged materials outside of the study area so that they can be more widely used, for example at Rollover Pass (note: not location specific).
234. Use dredged materials to create vegetated dunes and restore the beaches from Texas Point to High Island.
235. Mine existing placement areas for materials to build dunes and restore beaches along the Texas coast (note: not location specific).
236. Use dredged materials to build a barrier island from Texas Point to Rollover Pass.
237. After historic hydrology and salinity have been reestablished (as per 226 and 228) in Texas' degraded marshes (Sea Rim Pintail Flats Marsh, Lower Neches Marsh, Bessie Heights Marsh, Texas Point Marsh, McFaddin Marsh, Meyers Bayou Marsh, etc.), build land masses and islands, with coarse dredged sand used to establish bird grit sites (note: not location specific).
238. Use dredged materials to construct a bird island in Sabine Lake.
239. Use the higher-quality materials from offshore dredging for beach restoration.
240. Construct water control structures at the mouth of every canal and bayou in Texas that connects with the channel (Pilot Station, Texas Bayou, Keith Lake Fish Pass, Bessie Heights, Lower Neches, etc.) to restore the historic hydrology, and use

dredged materials to fill the canals after water control is accomplished (note: not location specific).

241. Use dredged materials to create vegetated dunes and restore the beaches from Texas Point to High Island.
242. Use dredged materials from the SNWW and from Entergy's canal dredging to restore the declining marshes on Entergy property.
243. Use dredged materials to levee Entergy's outflow canal to keep sediment out of the canal and to keep the flow of water from eroding the marsh.
244. Use dredged materials in any fashion that would keep saltwater from intruding into the marshes on Entergy property.

### 3.9 Post-Workshop Activities

After each workshop, suggestions were clarified on the basis of the various sets of notes that had been taken, were provided sequential numbers for each succeeding workshop, and were placed in the electronic database. The locations of suggestions on the hardcopy maps were assigned sequential numbers for each succeeding workshop, transferred to the electronic maps, and checked for precision in keeping with the suggestions. This information was e-mailed to the Galveston District. The Mylar overlays served as a permanent record of the suggestions from each workshop. Finally, the suggestions and their locations were organized electronically by category. The following maps show the 244 suggestions in terms of their categorical designations.

## 4.0 SNWW RIVER TRIPS

The SNWW study team members and resource agencies were given an introductory boat tour of the proposed project area on September 13, 2000. SNND Board Member Sonny Sherman provided a houseboat for the trip. Representatives from all ICT agencies were invited to travel down the SNWW from Beaumont to Sabine Pass. They were accompanied by USACE study team members who provided introductory information on the proposed project.

A boat trip from Beaumont to Sabine Pass down the SNWW was held for public news media on September 23, 2003. SNND Board Member Sonny Sherman provided a houseboat for the trip. Media from the entire Study Area were invited to travel and observe the channel, and speak with team members, resource agencies, and the SNND. The objective of these trips was to generate public interest in the project and encourage greater participation in public meetings.

## 5.0 TEXAS HABITAT PROTECTION ADVISORY PANEL MEETINGS

Status updates on the preparation of the Draft EIS were presented at Texas Habitat Protection Advisory Panel (AP) Meetings on December 9, 2003, and December 6, 2005. The AP was briefed on alternatives, technical workgroup activities, and H-S and WVA modeling procedures and results. The Preferred Alternative (48x700 ft project) was presented to the AP on September 26, 2006. The AP is composed of persons from recreational and commercial fishing groups, conservation organizations, academia, and state and federal resource agencies who meet to

review and discuss fishery habitat issues. It is one of eight regional fishery management councils established by the Magnuson-Stevens Fishery Conservation and Management Act of 1976.

## 6.0 SOUTHEAST TEXAS WATERWAY ADVISORY COUNCIL (SETWAC) MEETINGS

USACE representatives regularly attended SETWAC meetings to provide status updates of the project. SETWAC is a "harbor safety committee" established by the U.S. Coast Guard (USCG) in 1997. SETWAC is a public forum to facilitate discussion and exchange of views and advice among all stakeholders on a wide range of issues relevant to ports on the Sabine and Neches Rivers. Topics discussed at the meetings include, but are not limited to, communications, traffic management, anchorages, and other topics dealing with safety, efficiency, preservation, and improvement of the transit and usage of the Sabine-Neches Waterway System. Members of SETWAC include the USCG, USACE, the SNND, the Ports of Beaumont, Orange, Port Arthur and Sabine, public safety and emergency management agencies from surrounding local governments, commercial fishing associations, petrochemical plants and terminals along the SNWW, the Sabine Pilots Association, harbor tug companies, shipping agents and operating companies, and vessel repair companies.

## 7.0 LEADERSHIP OF SOUTHEAST TEXAS CLASS OF 2007 CONFERENCE

On January 25, 2007, representatives from USACE, SNND, the Sabine Pilots Association, and Bracewell and Giuliani provided updates regarding the proposed SNWW CIP to this conference in Orange, Texas. The central topic for the conference was the proposed CIP. USACE and SNND provided an overview and current status of the feasibility study and EIS.

## 8.0 SABINE PILOTS ASSOCIATION (SPA)

USACE and SNND met with members of the SPA several times throughout the preparation of the EIS. The purpose of the meetings was to obtain information on transit rules, transit times, and safety and other operational issues. Specific changes in depth and width, and specific navigational features such as turning basins and anchorages were discussed.

## 9.0 INDUSTRIAL USERS OF THE SNWW

USACE and SNND met with representatives from local industry several times throughout the course of this study. The meetings were held to identify specific needs of the industries in regard to use of the SNWW. Current and projected future needs were explored.

## 10.0 FUTURE PUBLIC INVOLVEMENT ACTIVITIES

Following completion of the Final Feasibility Report and the Final Environmental Impact Statement, additional public involvement activities will be initiated:

- Distribution to agencies and organizations for review and comment (see distribution list in FEIS Section 12.3);
- Presentation of the Preferred Alternative to local governments; and
- Publication of the FEIS Notice of Availability in the Federal Register, announcing the public comment period.

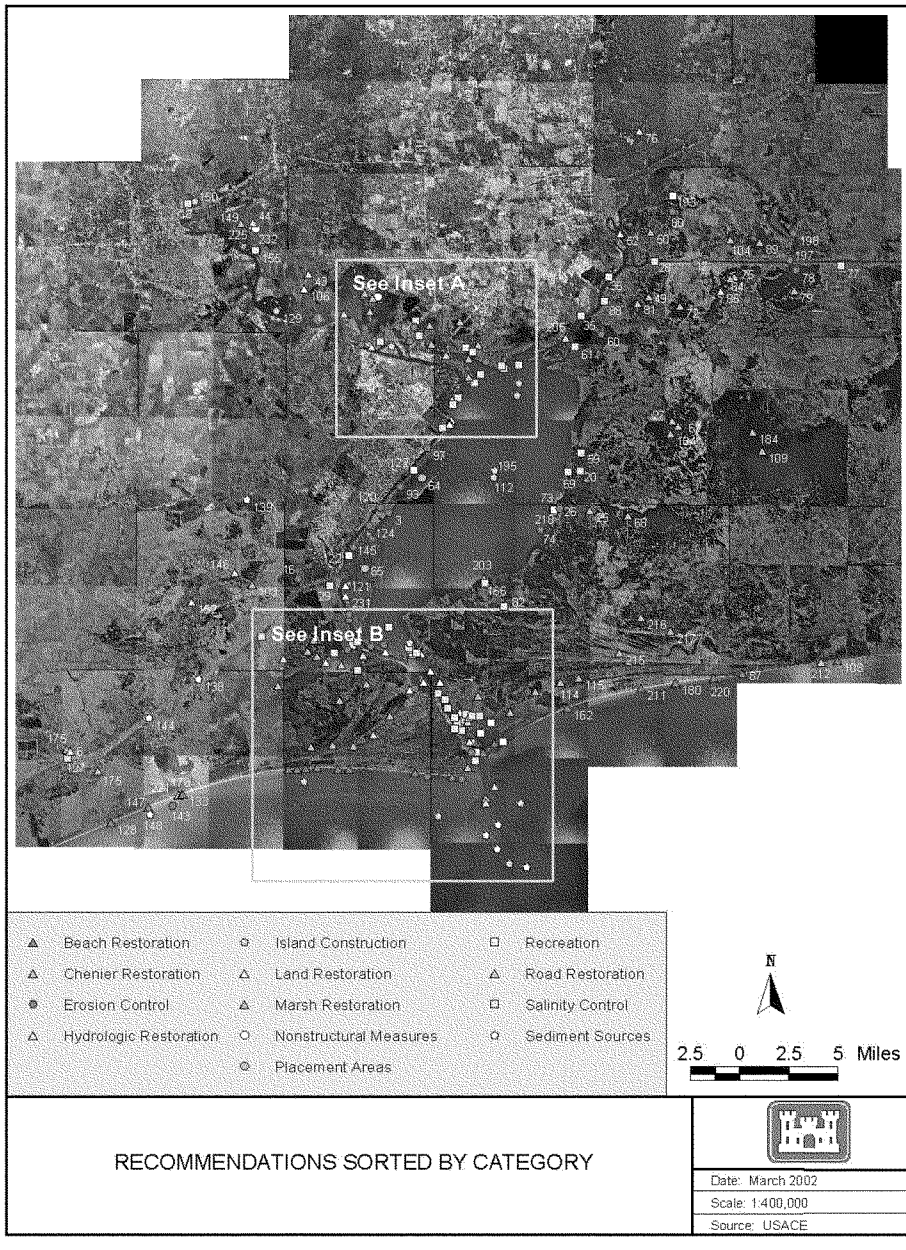


Figure 1: Recommendations Sorted by Category

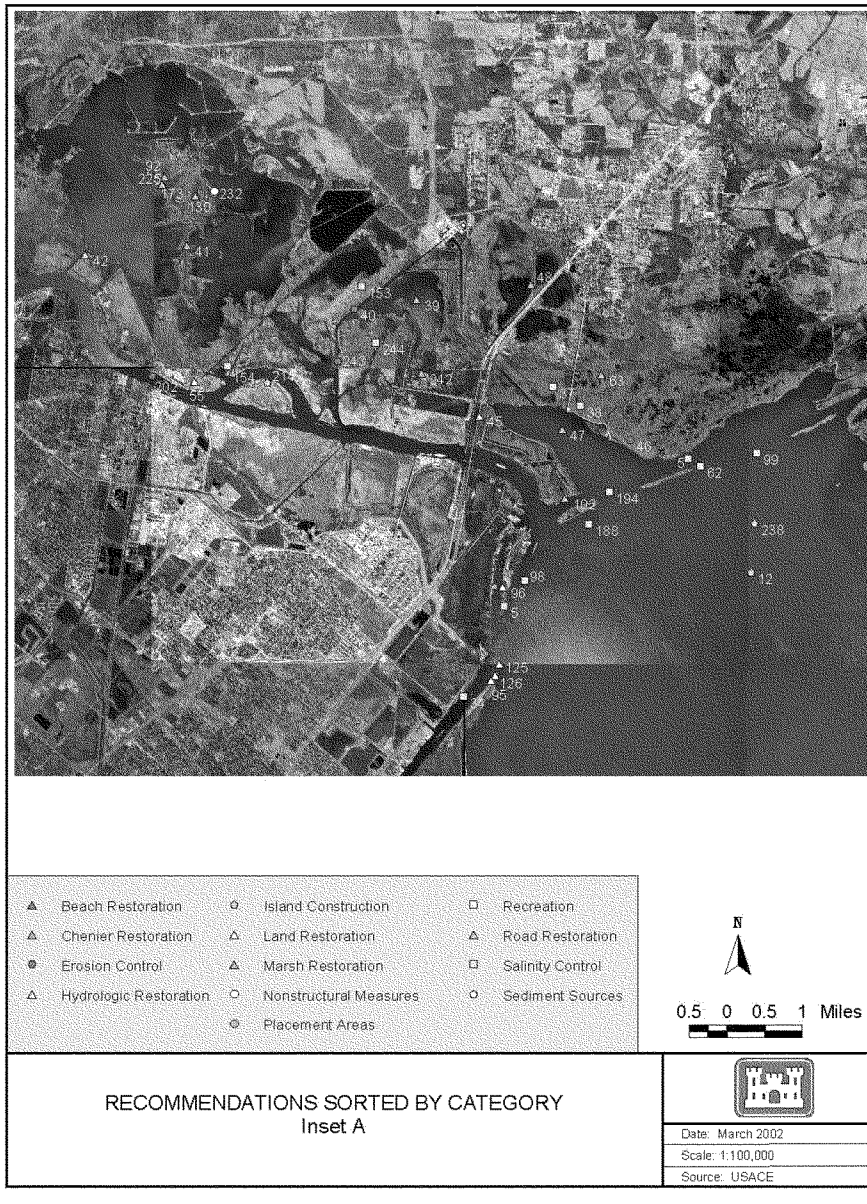


Figure 2: Recommendations Sorted by Category, Inset A

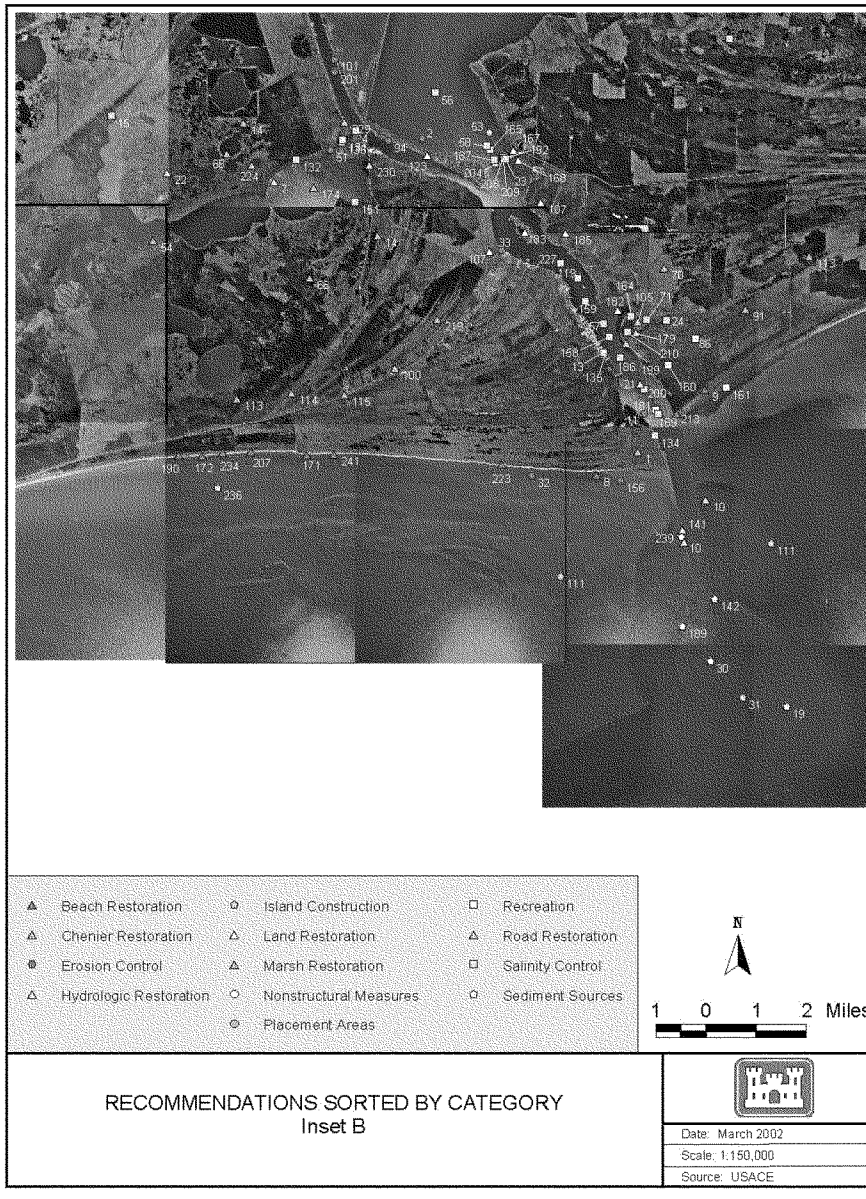


Figure 3: Recommendations Sorted by Category, Inset B

# Appendix A1

# Agency Coordination

8 May
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PE-LS

# State of Louisiana

M.J. "MIKE" FOSTER, JR.
GOVERNOR

JACK C. CALDWELL
SECRETARY

**DEPARTMENT OF NATURAL RESOURCES**

May 5, 2000

Major Randy L. Turner, Deputy District Engineer
Department of the Army
Galveston District Corps of Engineers
P. O. Box 1229
Galveston, TX 77553-1229

Dear Major Turner:

I am writing in reference to the Notice of Studies and Initial Public Meeting for Sabine-Neches Waterway, Texas Feasibility Study. We are concerned about increases in saltwater and tidal intrusion into the swamps and fresh to intermediate marshes of the Calcasieu-Sabine Basin east of Sabine River and Sabine Lake that may result from this navigation project.

There are more than a hundred square miles of fragile coastal marsh and swamp in southwestern Louisiana that rely on freshwater from the Sabine River for their productivity. These marshes have already suffered catastrophic losses over the past 50 years due to hydrologic alterations and, as a result, there is a sizeable state and federal restoration effort underway to ensure that the remaining wetlands will continue to support renewable fish and wildlife resources for future generations. There are, in fact, a large number of coastal restoration projects that have been constructed or are in various stages of planning/implementation that would be affected by significant salinity changes in the Sabine estuary. Wetlands of the Calcasieu/Sabine estuary are already stressed by the well-documented effects of navigation channel-induced saltwater intrusion.

We expect that this feasibility study will include a thorough analysis of the environmental effects of the existing navigation project as well as the incremental effects of any proposed project modification. You are probably aware that ongoing water planning activities under Texas Senate Bill 1 are evaluating diversion of the Sabine River from or below Toledo Bend Reservoir. Reductions in Sabine River stream flow and increased saltwater intrusion may cause significant adverse impacts to the estuarine system in both states. It is critical that this feasibility study evaluate the potential cumulative impacts to the Louisiana and Texas coastal marsh ecosystem from these hydrologic alterations.

We are very interested in being involved in the planning and decision-making process for this study and await notice from the Galveston District as to how we can appropriately participate in the study's environmental assessment of the southwest Louisiana marshes. In the meantime, please send us a copy of the project Reconnaissance Study so that we can fully understand the scope of the project and the nature of the federal interest that has been identified as justifying further study. Please contact me at (225) 342-7308 should you have any questions or like to discuss this further.

Sincerely,

Bill Good

Bill Good, Ph.D.
Coastal Restoration Division Administrator

COASTAL RESTORATION DIVISION
P.O. Box 94396 · Baton Rouge, Louisiana 70804-9396 · Telephone (504) 342-7308 · Fax (504) 342-9417

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State of Louisiana

James H. Jenkins, Jr.
Secretary

Department of Wildlife & Fisheries
Post Office Box 98000
Baton Rouge, LA 70898-9000
(225) 765-2800

M.J. "Mike" Foster, Jr.
Governor

May 8, 2000

Major Randy L. Turner
Deputy District Engineer
Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Notice of Studies and Initial Public Meeting for Sabine-Neches Waterway, Texas, Feasibility Study

Dear Major Turner:

The Louisiana Department of Wildlife and Fisheries is very interested in the above reference study and the impacts to the natural resources of Louisiana. We request that your agency keep us informed on the study and any meetings and/or field trips concerning this study.

This agency strongly supports the beneficial use of dredged material to restore wetlands within the Sabine River Basin. There are areas within Louisiana that we would suggest this dredged material be placed to restore some of the marsh lost.

Mr. Fred Dunham of my staff is assigned to this study and can be reached at (225) 765-2367, fax (225) 765-2452, or by e-mail dunham_fo@wlf.state.la.us.

Sincerely,

P E Bowman

Philip E. Bowman
Assistant Secretary

PEB:fod

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United States Department of the Interior
FISH AND WILDLIFE SERVICE
Division of Ecological Services
17629 El Camino Real, Suite #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882

June 20, 2000

Colonel Nicholas J. Buechler
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229
ATTN: Mr. Frank Garcia

Dear Colonel Buechler:

This is in response to Public Notice dated April 20, 2000 requesting comments on the feasibility phase of the Sabine-Neches Waterway (SNWW) Study. The SNWW connects the harbor facilities in Beaumont, Port Arthur, Orange, and Sabine Pass in Jefferson and Orange Counties, Texas, and Cameron and Calcasieu Parishes Louisiana with the Gulf of Mexico. This waterway also connects the Gulf Intracoastal Waterway (GIWW) in Calcasieu Parish, Louisiana to the GIWW in Jefferson County, Texas. Following are comments of the U.S. Fish and Wildlife Service , which have been coordinated with our Texas Chenier Plain and Louisiana Sabine National Wildlife Refuges and our Lafayette, Louisiana field office.

The Public Notice states that 3 alternatives being considered are channel deepening from the Gulf of Mexico to Beaumont, channel widening from Port Arthur to Beaumont, and using dredged material to enhance Bessie Heights and Rose City Marshes. Our comments are intended to provide the Corps with Service concerns regarding possible impacts to important native fish and wildlife habitats in the Sabine, Neches, and Calcasieu River Basins which could be affected by modifications to the SNWW.

**Salinity intrusion into important wetland habitats** --- The Service's main concern from any channel modifications are that increased salinity intrusion from an enlarged ship channel could affect freshwater and brackish wetland habitats already stressed by high salinity levels. These habitats include important freshwater wetlands at Taylor's Bayou, wetlands adjacent to the Gulf Intracoastal Waterway (GIWW) in Texas and Louisiana, cypress-tupelo wetland forests along the Neches River and north of the GIWW in Louisiana, large tracts of freshwater and brackish marsh east of Sabine Lake within Sabine National Wildlife Refuge, and marshes west of Sabine Lake at Lower Neches Wildlife Management Area (Texas Parks and Wildlife Department), and J.D. Murphree Wildlife Management Area.

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These habitats are some of the richest, in terms of productivity, diversity, and habitat value, in North America. Collectively, they provide important wintering habitat for over 2 million waterfowl annually and contribute hundreds of millions of dollars to the regional economy annually through recreational hunting and fishing, tourism, commercial fisheries, fur trapping, and outdoor recreation. These wetlands are today adversely impacted by elevated levels of salinity introduced through the SNWW and the Calcasieu Ship Channel, 40 miles to the east. Salinity intrusion from these two sources has, during the past 50 years, caused shifts in native wetland communities towards saline marsh, a less diverse marsh type. Recent studies by Lousisiana Department of Natural Resources have shown large amounts of marsh loss adjacent to manmade channels and canals throughout the area. This marsh loss and marsh alteration is presently causing millions of dollars in economic losses annually to the coastal counties of Jefferson and Orange and the parishes of Cameron and Calcasieu. As these wetlands provide habitat for some of our most valuable trust-mandated natural resources, the Service will not support any channel enlargement project which causes significant additional increases in salinity to adjacent inland marsh and swamp communities.

Therefore, the Service recommends that the Corps conduct three-dimensional hydrodynamic modeling studies to predict changes to salinity regimes, tidal amplitudes, hydroperiods, and marsh flooding durations within the lower Sabine and Neches River drainages from SNWW project modifications. The Service would like to participate in this modeling work group.

The Louisiana Department of Natural Resources (DNR) is presently contracting with Dr. Ehad Meselhe at the University of Louisiana at Lafayette for an H3D model to be used to predict similar changes in this region. There is available an extensive set of data on water salinities within these wetland habitats of concern, specifically in Sabine National Wildlife Refuge, McFaddin National Wildlife Refuge, Texas Point National Wildlife Refuge, J.D. Murphree Wildlife Management Area , Sabine Lake proper, Lake Bayou cypress swamp near Beaumont, Blue Elbow cypress swamp on the Sabine River, and Sabine Island Wildlife Management Area (Louisiana Department of Wildlife and Fisheries). Any model utilized can and should be able to be verified by accurately reproducing known climatic events within these or similar sites.

Additionally, the Service recommends that model iterations include a reasonable array of freshwater inflow scenarios reflecting historic extremes and include reasonable engineering and beneficial uses features designed to reduce predicted future and present salinity conditions. These should include: a navigational lock or gate near Sabine Pass, waterway restrictions at important salinity intrusion points such as the lower end of Sabine Lake, Keith Lake Channel, Pleasure Island boat pass, the GIWW west of the SNWW, the re-establishment of the Sabine Lake shoreline south of the GIWW, and the GIWW east of Sabine Lake. And, model scenarios should include a reasonably foreseeable array of scenarios predicting cumulative losses of Sabine River freshwater inflows caused by withdrawals under current Texas Senate Bill 1 (Texas Water Plan). Again, the Service would like to participate in the development of the model, its verification, and in analysis of its results throughout project planning.

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**Beneficial uses features** --- Additional beneficial uses features using project-generated dredged material to restore previously degraded or lost wetland habitat should be investigated in the event channel modifications can be designed so as to not cause increased salinity problems. Potential beneficial uses project sites include Bessie Heights Marsh, backdune marshes at Texas Point National Wildlife Refuge, beach nourishment at Holly Beach and Texas Point, marshes at McFaddin National Wildlife Refuge, and marshes within the Lower Neches and J.D. Murphree Wildlife Management Areas.

**Impacts to Kemp's Ridley Sea Turtle** --- Stranding records indicate the nearshore waters off Sabine Pass contain a seasonally large population of this most endangered sea turtle species. Project designs will have to include adequate monitoring and protection mechanisms to insure turtles are not killed during channel dredging within the jetty channel reach.

Thank you for the opportunity to provide input during this early stage of project planning. We look forward to working with your staff closely during the coming months to insure that our important native coastal fish and wildlife resources are conserved by careful planning and wise project design. Our Service "team", which will be working on the SNWW project, includes Darryl Clark (Lafayette Field Office, 337/291-3111), Phil Glass (Clear Lake Field Office, 281/286-8282), Andy Loranger and Patrick Walther (Texas Chenier Plain NWR, 409/267-3337), and Chris Pease (Sabine NWR, 318/762-3816). Please do not hesitate to call any of them, or me at 281/286-8282 if you have questions or if these recomendations require clarification.

Sincerely,

for Carlos H. Mendoza
Project Leader, Clear Lake ES Field Office

cc:
Daryll Clark, FWS Lafayette
Steven Gammill, Louisiana DNR
Andy Loranger, FWS Texas Chenier Plains NWR
Chris Pease, FWS Sabine NWR
Jim Sutherlin, TPWD J.D. Murphree WMA
Patrick Walther, FWS McFaddin NWR

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JUN 28 2000

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9721 Executive Center Drive N.
St. Petersburg, Florida 33702

June 23, 2000

Colonel Nicholas J. Buechler
District Engineer, Galveston District
Department of the Army, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Dear Colonel Buechler:

The National Marine Fisheries Service (NMFS) has reviewed the "Notice of Studies and Initial Public Meeting for Sabine-Neches Waterway, Texas Feasibility Study," dated April 20, 2000. requesting comments on the feasibility phase of the Sabine-Neches Waterway (SNWW) Study. The Feasibility Study will examine channel deepening from the Gulf of Mexico to Beaumont, channel widening from Port Arthur to Beaumont, and using dredged material to enhance Bessie Heights and Rose City Marshes.

The proposed channel modification will affect Essential Fish Habitat (EFH) for postlarval, juvenile, and adult red drum (*Sciaenops ocellata*), brown shrimp (*Penaeus aztecus*), white shrimp (*Litopenaeus setiferus*), and pink shrimp (*Penaeus duorarum*), postlarval and juvenile Spanish mackerel (*Scomberomorus maculatus*). Categories of EFH which may be affected if the project is constructed will include estuarine emergent wetlands, estuarine water column, and estuarine mud/sand bottoms. Detailed information on red drum, mackerel, shrimp, and other Federally managed fisheries and their EFH is provided in the 1998 amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico Fishery Management Council (GMFMC). The 1998 generic amendment was prepared as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (P.L. 94-265).

In addition to EFH designated for shrimp, Spanish mackerel, and red drum, wetlands adjacent to Sabine Lake, and the lower Sabine-Neches River watershed, provide nursery and foraging habitat that supports various forage species and economically-important marine fishery species such as spotted seatrout (*Cynoscion nebulosus*), flounder (*Paralichthys spp.*), Atlantic croaker (*Micropogonias undulatus*), black drum (*Pogonias cromis*), Gulf menhaden (*Brevoortia patronus*), striped mullet (*Mugil cephalus*) and blue crab (*Callinectes sapidus*). These estuarine-dependent organisms serve as prey for other fisheries managed under the MSFCMA by the GMFMC (e.g., red drum, mackerels, snappers, and groupers) and highly migratory species managed by the NMFS (e.g.,

billfishes and sharks). Wetlands also provide habitat for many benthic animals, including marine worms and crustaceans, which are important components of the estuarine food web. Furthermore, wetlands provide other estuarine support functions, including: (1) providing a physically recognizable structure and substrate for refuge and attachment above and below the water surface; (2) improving water quality by trapping sediments and assimilating pollutants; (3) preventing erosion; (4) collecting organic and inorganic material by slowing currents; and (5) providing nutrients and detrital matter to the Sabine Lake estuary.

The NMFS is concerned that the proposed channel deepening and widening will increase salinity, alter the hydroperiod, and increase the tidal amplitude in the lower Sabine-Neches watershed. This could adversely impact brackish and intermediate marshes within the lower Sabine-Neches watershed and could result in significant marsh loss within the watershed. Therefore, NMFS recommends that the Corps conduct a three-dimensional hydrodynamic modeling study to evaluate potential changes to salinity regimes, tidal amplitudes, hydroperiods, and marsh flooding duration. The model should include all major drainages within the lower Sabine and Neches River watershed and Sabine Lake, including the Gulf Intracoastal Waterway to Calcasieu Lake, and an assessment should be made to determine what affects the proposed channel deepening and widening will have on marshes in the lower watershed. Model iterations should include a reasonable array of freshwater inflow scenarios to reflect present hydrology and a reasonably foreseeable array of scenarios predicting cumulative losses of Sabine River freshwater inflows caused by withdrawals under current Texas Senate Bill 1 (Texas Water Plan). The model runs should compare the present channel configuration with the proposed deepened and widened channel, including any reasonable engineering and beneficial use features designed to reduce predicted salinity increases. NMFS would like to participate in the development of the model, its validation, and in analysis of its results throughout project planning.

For your information, the Louisiana Department of Natural Resources (DNR) is presently contracting with Dr. Ehad Meselhe at the University of Louisiana at Lafayette for an H3D model to be used to predict similar changes in this region. There is available an extensive set of data on water salinities within these wetland habitats of concern, specifically in Sabine National Wildlife Refuge, McFaddin National Wildlife Refuge, Texas Point National Wildlife Refuge, J.D. MurphreeWildlife Management Area, Sabine Lake proper, Lake Bayou cypress swamp near Beaumont, Blue Elbow cypress swamp on the Sabine River, and Sabine Island Wildlife Management Area (Louisiana Department of Wildlife and Fisheries).

Additional beneficial use features using project-generated dredged material to restore previously degraded or lost wetland habitat should also be investigated. Potential beneficial use project sites include Bessie Heights Marsh, back dune marshes at Texas Point National Wildlife Refuge, beach nourishment at Holly Beach and Texas Point, marshes at McFaddin National Wildlife Refuge, and marshes within the Lower Neches and J.D. Murphree Wildlife Management Areas.

If we may be of further assistance, please contact Mr. Rusty Swafford of our Galveston Facility at (409) 766-3699.

Sincerely,

Andreas Mager, Jr.
Assistant Regional Administrator
Habitat Conservation Division

# State of Louisiana

M.J. "MIKE" FOSTER, JR.
GOVERNOR

JACK C. CALDWELL
SECRETARY

DEPARTMENT OF NATURAL RESOURCES

June 26, 2000

Frank Garcia
Chief, Planning, Environmental & Regulatory Divison
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, Texas 77553-1229

RE: **C000171**, Galveston District, Corps of Engineers, Sabine-Neches Waterway Study, Southeast Texas and **Calcasieu and Cameron Parishes, Louisiana**

Dear Mr. Garcia:

This letter is in response to the Notice of Studies and Initial Public Meeting for the Sabine-Neches Waterway, Texas Feasibility Study. Our preliminary comments are presented below, however, it will be necessary for the Galveston District to submit a Consistency Determination on this project before we can make a final decision on the project. For timely review, we suggest that you submit the Consistency Determination at the same time that the Draft EIS is published.

In the past, Louisiana has experienced vast amounts of wetland loss, a large part due to saltwater intrusion following development of navigational channels. For this reason, we are especially concerned that deepening of the Sabine-Nechez channel may have similar devastating effects on wetlands in southwestern Louisiana. We strongly recommend that the Galveston District conduct hydrological simulation modeling of the saltwater effects likely to result from this project, and that features such as a saltwater lock be included in the study of alternatives.

We recommend that the feasibility study provide full need and justification for the project, and that a thorough analysis of all environmental effects of the existing navigation channel and project alternatives be conducted and presented in the study findings. Possibilities for beneficial use of the dredged material to create wetlands should be fully explored as Louisiana has a no-net wetlands loss policy. Further, we expect the Galveston District to address any potential cumulative and secondary effects that these hydrological alterations will have on the coastal ecosystem, and provide compensatory mitigation for any wetland losses that may result.

COASTAL MANAGEMENT DIVISION P.O. BOX 44487 BATON ROUGE, LOUISIANA 70804-4487
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70804

losses that may result.

Please keep us informed of significant project updates and timelines. We would welcome involvement in the planning and decision-making process for this study and would like to participate in the study's environmental assessment of the southwest Louisiana coastal marshes. If you have any questions concerning this determination please contact Brian Marcks of the Consistency Section at (225)342-7939 or 1-800-267-4019.

342-9939

Sincerely,

Terry W. Howey

Terry W. Howey,
Administrator

TWH/JH/bgm

cc: John Stacy, CMD FI
Tina Horn, Cameron Ph.
Pam Sturrock, Calcasieu Ph.
Darryl Clark, USFWS

TEXAS PARKS & WILDLIFE

July 11, 2000

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*To manage and conserve the natural and cultural resources of Texas for the use and enjoyment of this and future generations.*

Colonel Nicholas J. Buechler
U. S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229
ATTN: Mr. Frank Garcia

Dear Colonel Buechler:

Texas Parks and Wildlife Department (TPWD), acting in the public trust, has considerable fish and wildlife interests and public recreation interests in the area influenced by any proposed navigation improvements. TPWD's habitat ownerships within these potentially impacted areas include the Tony Houseman State Park and Wildlife Management Area at Blue Elbow Swamp, Lower Neches Wildlife Management Area, J. D. Murphree Wildlife Management Area, Sea Rim State Park, and Sabine Pass Battleground. These lands total approximately 40,000 acres of wetland habitats in Orange and Jefferson Counties. Additionally, habitats of particular interest in the potentially affected area include Sabine Lake; fresh, intermediate and brackish marshes under other public or private ownerships; swamps and bottomland forests associated with the Sabine and Neches watershed basins; and the rivers and tributaries of the basins. These habitats have suffered substantially from salt-water intrusion due to increased navigation channel depths, small access channels into marshes, subsidence, and reduced marsh re-nourishment due to navigation channels and dams. Any increase in salinity will only increase the rate of habitat loss and thus is not acceptable.

Texas Parks and Wildlife requests that the Corps of Engineers implement the following recommendations regarding the proposed Feasibility Phase of the Sabine-Neches Waterway (SNWW) Study.

- The Corps should develop a three-dimensional hydrodynamic model that will reflect potential changes associated with the deepening and widening of the navigation channels, including the three depths of 45, 50, and 55 feet. The model should include the watershed basins to the west to State Highway 124, extend north upstream to existing dams on the Neches and Sabine Rivers. The model should also extend eastward to the Calcasieu Ship Channel.

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512-389-4800
www.tpwd.state.tx.us

- Include in the model mitigative measures that could compensate for changes in salinity for each proposed depth. For example, submerged locks or barriers to salt water intrusion at the mouth of Sabine Pass should be considered. Major mitigative measures be located in a few strategic locations could reduce the need for structural measures scattered along every tributary or embayment opening. Mitigative measures should not adversely affect ingress and egress of marine organisms that utilize estuaries as part of their life cycle. It is important that the diversity and productivity of Sabine Lake and its associated marshes and swamps are not degraded by the navigation improvements but are maintained or improved.

- Feasibility studies should incorporate anticipated changes in freshwater inflows into the estuary as anticipated from State water planning process (SB-1) actively underway at this time. The water plan for the State will be finalized in 2001. While this planning process is now underway, the timeline for the plan is to year 2050 allowing anticipated changes in freshwater inflows to be evaluated.

- In addition to measuring changes in salinity, modeling efforts should assess and incorporate changes in the following variables:
  1) tidal amplitude,
  2) anticipated relative sea level rise,
  3) temperature,
  4) primary productivity (phytoplankton) of Sabine Lake,
  5) nutrient utilization and water flushing rate (hydroperiod) in Sabine Lake,
  6) marsh hydroperiod as well as the flooding regime, and
  7) sediment transport within the basins and along the shoreline west of Sabine Pass.

- Modeling efforts should also measure the impact to the following "target" species:

  rangia clam
  white shrimp
  Atlantic croaker
  blue crab
  Southern flounder
  mottled duck
  pig frog
  American alligator
  muskrat

- Specific habitat types that should be considered in the modeling effort include:

  Cypress-tupelo swamp
  Freshwater marsh
  Intermediate marsh
  Brackish marsh
  Oyster reefs (Blue Buck Point)

- State cultural and historical sites (Fort Griffen) along the mouth of Sabine Pass should be assessed.

- The Corps should establish a beneficial uses group (BUG) for this project. Additionally, the Corps should use a process similar to the one used for the Houston Ship Channel project by developing an Interagency Coordination Team (ICT).

The Department appreciates the opportunity to provide comments and is interested in participating in the modeling work group, ICT, and/or BUG. Questions can be directed to Woody Woodrow in the Upper Coast Conservation Office (281) 461-4071 Ext. 22 or Rollin MacRae in Austin at (512) 389-4639.

Sincerely,

Larry D. McKinney, Ph.D.
Senior Director, Water and Resource Protection

LDM:JOW:JRM:msf

# State of Louisiana

M.J. "MIKE" FOSTER, JR.
GOVERNOR

JACK C. CALDWELL
SECRETARY

**DEPARTMENT OF NATURAL RESOURCES**

July 19, 2000

Ms. Carolyn Murphy
Chief, Environmental Branch
Department of the Army
Galveston District Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

re: Point of Contact for the Sabine-Neches Waterway Widening and Deepening Feasibility Study Interagency Coordination Team (ICT)

Dear Ms. Murphy:

Thank you for your letter of July 13, 2000 inviting my office to nominate someone for the Sabine-Neches Feasibility Study. This proposed project is of concern to my office both as it relates to regulatory issues, i.e. federal consistency determinations, and restoration issues, i.e. potential impacts of increased channel size on the quantity and quality of coastal wetlands. My office has two divisions, Coastal Management Division and the Coastal Restoration Division, which handle regulatory and restoration issues, respectively. Ideally, I would appoint a representative from each division to address these different aspects of the proposed project. These representatives would have been Mr. Greg DuCote from CMD and Mr. Steve Gammill from CRD. However, as you have requested a single point of contact, I nominate my Deputy Assistant Secretary, Mr. Gerry Duszynski, as our ICT Representative. He will call upon Mr. DuCote and Mr. Gammill for assistance, as appropriate.

Sincerely,

James "Randy" Hanchey, P.E.
Assistant Secretary

cc: Dr. Bill Good, Administrator, CRD
Dr. Terry Howey, Administrator, CMD
Mr. Gerry Duszynski, Deputy Assistant Secretary, OCRM
Mr. Steve Gammill, Geoscience Supervisor, CRD
Mr. Greg DuCote, Program Manager, CMD

OFFICE OF COASTAL RESTORATION AND MANAGEMENT
P.O. BOX 44487 • BATON ROUGE, LOUISIANA 70804-4487 • TELEPHONE (225) 342-3583 • FAX (225) 342-1377
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DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
and Prevention (CDC)
Atlanta GA 30341-3724

May 28, 2002

Ms. Janelle Stokes
Environmental Section, Planning Branch
Planning Environmental and Regulatory Division
P.O. Box 1229
Galveston, Texas 77553-1229

Dear Ms. Stokes:

We saw in Federal Register Notice 67 Fr 35801 dated May 21, 2002 that the Army Corps of Engineers intends to prepare a Draft Environmental Impact Statement (DEIS) to address the Improvements to the Sabine-Neches Ship Channel Near Beaumont and Port Arthur, Texas. We understand the study will evaluate several widening and deepening alternatives to improve a deep-draft navigation channel that connects harbor facilities in the Beaumont and Port Arthur area with the Gulf of Mexico. We are responding on behalf of the Department of Health and Human Services (DHHS), U.S. Public Health Service.

We are also particularly concerned that the DEIS provide detailed information on the dredged sediments, including plans for testing and characterizing contaminated hazardous and toxic bottom sediments prior to removal. We also are interested in planned disposal locations of these removed sediments and the potential impacts that these materials may have on human populations or potential downstream water supplies.

While we have no specific comments to offer at this time, the following areas are of particular concern to us and should be addressed if appropriate for this DEIS.

I. Air Quality
- dust control measures during project construction, and potential releases of air toxins potential process air emissions after project completion
- compliance with air quality standards

II. Water Quality/Quantity
- special private or public potable water supply considerations, including ground and surface water resources
- compliance with water quality and waste water treatment standards
- ground and surface water contamination (e.g. runoff and erosion control)
- body contact recreation

III. Wetlands and Flood Plains
- potential contamination of underlying aquifers
- construction within flood plains which may endanger human health
- contamination of the food chain

IV. Hazardous Materials/Wastes
- identification and characterization of hazardous/contaminated sites
- safety plans/procedures, including use of pesticides/herbicides; worker training
- spill prevention, containment, and countermeasures plan

V. Non-Hazardous Solid Waste/Other Materials
- any unusual effects associated with solid waste disposal should be considered

VI. Noise
- identify projected elevated noise levels and sensitive receptors (i.e. residential, schools, hospitals) and appropriate mitigation plans during and after construction

VII. Occupational Health and Safety
- compliance with appropriate criteria and guidelines to ensure worker safety and health

VIII. Land Use and Housing
- special consideration and appropriate mitigation for necessary relocation and other potential adverse impacts to residential areas, community cohesion, community services
- demographic special considerations (e.g. hospitals, nursing homes, day care centers, schools)
- consideration of beneficial and adverse long-term land use impacts, including the potential influx of people into the area as a result of a project and associated impacts
- potential impacts upon vector control should be considered

While this is not intended to be an exhaustive list of possible impact topics, it provides a guide for typical areas of potential public health concern which may be applicable to this project.

Thank you in advance for your consideration. Please send a copy of the DEIS to the following address for our review and comment:

Paul Joe, DO, MPH
Medical Officer
National Center for Environmental Health
Centers for Disease Control & Prevention
4770 Buford Highway, MS (F-16), NE
Atlanta, Georgia 30341-3724

Sincerely,

Paul Joe

Paul Joe, DO, MPH
Medical Officer
National Center for Environmental Health (F16)
Center for Disease Control & Prevention

# United States Department of the Interior

FISH AND WILDLIFE SERVICE

P.O. Box 1306
Albuquerque, New Mexico 87103
http://ifw2es.fws.gov

In Reply Refer To:
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JUL 15 2002

Carolyn E. Murphy, Chief
Environmental Section
U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Dear Ms. Murphy:

This responds to the U. S. Army Corps of Engineers notice of intent, to prepare a Draft Environmental Impact Statement for the improvements to the Sabine-Neches Ship Channel near Beaumont and Port Arthur, Texas, published in the May 21, 2002, Federal Register.

Since June 2001, the U.S. Fish and Wildlife Service (Service) Clear Lake, Texas and Lafayette, Louisiana Ecological Services Field Offices have been actively involved with the Corp of Engineers, Galveston District, other Federal and State environmental resource agencies in both states, and the project sponsor in the planning efforts for the Sabine-Neches Ship Channel Improvements project. Service involvement includes participation in the Interagency Coordination Team's Beneficial Uses Group and the Salinity Modeling Group. The Service will prepare a Draft Fish and Wildlife Coordination Act Report detailing its analysis of project impacts and mitigation requirements. This draft report will be completed in 2003.

The Service looks forward to further coordination with the Galveston District and others on the planning of this project.

Sincerely,

Acting Regional Director

cc: Team Leader, Natural Resources Management, Office of Environmental Policy and Compliance, Department of the Interior, Washington, D.C.
Director (AFHC-DFPA/BFA/ERT) Attention: Don Peterson
Regional Director, Region 4, Attention: Regional Environmental Coordinator
Regional Director, Region 2, Attention: Regional Environmental Coordinator
Supervisors, Ecological Services Field Offices, Clear Lake, TX and Lafayette, LA

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

JAN 30 2003

Carolyn Murphy, Chief
Environmental Resources Section
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

Subject: Sabine-Neches Waterway (Channel Improvements to Beaumont)
Environmental Impact Statement (EIS)

Dear Ms. Murphy:

The Environmental Protection Agency (EPA), Region 6, appreciates your invitation to become a cooperating agency in the preparation of the subject EIS. EPA is very interested in the proposed project and will participate in the National Environmental Policy Act (NEPA) process regarding our specific programs and responsibilities, to the extent possible, including: 1) Section 309 of the Clean Air Act (CAA) in review of the EIS for compliance with NEPA and Council on Environmental Quality (CEQ) guidelines; 2) Section 404 of the Clean Water Act (CWA) in the evaluation of impacts on wetlands and waters of the United States; and if applicable, 3) Section 102(c) of the Marine Protection, Research, and Sanctuaries Act (MPRSA) regarding the possible designation of an environmentally acceptable ocean dredged material disposal site (ODMDS). However, we are currently unable to participate as a cooperating agency.

Section 309 of the CAA and Section 404 of the CWA

The EIS for the proposed project should: 1) clearly demonstrate the Federal need for the proposed project, particularly when balanced against the Federal interest in coastal restoration; 2) analyze less environmentally damaging practicable alternatives to the proposed project; 3) fully evaluate potential adverse wetland impacts associated with increased salinity, tidal amplitude, and vessel traffic; 4) evaluate any adverse impacts to the on-going deltaic land formation occurring at the mouth of the Sabine-Neches outlet; and 5) evaluate the potential for induced development of port, harbor, and associated ship-building facilities.

Section 102(c) of MPRSA

It is unclear at this time if a new ODMDS would be required for the proposed project. For example, it is possible that 'new work' materials removed in connection with the proposed channel enlargement could be disposed of for beneficial use in coastal waters that are not subject to Section 102(c) of the MPRSA. Since any new EPA ODMDS designation would be subject to NEPA review, the following EIS Sections may provide the technical evaluation and related information in order for EPA to designate, if necessary, an environmentally acceptable and feasible site:

Introduction - including ODMDS components in the background and project description, problems (e.g., suspended fluff or floculation), and purpose and need.

Alternatives - including ODMDS in the history and process of formulating and screening options. Evaluate the environmental impacts of the reasonable ODMDS alternatives, including the beneficial use of dredged material to the maximum extent practicable. These could include:

1) ODMDS alternative sites (i.e., deep water, mid-shelf, and shallow water sites, including the currently designated ODMDS; and

2) beneficial use options such as, but not limited to: a) wetlands creation; b) pumping into confined disposal where the material may dewater and compact; c) other beneficial uses of dredged material, such as creation of beach feeder berms, or beach nourishment; and d) an alternative of cost-sharing.

Affected Environments and Environmental Consequences - including relevant ODMDS areas under the applicable affected resources, and the environmental consequences associated with and resulting from the applicable ODMDS activities. The Draft EIS could also provide an analysis of the secondary impacts of ODMDS disposal, including but not limited to: 1) the effects on coastal loss, erosion and/or subsidence; and 2) reductions, if any, in the long-term productivity of the coastal ecosystem. These Draft EIS impact analyses and discussions could be summaries or conclusions taken from the actual work products in the Appendices.

Appendices - including ODMDS work products, such as: 1) the evaluations based on the five general (40 CFR 228.5) and 11 specific (40 CFR 228.6) criteria; 2) environmental site screening study; 3) modeling components for new construction and new maintenance materials; 4) contaminant and/or sediment studies; 5) site management and/or monitoring plans; and 6) a State Coastal Zone Consistency Determination.

We look forward to working with you and your staff on this EIS. Please keep us informed regarding future coordination activities and meetings, which will be very helpful in our discussion of travel and resource commitments. If you have any questions, feel free to contact me at (214) 665-8150 or Mike Jansky at (214) 665-7451.

Sincerely yours,

Robert D. Lawrence, Chief
Office of Planning and
Coordination (6EN-XP)

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF:

February 10, 2004

Ms. Estelle A. Bulka
Acting Chief, Office of Planning and Coordination
U.S. Environmental Protection Agency
Region 6
1445 Ross Ave., Suite 1200
Dallas, Texas 75202-2733

Dear Ms. Bulka:

The Galveston District, Corps of Engineers, would like to invite the U.S. Environmental Protection Agency, Region 6 (EPA), to participate as a Cooperating Agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway Feasibility Study (Channel Improvements to Beaumont). Our non-federal partner for this study is the Jefferson County Waterway and Navigation District. It has become apparent during the initial phases of this study that the designation of new ocean dredged material disposal sites (ODMDS) will be necessary to accommodate maintenance material for the offshore channel extension that will accompany channel deepening should the project be authorized. We propose that this EIS serve as a vehicle for EPA to prepare and develop environmental criteria for ocean disposal activities and to designate new or expanded ocean disposal sites associated with the proposed improvements, and to satisfy the requirements of Section 102 of the Marine, Protection, Research, and Sanctuaries Act. Additionally, if beneficial uses are identified for the disposal material, the District will have to consider and develop criteria for placing material under Section 404 of the Clean Water Act.

A combined EIS with EPA as a Cooperating Agency is preferred by this agency because preparation and coordination of a separate ODMDS EIS could seriously impact the completion schedule for this study. We have sufficient time to conduct required field work and prepare an ODMDS appendix for our combined EIS before the tentatively scheduled January 2005 completion of the preliminary draft. Public meeting(s) will be held in late summer/early fall to acquaint the public with the recommended plan in advance of releasing the draft for public review. Should you choose not to be a Cooperating Agency for this EIS, preparation of a separate EIS specifically for ODMDS designation will be necessary. Although we will also conduct the required analyses and prepare a preliminary draft EIS for EPA's coordination and issuance, time required to complete the separate process would likely delay issuance of the SNWW DEIS beyond the current schedule of April 2005.

In accordance with Section 1501.6 of the Council on Environmental Quality (CEQ) Regulations for Implementing the National Environmental Policy Act (NEPA), we hereby formally request that the EPA become a Cooperating Agency. To formalize the request, we are enclosing two originals of a proposed Cooperating Agency Agreement between the EPA and the Galveston District Corps of Engineers. If you agree to the terms of the agreement, please sign them and return one original to us.

If you should have any questions regarding this request and the agreement, please contact Ms. Janelle Stokes of my staff at (409) 766-3039.

Sincerely,

Lloyd Saunders

Lloyd H. Saunders, Ph.D.
Chief, Planning, Environmental
and Regulatory Division

Enclosure

**Environmental Impact Statement (EIS) for the Feasibility Study of the Sabine-Neches Waterway Project (Channel Improvements to Beaumont, Texas)**

**COOPERATING AGENCY AGREEMENT**

**between**

**The Corps of Engineers (CE)**
**Galveston District**
**The Lead Agency**

**and**

**The U.S. Environmental Protection Agency (EPA)**
**Region 6**
**The Cooperating Agency**

INTRODUCTION

This agreement outlines the responsibilities agreed to by the above two Federal agencies with respect to the preparation of both the Draft and Final Environmental Impact Statements for the Feasibility Study of the Sabine-Neches Waterway Project (Improvements of the Channel to Beaumont) with the Jefferson County Waterway and Navigation District as the local sponsor. The project study area is in the vicinity of Beaumont, Port Arthur, and Sabine Pass, Texas. The Galveston District CE has initiated development of an EIS to determine the environmental impacts of proposed channel improvements as well as environmental impacts of alternatives to the proposed action. The EIS will cover a full range of reasonable alternatives so that the CE decision-maker(s) will be aware of the full range of impacts of a final decision. The EIS will also serve as a vehicle for the EPA to prepare and develop environmental criteria for ocean disposal activities and to designate new or expanded ocean disposal sites associated with the proposed improvements and to satisfy the requirements of Section 102 of the Marine, Protection, Research, and Sanctuaries Act.

COOPERATING AGENCY RESPONSIBILITIES

1. The Cooperating Agency (EPA) will participate in the scoping and public meeting process and will consult with the lead agency as appropriate so that the discussion is consistent with the planned alternatives, to the extent resources allow.

2. The comments EPA provides to the CE under this agreement will be advisory, with the exception of final recommendations regarding ocean dredged material disposal site (ODMDS) designations. EIS conclusions specifically related to compliance with Section

102 of the Marine Protection, Research and Sanctuaries Act (MPRSA) will be the responsibility of EPA.

3. EPA will assist the CE in the preparation of the Environmental Impact Statement for the portions specifically related to Section 102 of MPRSA.

4. EPA will participate in field visits at the lead agency's request, to the extent resources allow.

5. This agreement will appear in all documents in which the EPA is designated as a cooperating agency.

6. EPA's participation as a cooperating agency does not affect its commenting role established under Section 309 of the Clean Air Act.

7. EPA will conduct all rulemaking required for formal designation of the ODMDS.

LEAD AGENCY RESPONSIBILITIES

1. The lead agency (CE) will forward to EPA a summary of all comments received during the preparation of the documents including those arising out of the scoping process, public meetings and circulation of the EIS's.

2. When necessary, the CE will conduct an in-house meeting with EPA staff to solicit views and input on regulatory and/or significant environmental issues associated with the proposed actions.

3. The CE is the lead agency and is responsible for final decisions in the draft and final EIS's and their publication. The lead agency will consult with EPA but will retain sole responsibility for determination of which overall project alternative is selected and what mitigation will be included in the project.

4. EPA will be given a complete and final copy of both the Draft and Final EIS's for review prior to final lead agency approval and distribution of the documents.

5. EPA will be promptly informed of all schedule changes that would affect timely completion of the EIS documents.

6. A statement that describes the extent of EPA's role as a cooperating agency will be placed in the introduction section of the EIS.

7. If budget shortfalls prohibit EPA travel associated with EIS coordination activities, the lead agency will consider the option of funding travel or meeting with Regional Staff at the Region 6 Office in Dallas, Texas.

8. This agreement shall become effective upon the date it is signed by both parties. This agreement may be amended upon written agreement executed by both parties. This agreement is terminated when the lead agency Record of Decision is signed or when written notice is given by either agency.

FOR U.S. Environmental Protection Agency,
Region 6 (Cooperating Agency):

Estelle A. Bulka
Acting Chief, Office of Planning
and Coordination
U.S. Environmental Protection Agency
Region 6
Dallas, Texas

Date: 18 Feb 2004

FOR Corps of Engineers,
(Lead Agency):

Lloyd H. Saunders
Chief, Planning, Environmental
and Regulatory Division
Corps of Engineers,
Galveston District
Galveston, Texas

Date: 10 Feb 2004

# State of Louisiana

KATHLEEN BABINEAUX BLANCO
GOVERNOR

SCOTT A. ANGELLE
SECRETARY

**DEPARTMENT OF NATURAL RESOURCES**
**OFFICE OF COASTAL RESTORATION AND MANAGEMENT**

February 23, 2005

Janelle Stokes, Environmental Lead, SNWW Feasibility Study
U.S. Army Corps of Engineers, Galveston District
CESWG-PE-PR
P.O. Box 1229
Galveston, Texas 77553

Dear Ms. Stokes:

The Louisiana Department of Natural Resources, Office of Coastal Restoration and Management, wishes to enter the following comments into the official record of the Sabine-Neches Waterway (SNWW) Navigation Improvement Interagency Coordination Team. It is this Agency's expectation that each outstanding item will be addressed thoroughly and satisfactorily.

1. All environmental documents meant to satisfy NEPA and/or NOAA Coastal Zone Management Act (CZMA) Federal Consistency requirements must contain full and complete analyses of feasible alternatives. Analyses shall include alternative project types for the movement of hydrocarbon products upstream and downstream of the SNWW. The documents must give a full, fair, and accurate accounting of past, present, and future uses and users of the waterway. They must show that other alternatives would or would not meet the economic needs of the users and the goals of the project. The lessening of impacts from the construction of either alternative within the cost benefit analysis must also be taken into account.

2. Consistency with Louisiana's coastal management program will only be determined by a full review of the complete Consistency Determination submitted by the U.S. Army Corps of Engineers, Galveston District, pursuant to state and federal CZMA programs. That review will address the extent to which the recommended project has avoided, minimized, and compensated for impacts.

3. Mitigation measures for the navigation improvement project should include enforceable minimum Sabine River flow requirements.

For additional information, please contact William K. "Kirk" Rhinehart at (225) 342-2179.

Sincerely yours,

Gerald M. Duszynski
Acting Assistant Secretary

P. O. BOX 44487 • BATON ROUGE, LA 70804-4487 • 617 N. THIRD STREET • 10TH FLOOR • BATON ROUGE, LA 70802
PHONE (225) 342-3583 • FAX (225) 342-1377 • WEB http://www.dnr.state.la.us
AN EQUAL OPPORTUNITY EMPLOYER

cc: Kirk Rhinehart
David Frugé
Tony Duplechin
Gregory DuCote
Kyle Balkum
Jeff Harris

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

July 21, 2006

Environmental Section

Christy Lavergne
Louisiana Department of Wildlife and Fisheries
Marine Fisheries Division
P.O. Box 98000
Baton Rouge, LA 70898-9000

Dear Ms. Lavergne:

The Galveston District, Corps of Engineers, and the Jefferson County Waterway and Navigation District are in the final stages of preparing a draft feasibility report and environmental impact statement for the Sabine-Neches Waterway , Texas and Louisiana, Channel Improvement Project (SNWW CIP). Representatives of the Louisiana Department of Wildlife and Fisheries (LDWF) and other Louisiana resource agencies have participated with Texas and Federal agency representatives on an Interagency Coordination Team (ICT) which has evaluated impacts and developed mitigation measures for the Selected Plan of navigation improvements. Decisions on project impacts and compensatory mitigation were made by the ICT's designated workgroup with the full participation and concurrence of your agency's representatives. However, the LDWF ICT representatives (Mr. Kyle Balkum and Mr. Michael Harbison) have recommended that we contact you to obtain official comments from your agency regarding: 1) our assessment of the proposed dedicated dredging in Sabine Lake to supply sediment for marsh restoration proposed as mitigation; and 2) mitigation of impacts to oyster reef in Sabine Pass.

Complete details of project impacts and mitigation have been coordinated at length with the ICT. The Draft Environmental Impact Statement, currently scheduled for public review in late 2006, will be provided for your agency's formal review and comment at that time. A brief project summary is provided here to provide a context for the separate resolution of these two issues. The primary components of the Selected Plan for the SNWW CIP consist of deepening the existing inland reaches of the navigation channel from 40 to 48 ft to the Port of Beaumont, extending the existing entrance channel into the Gulf of Mexico at a depth of 50-ft, and widening the existing channel to 700 ft through Sabine Pass to the Taylor's Bayou Turning Basin near Port Arthur, Texas. The primary impacts to Louisiana are indirect impacts to Louisiana's intertidal wetlands associated with increased salinities. Ecological modeling of impacts has determined that 499 acres of intertidal marsh in areas east of Sabine Lake will be lost over 50 years due to salinity increases associated with the deeper navigation channel. The proposed mitigation plan developed by the ICT's Habitat Restoration Workgroup will restore a total of 3,502 acres of

emergent marsh in the Sabine National Wildlife Refuge (SNWR ) and the Black Bayou area as full compensation for project impacts to Louisiana (USACE, 2006). The Black Bayou mitigation measures will restore 2,096 acres of emergent marsh in three open-water areas using maintenance material from the Channel to Orange over the 50-year project life, and a one-time dedicated dredging of accumulated material in the Lake Charles Deep Water Channel/GIWW. No issues requiring separate resolution have been identified by the LDWF ICT representatives concerning the Black Bayou mitigation measures.

Sabine Lake Dedicated Dredging

The portion of the mitigation to be conducted in the SNWR would consist of the restoration of 1,406 acres of emergent marsh. Dedicated dredging of Sabine Lake would be performed to supply the soils needed to restore marsh acreage and elevation, and mitigate for projected salinity increases in this area. A map showing the area of dedicated dredging and marsh restoration areas is Enclosure 1. The SNWW mitigation measure involves the one-time removal of Sabine Lake sediments by hydraulic pipeline dredge and the pumping of this material into three separate open water areas of the SNWR.

The area proposed for dedicated dredging is located within the Sabine Lake Public Oyster Area. However, the affected portion of Sabine Lake is too fresh to support viable oyster populations. Sabine Lake salinities in the vicinity of Willow Bayou averaged 5.3 parts per thousand (ppt) from 1984 to 1993 (Paille, 1996). Mean 1966 to 2000 salinities from stations located on the SNWR suggested that average Sabine Lake spring salinities are less than 3 ppt, summer salinities range from 3 ppt to 6 ppt, fall salinities are slightly greater than 6 ppt, and winter salinities range from 3 ppt to 6 ppt for the mid-eastern portion of Sabine Lake near SNWR (Louisiana Coastal Wetland Conservation and Restoration Task Force, 2002). Salinity sampling conducted in 2001 in support of hydrodynamic modeling for the SNWW Feasibility Study (Fagerburg, 2003) recorded summer salinities ranging from 3 ppt to 6 ppt at the northern end of Sabine Lake, and fall salinities primarily ranging from 1 ppt to 6 ppt, with one month of higher salinities averaging 9 ppt. The hydrodynamic model developed for the Feasibility Study revealed that observed salinity in Sabine Lake is highest at both the southern end (where the lake connects to Sabine Pass near Blue Buck Point) and at the northwestern corner (where the lake connects to the Sabine-Neches canal). The lowest salinities are observed in the central and eastern portions of the lake, which are furthest from the hydraulic connection to sources of saline water. (Brown et al., 2006).

Optimal salinity for oysters in Louisiana is from 10 to 15 ppt. Oyster larvae are killed below 10 ppt; salinities above 15 ppt are tolerated by oysters, but oyster predation by the oyster drill and others (i.e., *Perkinsus*) significantly increases above that salinity level (Breithaupt and Dugas 1979). Davis (1958) observed that oyster larval settlement and spat development occurred at salinities between 5 and 35 ppt. Adult oysters are able to withstand brief periods of salinities less than 5 ppt, but feeding, growth, and reproduction are severely reduced at those levels (Galtsoff 1964). Thus salinities in the vicinity of the East Sabine Lake Project area (6 ppt or lower) are in the marginal lower range for oyster production. Therefore, while not impossible, it is very

unlikely that oyster larvae, spat, and adults will be able to survive within the existing project area salinity regimes, except during drought years.

Sabine Lake oyster reefs are located in the southern portion of the lake in the vicinity of Blue Buck Point and the Highway 82 Causeway. Although there appear to be no published reports nor regular sampling programs of Sabine Lake oyster production, some unpublished data is available. Sampling conducted by the Texas Parks and Wildlife Department in the Blue Buck Point reef area from 1986 to 1991 (Mambretti personal communication, 2003) and a sonar survey of the southern third of Sabine Lake conducted in conjunction with a proposed Department of Army permit (Stelly personal communication, 2003) have mapped oyster reef in this area. In addition, the remote sensing survey documented that oyster reefs are concentrated in the Blue Buck Point vicinity and taper off quickly to the north. Because of the lower salinities in the upper two-thirds of Sabine Lake, it is unlikely that oyster reefs extend beyond the southern third of Sabine Lake. The dedicated dredging proposed here would occur at least 3.5 miles inland from the nearest mapped occurrence of oyster reefs in the southern portion of Sabine Lake near Blue Buck Point.

The dedicated dredging would take approximately 6.0 million cubic yards of material from a borrow trench in Sabine Lake located from 500 to 1500 ft from the SNWR shore. The borrow trench would extend north from near Willow Bayou for a distance of 3.9 miles, and average 1,030 ft wide by 7.5 feet deep. Trench ends would be sloped to gradually reconnect bottom elevations to the existing lakebed. The borrow trench would be continuous and parallel to the lake shoreline, in line with the common long-shore circulation pattern present in Sabine Lake. This circulation is expected to prevent the development of hypoxic conditions that would be detrimental to aquatic organisms. It is expected that the canal would eventually fill with Sabine River sediments. An access canal would also be needed for the pipeline dredge to reach the proposed borrow canal construction area. This canal would access the area from the section of the GIWW which crosses north Sabine Lake, and is shown the attached map.

USFWS and LDWF representatives on the ICT Habitat Restoration Workgroup have agreed that the proposed mitigation measure, based on application of the Wetland Value Assessment methodology, would have a net beneficial effect and cause no serious impacts to oysters and other biological resources and estuarine lake habitat. The Workgroup as a whole has approved adoption of the proposed action as a mitigation measure. Long-term benefits of a higher, more stable marsh would more than offset short-term impacts to benthic organisms during the one-time dredging episode. Dedicated dredging in Region 4 was approved in the CWPPRA Coast 2050 Plan (LCWCR/WCRA, 1998) as a common restoration strategy for wetland creation, as it furthers a strategic goal of ensuring vertical accumulation of coastal marshes relative to sea level rise and subsidence. The Coast 2050 plan was approved by participating state and Federal agencies, and all 19 coastal parishes.

Sabine Pass Oyster Impacts

One of the few direct impacts associated with channel widening and deepening proposed by the Selected Plan would be the loss of 7.3 acres of oyster shell reef on the Louisiana side of the Sabine Pass navigation channel. The reefs, mapped in 2003 by a remote sensing and oyster sampling survey undertaken for the SNWW feasibility study (Enright, 2003), are not located within a designated Louisiana Public Oyster Area or an Oyster Lease Area. Side-scan sonar and systematic sampling with a steel shell dredge mapped 60.1 acres of oyster reef within the remote-sensing survey corridor in Louisiana, 7.3 acres of which lie within the top-of-cut of the Selected Plan's 48 ft deep x 700 ft wide channel. A map of these reefs is provided as Enclosure 2. The shell dredge sampling recorded counts of live and dead American oysters (*Crassostrea virginica*), and half shells within 37 100-foot long transects (Enclosure 3). Twelve of these transects yielded no live or dead oysters, and few to no half shells. The remainder contained from to 2 to 43 live oysters, or an average of 12 live oysters in each sample. The Sabine Pass Channel will be enlarged using a 30-inch cutterhead hydraulic pipeline dredge. Excavated material and sea water will be suctioned into the hydraulic pipeline and deposited in an existing, upland placement area on the east side of Sabine Pass. Material will not be side cast on the remaining oyster reef beyond the top-of-cut of the widened channel. We propose to compensate for the biological impacts associated with the loss of 7.3 acres of existing reef by the creation of an equivalent amount of new oyster reef. Details such as location, pad thickness, and reef material can be determined through ICT consultation.

Based upon the hydrologic, biological and geophysical data summarized above, we request a finding that: 1) project activities of the Selected Plan for the SNWW CIP will not adversely impact Public Oyster Area resources and oyster habitat and that all relevant survey/assessment requirements have been satisfied for the Sabine Lake dedicated dredging for marsh restoration; and 2) that the proposed mitigation is adequate compensation for impacts to 7.3 acres of oyster in Sabine Pass. If you have any questions, please do not hesitate to call Ms. Janelle Stokes at 409-766-3039.

Sincerely,

Dolan Dunn
Chief, Planning, Environmental and
Regulatory Division

Breithaupt, R. and R. Dugas. 1979. A study of the southern oyster drill (*Thais haemastoma*) distribution and density on the oyster seed grounds. Louisiana Wildlife and Fisheries Commission. New Orleans, Louisiana. 1979. Technical Bulletin No. 30. 20 pp.

Brown, G. L., M. S. Sarruff, R.Vemulakonda, G. H. Nail, J. Stokes, and B. Mann. 2006. Numerical Model Study of Potential Salinity Impacts Due to Proposed Navigation Improvements to the Sabine-Neches Waterway, Texas. U.S. Army Engineer Research Development Center – Coastal and Hydraulics Laboratory (ERDC-CHL), Vicksburg, Mississippi.

Davis, H. C. 1958. Survival and growth of clam and oyster larvae at different salinities. Biological Bulletin (Woods Hole). 114(3):296-307.

Enright, Jeffrey M., 2003. Interim Letter Report: Historic Properties Identification, Oyster Reef Identification, and Pipeline and Obstruction Identification for the Sabine-Neches Waterway Widening and Deepening, Jefferson and Orange Counties, Texas and Cameron Parish, Louisiana. PBS&J Project 441186.01, Austin, Texas.

Fagerburg, Timothy. 2003. Field Data Collection Summary Report for the Sabine-Neches Waterway Study. U.S. Army Engineer Research and Development Center, Waterways Experiment Station (ERDC-WES), Vicksburg, Mississippi.

Galtsoff, P. S. 1964. The American oyster *Crassostrea virginica* Gmelin. U. S. Fish and Wildlife Service Fisheries Bulletin 64. 480 pp.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2002. Hydrologic Investigation of the Louisiana Chenier Plain. Baton Rouge, LA: Louisiana Department of Natural Resources, Coastal Restoration Division. 135 pp. + appendices.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority (LCWCR/WCRA). 1998. Coast 2050: Toward a Sustainable Coastal Louisiana, Louisiana Department of Natural Resources, Baton Rouge, Louisiana.

Mambretti, J. 2003. Personal communication November 18, 2003. Texas Parks and Wildlife Department. Port Arthur, Texas.

Paille, R. 1996. Water exchange patterns and salinities of marshes between Calcasieu and Sabine Lakes. In: Proceedings of the Sabine Lake Conference, September 13-14, 1996. Beaumont, Texas. Texas A and M University, TAMU-SG-97-101, NOAA Grant No. NA56RG0388. 66 pp.

Stelly, Terry. 2003. Personal communication, February 4, 2003. Texas Parks and Wildlife Department – Coastal Fisheries. Port Arthur, Texas.

U.S. Army Corps of Engineers. 2006. Draft Report: Ecological Modeling Report, Sabine-Neches Waterway Feasibility Study (Navigation Improvements to Beaumont), Texas and Louisiana. Galveston District, Galveston, Texas.

Enclosures

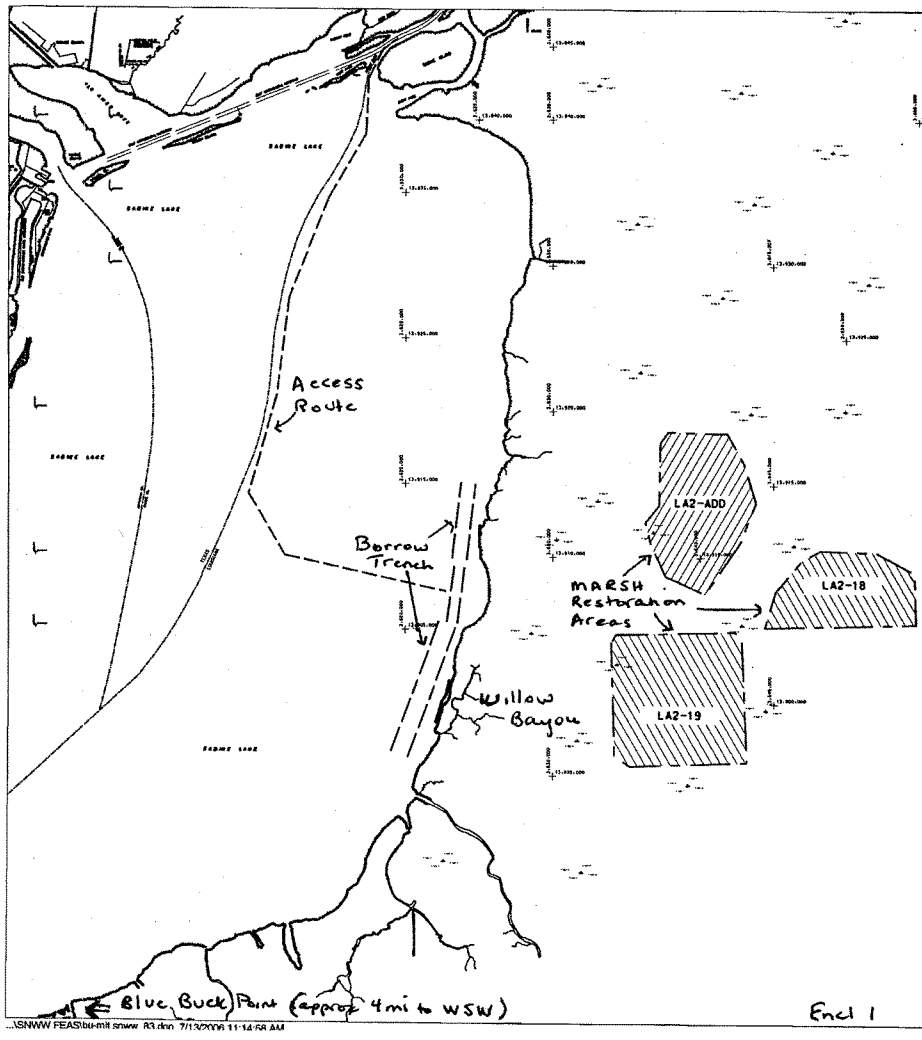
Copy Furnished (w/encl.):

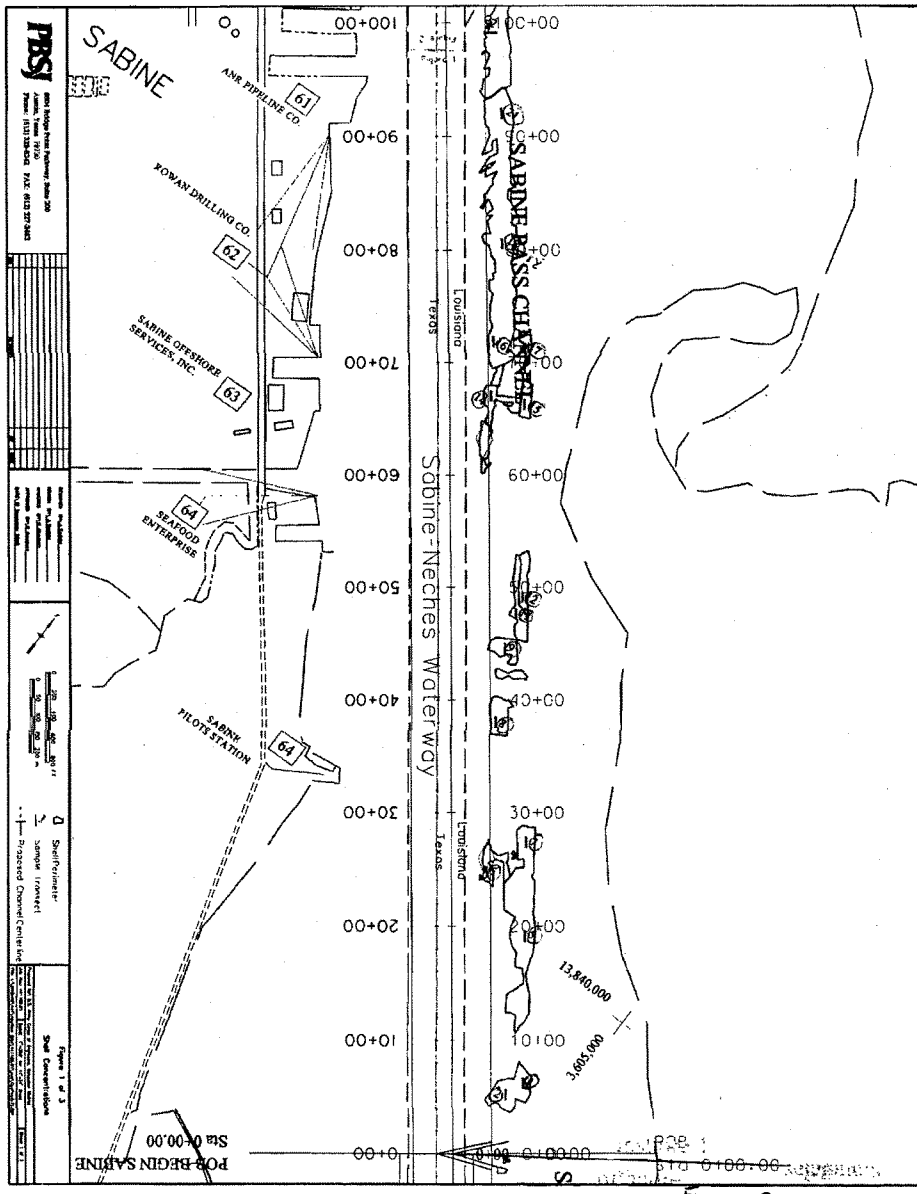
Michael Harbison
Louisiana Department of Wildlife and Fisheries
Marine Fisheries Division
1213 North Lakeshore Drive
Lake Charles, LA 70601

Kyle Balkum
Louisiana Department of Wildlife and Fisheries
Fur and Refuge Division
P. O. Box 98000
Baton Rouge, LA 70898-9000

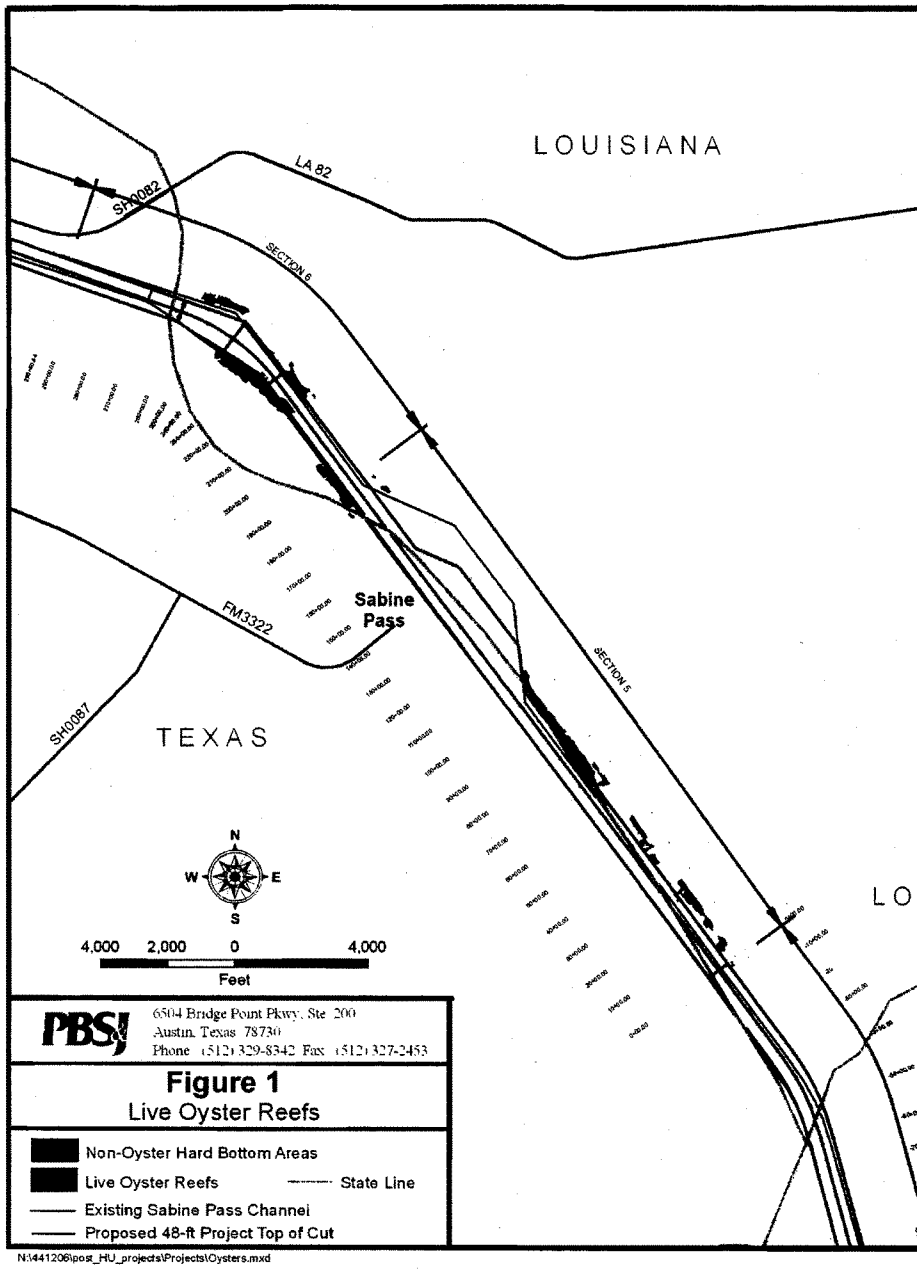
Bob Love
Louisiana Department of Wildlife and Fisheries
Fur and Refuge Division
P. O. Box 98000
Baton Rouge, LA 70898-9000

Dedicated Dredging
for
Marsh Restoration
SNWR






Encl 3
OYSTER SAMPLING LOCATIONS
(1)

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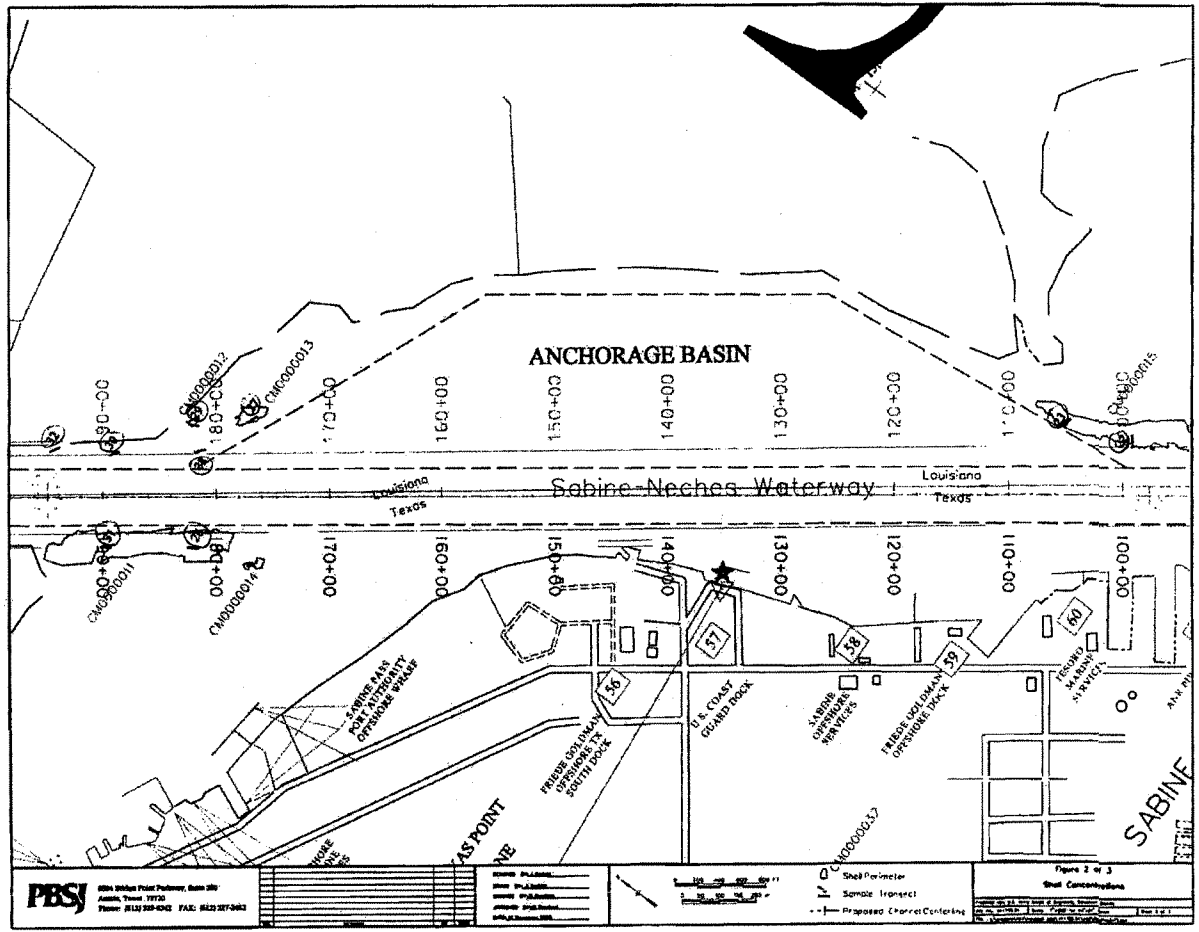
Encl 2


ANCHORAGE BASIN
Sabine-Neches Waterway
Louisiana
Texas
Louisiana
Texas
90+00
180+00
170+00
160+00
150+00
140+00
130+00
120+00
110+00
100+00
CM000011
CM000012
CM000013
CM000014
CM000015
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56
57
58
59
60
SABINE PASS PORT AUTHORITY OFFSHORE WHARF
FRIEDE GOLDMAN OFFSHORE INC SOUTH DOCK
U.S. COAST GUARD DOCK
SABINE OFFSHORE SERVICES
FRIEDE GOLDMAN OFFSHORE DOCK
TEXAS MARINE SERVICES
SABINE
PBSJ
Shell Perimeter
Sample Transect
Proposed Channel Centerline
Figure 2 of 3
Shell Concentrations

PBSJ
Figure 3 of 3
Sabine-Neches Waterway
RANGE REAR
RANGE
TO CAMERON, LA.
CAUSEWAY
BUTTI CHAN CONSTRUCTION
Ladisbro
Texas
Proposed Channel Centerline
Temporary Transect
Spoil Placement
PI 260+13.36
PC 224+40.15
200+00
210+00
220+00
230+00
240+00
250+00
260+00
270+00
280+00
290+00
300+00
13,850,000
13,900,000
13,855,000
2,590,000

**TABLE 3**
**OYSTER SAMPLING RESULTS**

| Sample Transect | Number of Live Oysters | Number of Dead Oysters | Number of Half Shells | Exposed (E)/ Buried (B) | % Shell Hash (estimated) | % Mud (estimated) | Photograph Number |
|---|---|---|---|---|---|---|---|
| 1 | 23 | 2 | 15 | E | 0 | 0 | 1151 |
| 2 | 3 | 2 | 34 | E | 0 | 0 | 1150 |
| 5 | 21 | 5 | 53 | partially buried | 15 | 30-40 | 1152 |
| 6 | 0 | 0 | 44 | E | 0 | 0 | 1153 |
| 7 | 16 | 3 | 9 | E | 0 | 0 | 1154 |
| 8 | 0 | 0 | 27 | B | 10 | 80 | 1155 |
| 9 | 0 | 1 | 0 | E | 0 | 0 | 0012 |
| 11 | 10 | 1 | 2 | E | 0 | 0 | 0013 |
| 12 | 3 | 0 | 11 | E | 5 | 0 | 1156 |
| 14 | 0 | 0 | 0 | - | - | - | - |
| 15 | 2 | 0 | 3 | E | 0 | 0 | 0015 |
| 16 | 12 | 2 | 0 | E | 0 | 0 | 0016 |
| 17 | 2 | 1 | 3 | E | 0 | 0 | 0017 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **18** | 23 | 11 | 34 | E | 10 | 0 | 1157 |
| **21** | 0 | 0 | 2 | E | 0 | 0 | 0019 |
| **22** | 0 | 0 | 8 | E | 0 | 0 | 0020 |
| **23** | 9 | 0 | 10 | E | 0 | 0 | 1158 |
| **26** | 43 | 1 | 33 | E | 0 | 0 | 1161 |
| **27** | 16 | 3 | 23 | E | 10-15 | 0 | 1159 |
| **28** | 0 | 0 | 0 | - | 0 | 100 | 0023 |
| **29** | 13 | 0 | 32 | B | 10 | 60 | 1160 |
| **30** | 0 | 0 | 2 | - | 0 | 100 | 0025 |
| **31** | 20 | 0 | 17 | E | 0 | 0 | 1162 |
| **32** | 0 | 0 | 0 | - | 5 | 95 | 0020 |
| **35** | 0 | 0 | 5 | C | 0 | 0 | 0027 |
| **36** | 0 | 0 | 17 | B | 0 | 75 | 1166 |
| **37** | 17 | 0 | 9 | B | 5 | 85 | 1167 |
| **38** | 0 | 0 | 0 | - | 0 | 0 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **39** | 5 | 0 | 21 | C | 0 | 0 | 0028 |
| **40** | 11 | 0 | 8 | E | 0 | 0 | 1168 |
| **41** | 16 | 7 | 22 | E | 5 | 0 | 1163 |
| **42** | 8 | 1 | 7 | E | 5 | 0 | 1165 |
| **45** | 4 | 1 | 0 | E | 0 | 0 | 1164 |
| **46** | 0 | 0 | 2 | - | 10 | 90 | 0031 |
| **47** | 2 | 0 | 7 | C | 0 | 0 | 0030 |
| **48** | 18 | 2 | 10 | E | 0 | 0 | 1169 |
| **50** | 0 | 0 | 0 | - | 0 | 0 | - |

State of Louisiana

KATHLEEN BABINEAUX BLANCO
GOVERNOR

DEPARTMENT OF WILDLIFE AND FISHERIES

DWIGHT LANDRENEAU
SECRETARY

August 30, 2006

Dolan Dunn
Planning, Environmental, and Regulatory Division
Galveston District, U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

RE: Sabine-Neches Waterway mitigation project in Sabine Lake, Louisiana

Mr. Dunn:

We are in receipt of your July 21, 2006 letter concerning the above captioned project. We have reviewed additional information related to the project, including the proposed mitigation plan that involves dredging approximately six million cubic yards of water bottoms from Sabine Lake, Louisiana for potential marsh creation/restoration in the adjacent Sabine National Wildlife Refuge. We have also reviewed written correspondence and Interagency Coordination Team information concerning the project that occurred over the past few years. It is clear from this information that the project's purpose is economically driven, and the environmental component stems only from the required mitigation for impacts associated with possible salinity increase in Sabine Lake. Although mitigation will serve as potential marsh creation/restoration on the Sabine National Wildlife Refuge, water bottom habitat within Sabine Lake will be impacted by dredging activities in the mitigation borrow area. As proposed, the required mitigation involves trading potential habitat creation/restoration in one area (Sabine NWR) for potential habitat degradation in another (Sabine Lake).

As you are aware, Sabine Lake is a public oyster area and this agency is mandated to diligently protect and conserve such areas. We exercise these protective measures regardless of the water bottom type (i.e. reef, sand, mud, etc.) or the current presence/absence of live oyster resources. In addition, it has been our long-standing practice that water bottoms associated with a proposed project within a public oyster area must be assessed prior to project implementation, and that compensation is required for impacts to those water bottoms.

Therefore, in order for this agency to consider a waiver of compensation for impacts to the water bottoms of the Sabine Lake public oyster area in relation to the mitigation borrow site, a full water bottom assessment must be performed and submitted to this agency prior to project implementation. A copy of the water bottom assessment protocol to be followed is attached for your information.

P.O. BOX 98000 • BATON ROUGE, LOUISIANA 70898-9000 • PHONE (225) 765-2800
AN EQUAL OPPORTUNITY EMPLOYER

In addition, Louisiana Revised Statutes 56:2011-2015 outlined provisions relative to the dredging of fill material from water bottoms owned by the state of Louisiana and royalties thereon. No fill material shall be dredged from state-owned water bottoms unless a permit for that removal is issued by the Louisiana Department of Wildlife and Fisheries (LDWF). A severance royalty for each cubic yard of material removed from state-owned water bottoms shall also be paid to the state through LDWF. The proposed compensatory mitigation plan includes a proposal to sever approximately 6.0 million cubic yards of water bottom material (approximate severance value: $1,200,000) from Sabine Lake, a state-owned water bottom, and placement of the material on federally owned and managed property. Therefore, pursuant to R.S. 56:2011-2015, LDWF requests that the project applicant apply for a permit and pay the appropriate severance royalties for the proposed removal of material from state-owned water bottoms.

Thank you for providing us with the opportunity to comment on your mitigation plan. Please contact Patrick Banks at 225.765.2370 or by email at pbanks@wlf.louisiana.gov if you have additional questions concerning the water bottom assessment requirements. For more information concerning the fill material permit process involving the removal of state-owned water bottoms, please contact Biologist Assistant Division Administrator Robert Love at 225.765.2814.

Sincerely,

for W. Parke Moore, III
Assistant Secretary

Sincerely,

John E. Roussel
Assistant Secretary

pdb/kb

attachment

c: Karen Foote
Robert Love
Michael Harbison
Heather Warner-Finley
Kyle Balkum
Patrick Banks
Venise Ortego
Christy Lavergne
Daryl Clark – USFWS

**DEPARTMENT OF THE ARMY**
**GALVESTON DISTRICT, CORPS OF ENGINEERS**
**P. O. BOX 1229**
**GALVESTON, TEXAS 77553-1229**

January 23, 2007

Environmental Section

Steve Parris
U.S. Fish and Wildlife Service
Clear Lake Ecological Services
17629 El Camino Real, Suite 211
Houston, TX. 77058

Dear Mr. Parris:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

We are required by the Council on Environmental Quality (CEQ) Regulations for Implementing the National Environmental Policy Act (NEPA) (40 CFR Part 1501.6) and subsequent policy guidance to invite all agencies with "jurisdiction by law" or who have "special expertise with respect to any environmental issue" to participate in the preparation of our NEPA documents as cooperating agencies. Previously, we understood that inviting your participation in our SNWW Interagency Coordinating Team informally accomplished the substance of this requirement. However, we are now required to send agencies a written invitation to participate as a cooperating agency; those that agree will be identified on the cover page of the SNWW EIS.

We request that you provide a written response to this invitation. For non-federal agencies which agree to become a cooperating agency, we will develop a memorandum of agreement to formalize expected roles and responsibilities. If you should have any questions regarding this request, please contact Janelle Stokes of my staff at (409) 766-3039.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

January 23, 2007

Environmental Section

Kyle Balkum
Louisiana Department of Wildlife and Fisheries
Habitat Section
P.O. Box 98000
Baton Rouge, Louisiana 70898

Dear Mr. Balkum:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

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Sincerely,

for Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

January 23, 2007

Environmental Section

Dan Llewellyn
Louisiana Department of Natural Resources
Ecosystem Planning & Management Section
Coastal Restoration Division
P.O. Box 44027, Capitol Station
Baton Rouge, LA 70804-4027

Dear Mr. Llewellyn:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

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Sincerely,

Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

January 23, 2007

Environmental Section

Roy E. Crabtree, Ph.D.
Regional Administrator
National Marine Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

Dr.
Dear ~~Mr~~. Crabtree:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

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Sincerely,

for Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

January 23, 2007

Environmental Section

Eddie Seidensticker
Natural Resources Conservation Service
Cedar Bayou Field Office
7705 West Bay Road
Baytown, Texas 77520

Dear Mr. Seidensticker:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

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Sincerely,

Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
**GALVESTON DISTRICT, CORPS OF ENGINEERS**
**P. O. BOX 1229**
**GALVESTON, TEXAS 77553-1229**

January 23, 2007

Environmental Section

Junji Matsumoto
Texas Water Development Board
Hydrologic and Environmental Monitoring Division
1700 N. Congress Ave.
Austin, TX 78701

Dear Dr. Matsumoto:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

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Sincerely,

Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
**GALVESTON DISTRICT, CORPS OF ENGINEERS**
**P. O. BOX 1229**
**GALVESTON, TEXAS 77553-1229**

January 23, 2007

Environmental Section

Jarrett O. Woodrow
Texas Parks and Wildlife Department
Team Leader
1502 FM 517 East
Dickenson, TX 77539

Dear Mr. Woodrow:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

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Sincerely,

Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
**GALVESTON DISTRICT, CORPS OF ENGINEERS**
**P. O. BOX 1229**
**GALVESTON, TEXAS 77553-1229**

January 23, 2007

Environmental Section

Robert Burgess
Texas Commission on Environmental Quality
Water Quality Assessment
Water Permits and Resource Management
P.O. Box 13087 MC-150
Austin, TX 78711-3087

Dear Mr. Burgess:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

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Sincerely,

for Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
**GALVESTON DISTRICT, CORPS OF ENGINEERS**
**P. O. BOX 1229**
**GALVESTON, TEXAS 77553-1229**

January 23, 2007

Environmental Section

Tammy Brooks
Texas General Land Office
Coastal Management Program
P. O. Box 12873
Austin, TX 78711-2873

Dear Ms. Brooks:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

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Sincerely,

for Carolyn Murphy
Chief, Environmental Section

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

January 23, 2007

Environmental Section

Benjamin Tuggle
Regional Director
U.S. Fish and Wildlife Service
Southwest Region (2)
P.O. Box 1306
Albuquerque, N.M. 87103

Dear Dr. Tuggle:

This letter requests a compatibility determination for the beneficial use of dredged material for shoreline nourishment in the Texas Point National Wildlife Refuge (TPNWR), Jefferson County, Texas. This activity is being recommended in conjunction with the proposed Sabine-Neches Waterway (SNWW) Channel Improvement Project, Jefferson and Orange Counties, Texas, and Cameron Parish, Louisiana. The Galveston District is currently preparing a draft feasibility report and environmental impact statement which recommends enlargement of the existing navigation project to a proposed 48 x 700 foot channel.

As part of this project, shoreline nourishment is proposed for 3 miles of the Gulf of Mexico shoreline within the TPNWR, from 0.5 to 3.5 miles from the West Jetty, using maintenance material from the Sabine Pass portion of the SNWW navigation channel. The location of the proposed shoreline nourishment is shown on Enclosure 1. The Dredged Material Management Plan (DMMP) for the proposed project includes unconfined placement of maintenance material along the shoreline every 6 years for the 50-year project life (8 placement episodes). Shoreline nourishment at Texas Point will alternate with shoreline placement on the Louisiana Gulf shoreline, east of the SNWW. Rapid shoreline retreat in the TPNWR is resulting in substantial loss of wetlands. Additional shoreline erosion of approximately 0.42 feet per year is projected in conjunction with the proposed extension of the SNWW entrance channel. The proposed shoreline nourishment would protect the shoreline from existing erosion and eliminate the projected increase in erosion over the project life.

It is expected that the maintenance material from Sabine Pass will reflect the historical average of 51 percent silt, 31 percent clay, and 18 percent sand. The material would be hydraulically pumped into the near shore zone; some material is expected to flow over existing marsh while the remainder flows into the nearshore waters. Marsh plantings would occur as soon as possible on the inland half of the emergent berm to assist in stabilization. Experience with a similar project at Texas Point indicates that a majority of the dredged material will dissipate quickly during each placement event; however, some will remain and form a shelf on the shallow nearshore slope in front of the existing marsh edge.

Unconfined placement on the shoreline will have a net beneficial effect on this environment. Although placement events will temporarily impact shallow near shore waters and eroding marsh, benthic organisms in the nearshore zone will quickly rebound from the short term impact, as will marsh areas along the shore front which are nourished with additional sediment. Material added to the shoreline with these nourishment episodes will stabilize the eroding shoreline, and add sediment to the longshore current which will nourish areas to the west that are eroding at even greater rates. The potential for the nourishment activity to affect threatened and endangered species has been evaluated. No designated or proposed critical habitat would be affected. The federally-listed, endangered piping plover (wintering population) and sea turtles may occur in the shoreline nourishment area. No impacts to the wintering population of the piping plover are expected, however, because there is no intertidal beach or sand flat along this shoreline and therefore there is no wintering habitat for piping plover. The absence of a sand beach also negates potential for sea turtle nests in the nourishment zone. A contaminants assessment prepared for this project has determined that sediments and water from the SNWW are suitable for beneficial uses. Sediment and water sampling will be conducted prior to each maintenance cycle to ensure that these materials remain suitable for shoreline nourishment.

The proposal for shoreline nourishment at TPNWR was developed in coordination with Mr. Andy Loranger (Texas Chenier Plain National Wildlife Refuge Complex, 409/267-3337) and Mr. Phil Glass (Clear Lake Ecological Field Office, 281/286-8282). It was also recommended by the SNWW Interagency Coordination Team, a group of federal and state agencies which have reviewed impact assessments and recommended restoration and mitigation measures for the proposed SNWW project. Furthermore, the shoreline nourishment feature is included in the Draft Coordination Act Report for the project, which will be completed shortly.

Based upon the information presented above, we request your concurrence that the proposed shoreline nourishment is compatible with the major purposes of the TPNWR. If you have any questions, please contact Ms. Janelle Stokes at 409/766-3039.

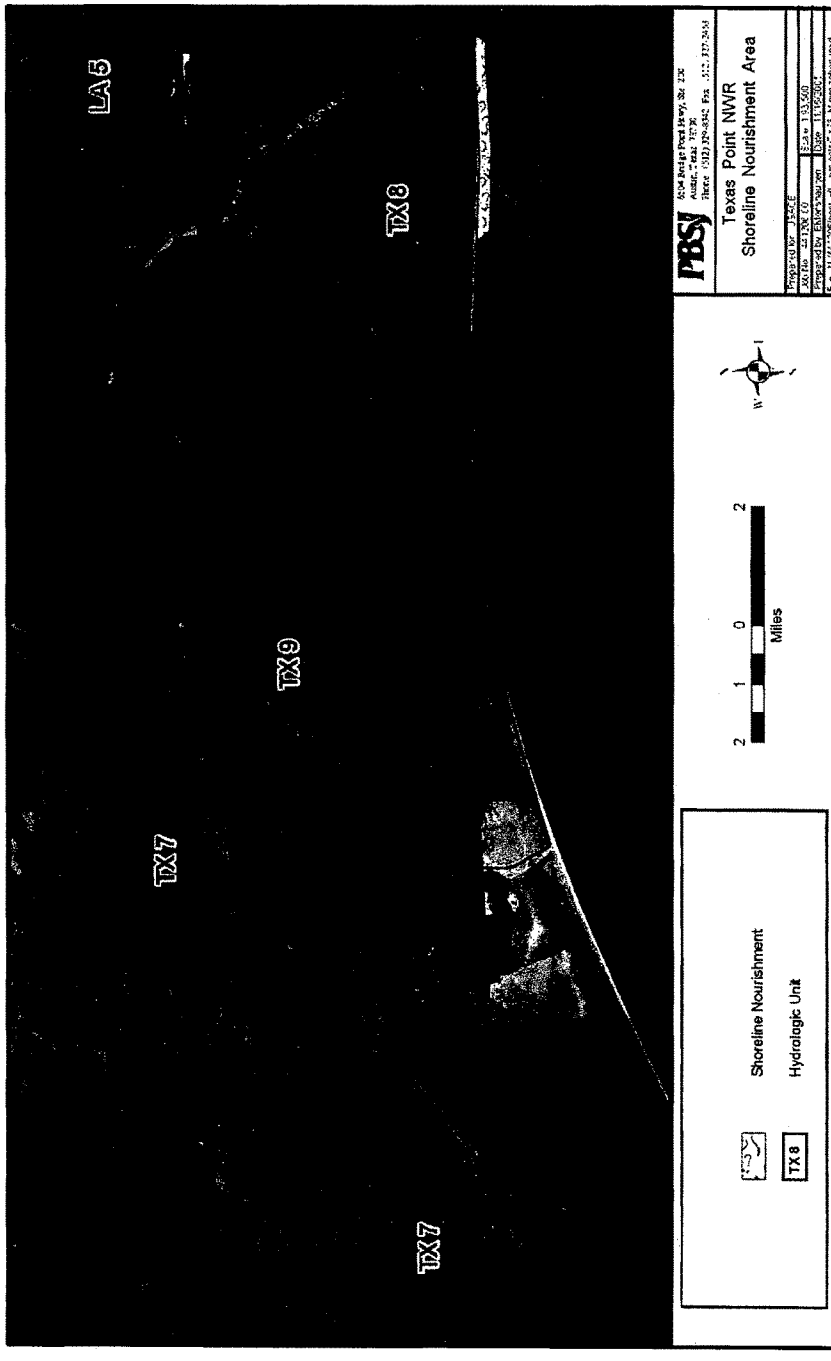
Sincerely,

Carolyn Murphy
for Chief, Environmental Section

Enclosure

CF with enclosure:
Mr. Andy Loranger
Complex Manager
Texas Chenier Plain National Wildlife Refuge Complex
P.O. Box 278
Anahuac, TX 77514

Mr. Phil Glass
U.S. Fish and Wildlife Service
Clear Lake Ecological Services Field Office
17629 El Camino Real
Road, Suite 211
Houston, Texas 77058


LA5
TX8
TX9
TX7
TX7
Shoreline Nourishment
Hydrologic Unit
TX8
2 1 0 2
Miles
W
PBSJ
Texas Point NWR
Shoreline Nourishment Area

Enclosure 1

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

January 24, 2007

Environmental Section

Sam Hamilton
Regional Director
U.S. Fish and Wildlife Service
Southeast Region (4)
1875 Century Blvd. #400
Atlanta, Georgia 30345

Dear Mr. Hamilton:

This letter requests a compatibility determination for marsh restoration in the Sabine National Wildlife Refuge (SNWR), Cameron Parish, Louisiana. This activity is being recommended as compensatory mitigation for unavoidable impacts of the proposed Sabine-Neches Waterway (SNWW) Channel Improvement Project, Jefferson and Orange Counties, Texas, and Cameron Parish, Louisiana. The Galveston District is currently preparing a draft feasibility report and environmental impact statement which recommends enlargement of the existing navigation project to a proposed 48 x 700 foot channel.

As part of the proposed project, 3 separate areas totaling 3,775 acres have been selected as marsh restoration sites in the SNWR's Willow Bayou unit (Enclosure 1). Intermediate marsh in the proposed restoration areas has been converting to open water at a rapid pace. Salinity increases associated with a deeper SNWW navigation channel are expected to exacerbate this trend. The proposed mitigation compensates for this loss by restoring a total of 1,406 acres of emergent intermediate marsh within the 3 restoration sites.

The marsh would be restored by the addition of mineral soil removed by hydraulic pipeline dredge from the bottom of Sabine Lake. Borrow areas would be located at least 500 feet from shore. Material would be placed by the unconfined flow of dredged material from a hydraulic pipeline. Pipeline routes would follow existing canals and levees wherever possible. Within the restoration area, frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevation. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

This extensive marsh restoration effort will result in the displacement of currently shallow open water habitat. While some open water habitats are valuable and may be critical in some instances in maintaining fisheries productivity, intertidal marshes are critically important in maintaining this productivity over time as they provide more food and cover for juvenile fishery organisms than open water habitats. The potential for the marsh restoration activities to affect threatened and endangered species was evaluated. No designated or proposed critical habitat would be affected. None of the federally-listed species identified for Cameron Parish are

expected to occur in the restoration areas. A contaminants assessment for the proposed Federal project identified no contaminated sites or sediments in the vicinity.

The proposal for marsh restoration in the SNWR was coordinated with Mr. Donald Voros (Southwest Louisiana National Wildlife Refuge Complex, (337/598-2216), Mr. Terry Delaine (Sabine National Wildlife Refuge, (337/558-5574), Mr. Roy Walter (Southwest Louisiana National Wildlife Refuge Complex, (337/598-2216) and Mr. Darryl Clark (Louisiana Field Office, (337/291-3111). It was also recommended by the SNWW Interagency Coordination Team, a group of federal and state agencies which have reviewed impact assessments and recommended restoration and mitigation measures for the proposed SNWW project. Furthermore, the marsh restoration measure is included in the Draft Coordination Act Report for the project, which will be completed shortly.

Based upon the information presented above, we request your concurrence that the proposed shoreline nourishment is compatible with the major purposes of the SNWR. If you have any questions, please contact Ms. Janelle Stokes at 409/766-3039.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Enclosure

CF with enclosure:

Mr. Donald Voros
Complex Manager
Southwest Louisiana National Wildlife Refuge Complex
1425 Highway 27
Bell City, LA 70630

Mr. Terry Delaine
Refuge Manager
Sabine National Wildlife Refuge
7000 Southland Field Rd.
Sulphur, LA 70664

Mr. Roy Walter
Complex Biologist
Southwest Louisiana National Wildlife Refuge Complex
1425 Highway 27
Bell City, LA 70630

Mr. Darryl Clark
U.S. Fish and Wildlife Service
Louisiana Field Office
646 Cajundome Blvd, Suite 400
Lafayette, LA 70506

LA3
LA8
LA2
LA7
LA4
LA9
1 0.5 0 1
Miles
Marsh Restoration Area
LA2
Hydrologic Unit
N
W
E
S
PBSJ
Marsh Restoration Sites
Willow Bayou Unit

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue S.
St. Petersburg, Florida 33701

January 30, 2007

Colonel David C. Weston
District Engineer
Galveston District, Corps of Engineers
Department of the Army
P. O. Box 1229
Galveston, Texas 77553-1229

Dear Colonel Weston:

Thank you for your letter of January 23, 2007, inviting NOAA's National Marine Fishery Service (NMFS), Southeast Region, to participate as a cooperating agency in developing the environmental impact statement for the Sabine-Neches Waterway Feasibility Study. The project proposes to implement navigation improvements for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River.

The NMFS Southeast Region accepts the invitation from the Department of the Army to serve as a cooperating agency on this project. However, due to staffing and travel funding constraints, our participation may be limited to review and comment on draft documents, teleconferences, and occasional travel for meetings. I appreciate your request for NMFS Southeast Region's assistance in the development of this environmental document. If we may be of further assistance, please contact Mr. Rusty Swafford, of our Habitat Conservation Division, Galveston field office, at (409) 766-3699.

Sincerely,

Miles M. Croom

for Roy E. Crabtree, Ph.D.
Regional Administrator

cc: F/SER46 – Ruebsamen, Swafford
F/SER - Keys

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

February 20, 2007

Environmental Section

Billy Eakin
Regional Manager
Louisiana Department of Environmental Quality
Southwest Regional Office
1301 Gadwell
Lake Charles, LA 70615

Dear Mr. Eakin:

The Galveston District, Corps of Engineers, and our non-federal sponsor, the Jefferson County Waterway and Navigation District, would like to invite your agency to participate as a cooperating agency in the development of an Environmental Impact Statement (EIS) for the Sabine-Neches Waterway (SNWW) Feasibility Study. Navigation improvements are being proposed for the existing 65-mile long deep draft channel from the Gulf of Mexico to the Port of Beaumont on the Neches River. Environmental effects are being analyzed for adjacent intertidal marshes and forested wetlands in a large surrounding area which includes Sabine Pass and Sabine Lake, adjacent marshes in Texas and Louisiana, tidally influenced portions of the Neches and Sabine Rivers, and a proposed 13-mile long channel extension in the Gulf of Mexico. The Draft EIS is currently scheduled for publication in the summer of 2007.

We are required by the Council on Environmental Quality (CEQ) Regulations for Implementing the National Environmental Policy Act (NEPA) (40 CFR Part 1501.6) and subsequent policy guidance to invite all agencies with "jurisdiction by law" or who have "special expertise with respect to any environmental issue" to participate in the preparation of our NEPA documents as cooperating agencies. Previously, we understood that inviting your participation in our SNWW Interagency Coordinating Team informally accomplished the substance of this requirement. However, we are now required to send agencies a written invitation to participate as a cooperating agency; those that agree will be identified on the cover page of the SNWW EIS.

We request that you provide a written response to this invitation. For non-federal agencies which agree to become a cooperating agency, we will develop a memorandum of agreement to formalize expected roles and responsibilities. If you should have any questions regarding this request, please contact Janelle Stokes of my staff at (409) 766-3039.

Sincerely,

Carolyn Murphy

Carolyn Murphy
Chief, Environmental Section

# Coastal Coordination Council

P.O. Box 12873 ♦ Austin, Texas 78711-2873 ♦ (800) 998-4GLO ♦ FAX (512) 475-0680

**Chairman**

**Jerry Patterson**
Texas Land Commissioner

♦

**Members**

**J. Robert Brown**
Parks & Wildlife Commission of Texas

**Jose Dodier**
Texas State Soil & Water Conservation Board

**Jack Hunt**
Texas Water Development Board

**Vacant**
Texas Transportation Commission

**Elizabeth Jones**
Railroad Commission of Texas

**Robert "Bob" Jones**
Coastal Resident Representative

**James R. Matz**
Coastal Business Representative

**Mayor Victor Pierson**
Coastal Government Representative

**Robert R. Stickney**
Sea Grant College Program

**John L. Sullivan**
Agriculture Representative

**Vacant**
Texas Commission on Environmental Quality

♦

**Ben Rhame**
Council Secretary

**Jesse Solis, Jr.**
Permit Service Center
Corpus Christi
1-866-894-3578

**Allison Buchtien**
Permit Service Center
Galveston
1-866-894-7664

March 1, 2007

Ms. Carolyn Murphy
Chief, Environmental Section
US Army Corps of Engineers
PO Box 1229
Galveston, TX 77553-1229

**Re: Cooperating agency for Sabine-Neches Waterway Feasibility Study**

Dear Ms. Murphy:

The General Land Office and Coastal Coordination Council agree to become a cooperating agency for the Sabine-Neches Waterway Feasibility study.

Currently, Juan Moya and Tammy Brooks serve on the Interagency Coordination Team and would continue to be the points of contact.

Please contact Juan Moya at (512) 475-3735 or at juan.moya@glo.state.tx.us and Tammy Brooks at (512) 463-9212 or at tammy.brooks@glo.state.tx.us.

Sincerely,

Eddie Fisher
Director of Coastal Stewardship
Coastal Resources Program Area

KATHLEEN BABINEAUX BLANCO
GOVERNOR

State of Louisiana
DEPARTMENT OF WILDLIFE AND FISHERIES

BRYANT O. HAMMETT, JR.
SECRETARY

**March 5, 2007**

Ms. Carolyn Murphy, Chief
Environmental Section
Galveston District
United States Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

RE: *Application Number: EIS for Sabine-Neches Waterway (SNWW) Feasibility Study*

Dear Ms. Murphy:

The professional staff of the Louisiana Department of Wildlife and Fisheries, wishes to be a cooperating agency and will provide technical review as well as attend meetings and site visits as necessary.

The Louisiana Department of Wildlife and Fisheries seeks to work with you in a facilitative manner on this and future endeavors. Please do not hesitate to contact me at (225-765-2819) should you need further assistance.

Sincerely,

Kyle F. Balkum
Biologist Program Manager

gsb

c: Venise Ortego, Permits Coordinator
Gretchen Brown, LDWF
Patrick Banks, LDWF
Heather Finley, LDWF
Michael Harbison, LDWF

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
McFaddin/Texas Point National Wildlife Refuges
P.O. Box 358
Sabine Pass, TX 77655-0358
(409)971-2909 fax (409)971-2104

March 30, 2007

Carolyn Murphy
Chief, Environmental Section
Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

Dear Ms. Murphy:

This letter is in reply to your request for a compatibility determination for the beneficial use of dredged material for shoreline nourishment in the Texas Point National Wildlife Refuge, Jefferson County, Texas. This is a project that the Fish and Wildlife Service supports. I will do a compatibility determination on this project. Our compatibility determinations require a 30-day public review, so I would like to coordinate it with the public review of the Corps' Environmental Impact Statement that addresses this project as well. Please keep me informed as to when the EIS will go out for public comment and I will put the compatibility determination out for public comment at the same time.

If this is not acceptable to you, or you would like to discuss this further, please call me at (409)971-2909.

Sincerely

Dean Bossert

Dean Bossert
Refuge Manager

**United States Department of the Interior**
**FISH AND WILDLIFE SERVICE**
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882

April 9, 2007

Colonel David C. Weston
U.S. Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553

Dear Colonel Weston:

This letter supersedes our March 20, 2007, letter in response to your request that the Fish and Wildlife Service (Service) participate as a National Environmental Policy Act (NEPA) cooperating agency for the Sabine-Neches Waterway (SNWW) Feasibility Study. As your staff is aware, the Service has participated as an active member of the Interagency Coordination Team (ICT) for the SNWW study since 2002. As part of the ICT, Service biologists have helped in mapping important native fish and wildlife areas, determining hydrological parameters for hydrodynamic/salinity modeling, developing mitigation and beneficial use sites and methods, and preparing impact assessments.

We welcome the opportunity to continue our participation in NEPA document preparation and planning for the SNWW project as a cooperating agency. If you have any questions feel free to contact me or Mr. Phil Glass, staff biologist, at our Clear Lake Field Office.

Sincerely,

Stephen D. Parris

Stephen D. Parris
Field Supervisor, Clear Lake ES Field Office

cc:
Carolyn Murphy, Chief, Environmental, U.S. Army Corps of Engineers, Galveston, TX

TAKE PRIDE IN AMERICA

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

September 22, 2009

Environmental Section

Ms. Teresa Bruner
Southwest Region Regional Administrator
Federal Aviation Administration
Southwest Region
2601 Meacham Boulevard
Fort Worth, TX 76137-4298

Dear Ms. Bruner:

The US Army Corps of Engineers, Galveston District and the Sabine Neches Navigation District (non-federal sponsor) are conducting a study of potential navigation improvements to the Sabine-Neches Waterway (SNWW). The SNWW is located in Jefferson and Orange Counties in Texas and Cameron Parish in southwest Louisiana (Figure 1). A preliminary draft environmental impact statement has identified a Preferred Alternative (PA) that would deepen the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont from 40 to 48 feet. Dredged material from deepening and continued maintenance of inland channel reaches would be placed in 16 existing upland placement areas (PAs) and three marsh restoration features. Mitigation for unavoidable project impacts would also restore marsh in five existing degraded marsh areas east of Sabine Lake and the Sabine River.

Upon review of FAA AC 150/5200-33, we have determined that certain components of the Preferred Alternative (use of existing upland PAs, proposed marsh restoration features, and marsh mitigation areas) could serve as wildlife attractants. We have mapped the locations of three local public use airports (the Southeast Texas Regional Airport, the Orange County Airport, and the Beaumont Municipal Airport) to determine if project features meet or conflict with minimum separation criteria for potentially hazardous land use practices. Figure 2 shows the 5,000-foot, 10,000-foot, and the 5-mile range perimeters around the three airports in the project vicinity. No PAs, marsh restoration features, or marsh mitigation areas are located within the separation perimeters for the Orange County Airport or the Beaumont Municipal Airport.

All or portions of four existing upland PAs (PA 18, 21, 23-23A, and 24) are located outside the 10,000-foot criteria, but partially or wholly within the 5-mile perimeter of the Southeast Texas Regional Airport; no marsh restoration features or marsh mitigation areas are located with the 5-mile separation perimeter for this airport (Figure 3). The four upland PAs were

originally designated for use for the SNWW Navigation Project in 1975, and will be used for disposal of dredged maintenance material (spoil) on average every four to six years, as they are now, with the exception of PA 23A. PA 23A, although designated in 1975, has not been used recently, but will be used for the improved project. All four PAs provide some habitat for birds and wildlife species at times between the dredging cycles. No new PAs are proposed within the separation perimeter.

Based upon the information presented above, we request your review and concurrence that continued use of these four existing PAs does not constitute a change in land-use and is compatible with airport operations, and that it is not necessary to submit FAA Form 7460-1 for this project. If you have any questions regarding the project, please contact Janelle Stokes at (409) 766-3039.

Sincerely,

Carolyn Murphy

Carolyn Murphy
Chief, Environmental Section

Enclosures (3)

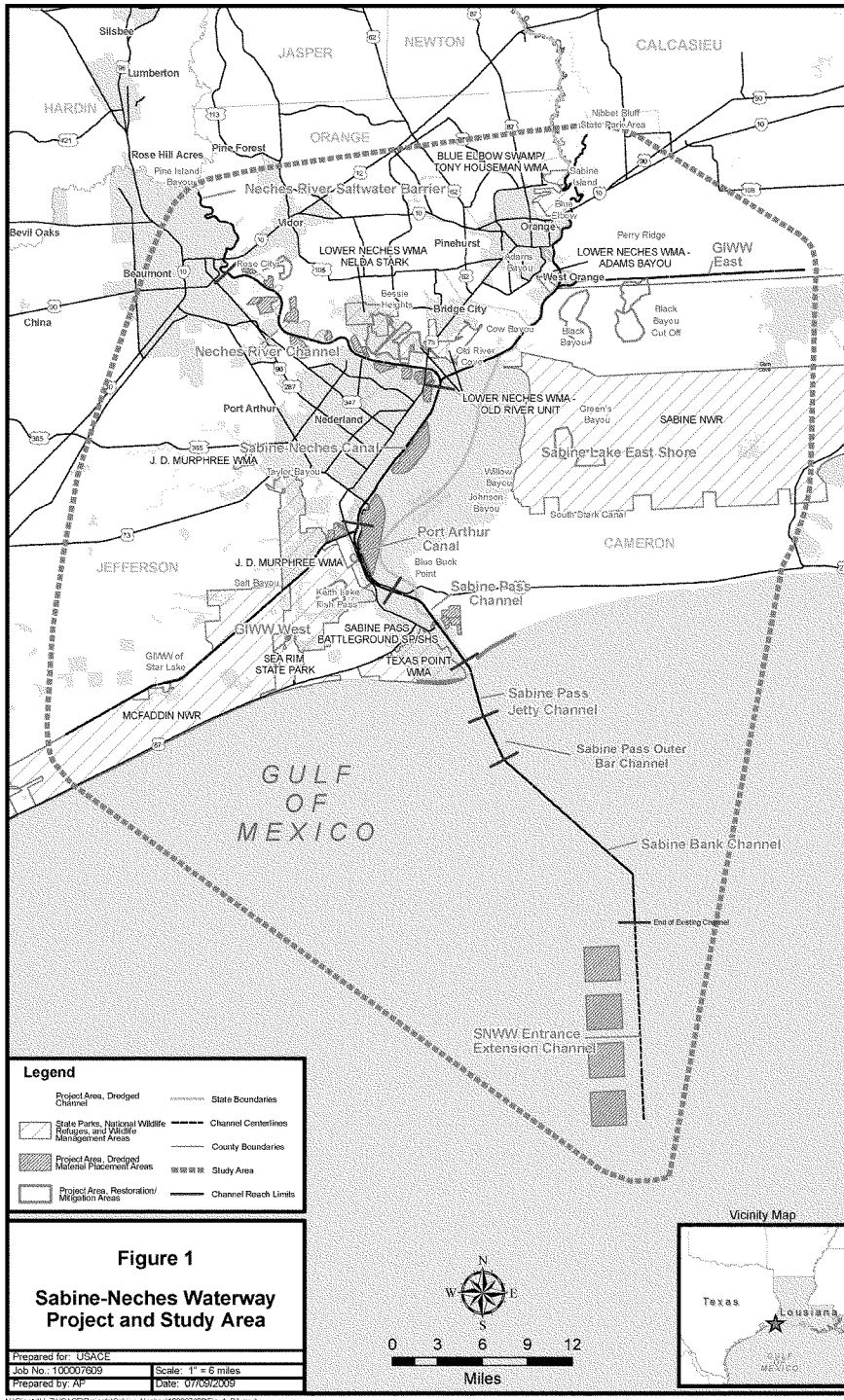



**Figure 1**

**Sabine-Neches Waterway Project and Study Area**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 6 miles |
| Prepared by: AP | Date: 07/03/2009 |

N:\Clients\U_Z\USACE\Projects\Sabine_Neches\100007609\Fig_1_BA.mxd

Figure 2

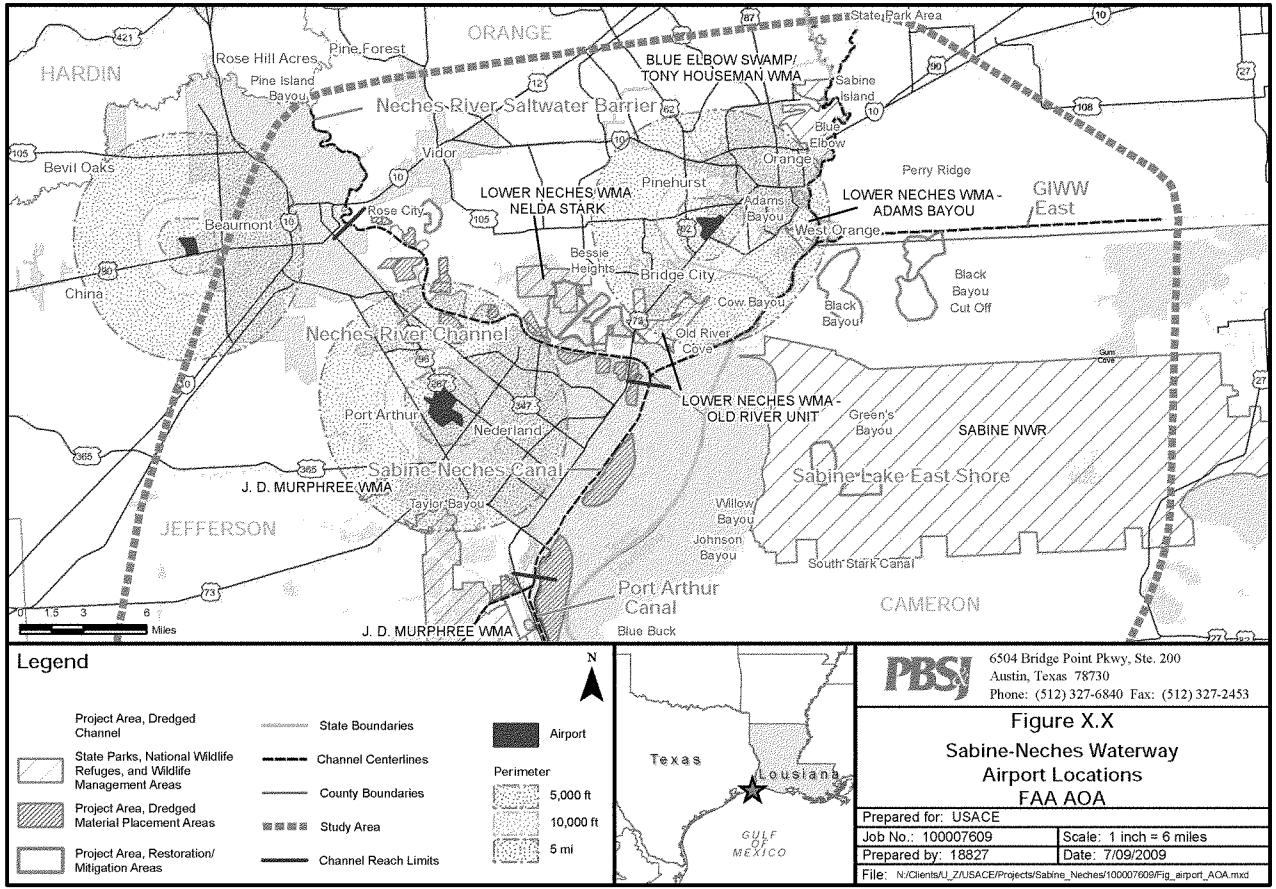
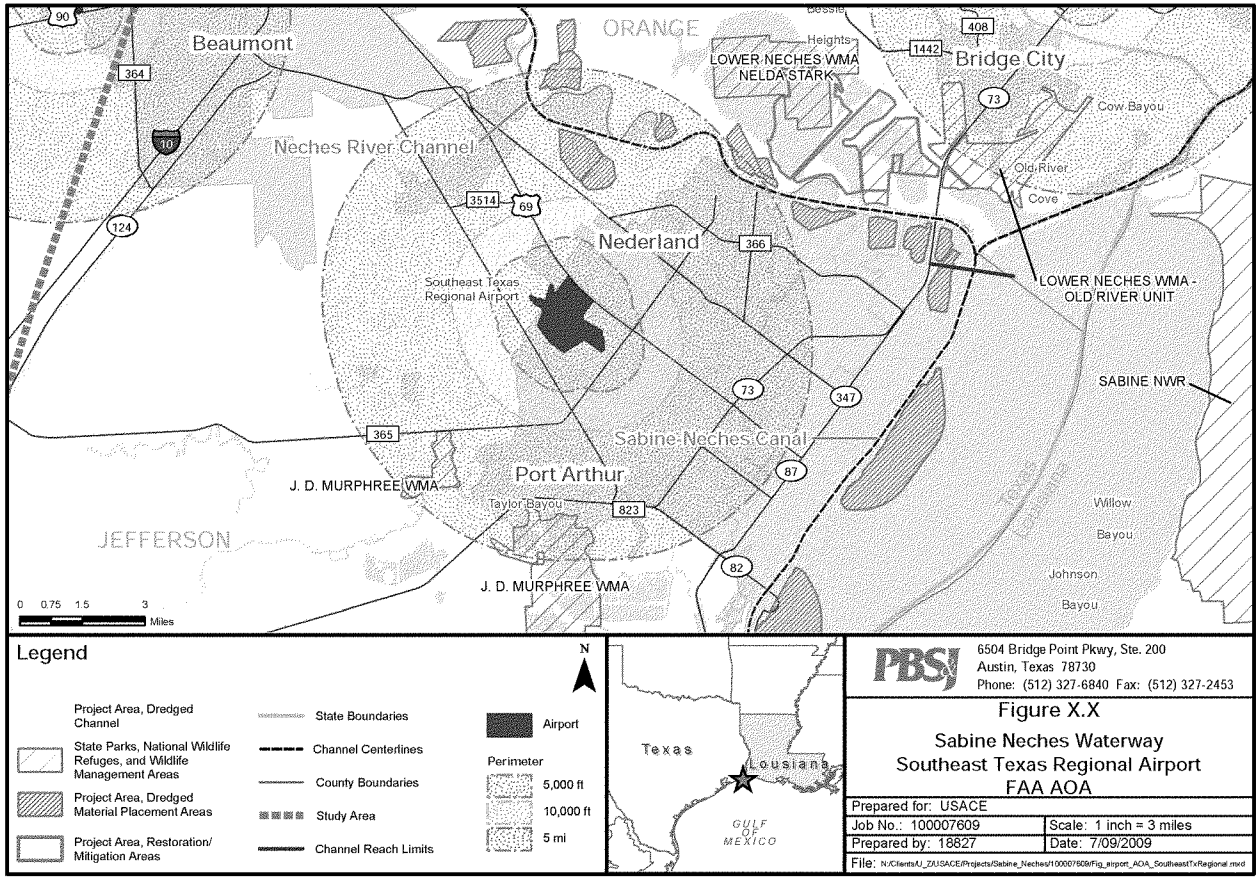

ORANGE
HARDIN
JEFFERSON
CAMERON
Rose Hill Acres
Pine Forest
Pine Island Bayou
Neches River Saltwater Barrier
BLUE ELBOW SWAMP/ TONY HOUSEMAN WMA
State Park Area
Sabine Island
Blue Elbow
Orange
Bevil Oaks
Vidor
Pinehurst
Perry Ridge
LOWER NECHES WMA NELDA STARK
LOWER NECHES WMA - ADAMS BAYOU
GIWW East
Adams Bayou
West Orange
Rose City
Beaumont
China
Bessie Heights
Bridge City
Cow Bayou
Black Bayou
Black Bayou Cut Off
Neches River Channel
Old River Cove
LOWER NECHES WMA - OLD RIVER UNIT
Green's Bayou
SABINE NWR
Port Arthur
Nederland
Sabine-Neches Canal
J. D. MURPHREE WMA
Taylor Bayou
Sabine Lake East Shore
Willow Bayou
Johnson Bayou
South Stark Canal
Port Arthur Canal
Blue Buck
Miles
Legend
N
Project Area, Dredged Channel
State Parks, National Wildlife Refuges, and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
Project Area, Restoration/ Mitigation Areas
State Boundaries
Channel Centerlines
County Boundaries
Study Area
Channel Reach Limits
Airport
Perimeter
5,000 ft
10,000 ft
5 mi
Texas
Louisiana
GULF OF MEXICO
PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 327-6840 Fax: (512) 327-2453
Figure X.X
Sabine-Neches Waterway
Airport Locations
FAA AOA
Prepared for: USACE
Job No.: 100007609
Scale: 1 inch = 6 miles
Prepared by: 18827
Date: 7/09/2009
File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Fig_airport_AOA.mxd

Figure 3


Beaumont
ORANGE
Bessie Heights
LOWER NECHES WMA
NELDA STARK
Bridge City
Cow Bayou
Old River Cove
Neches River Channel
Nederland
Southeast Texas Regional Airport
LOWER NECHES WMA - OLD RIVER UNIT
SABINE NWR
Sabine Neches Canal
Port Arthur
J. D. MURPHREE WMA
Taylor Bayou
JEFFERSON
Willow Bayou
Johnson Bayou
0 0.75 1.5 3 Miles
Legend
Project Area, Dredged Channel
State Parks, National Wildlife Refuges, and Wildlife Management Areas
Project Area, Dredged Material Placement Areas
Project Area, Restoration/ Mitigation Areas
State Boundaries
Channel Centerlines
County Boundaries
Study Area
Channel Reach Limits
Airport
Perimeter
5,000 ft
10,000 ft
5 mi
N
Texas
Louisiana
GULF OF MEXICO
PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 327-6840 Fax: (512) 327-2453
Figure X.X
Sabine Neches Waterway
Southeast Texas Regional Airport
FAA AOA
Prepared for: USACE
Job No.: 100007609
Scale: 1 inch = 3 miles
Prepared by: 18827
Date: 7/09/2009
File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Fig_airport_AOA_SoutheastTxRegional.mxd

**United States Department of Agriculture**

NRCS

Natural Resources Conservation Service
101 South Main Street
Temple, TX 76501

March 16, 2010

ATTN: Carolyn Murphy, Chief
Environmental Section, Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Subject: LNU--Farmland Protection, Draft Environmental Impact Statement
for the Sabine-Neches Waterway Channel Improvement Project
Texas Ocean Dredged Material Disposal Site Designation
Jefferson and Orange Counties, Texas

We have reviewed the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project/Texas Ocean Dredged Material Disposal Site Designation in Jefferson and Orange Counties, Texas, as outlined in your letter of March 5, 2010. This is part of the National Environmental Policy Act (NEPA) evaluation for the U.S. Army Corps of Engineers.

The soil mapped in the proposed project area is not Important Farmland and is, therefore, exempt from the FPPA. We have completed a Farmland Conversion Impact Rating (form AD-1006) indicating the exemption. 1

We are enclosing the completed AD-1006 for the project indicating the approval status. Thank you for the resource materials you provided. If you have any questions please contact Micki Yoder at (254) 742-9826, Fax (254) 742-9859.

Sincerely,

For DONALD W. GOHMERT
State Conservationist

Enclosure

U.S. Department of Agriculture

# FARMLAND CONVERSION IMPACT RATING

| | |
|---|---|
| **PART I** *(To be completed by Federal Agency)* | Date Of Land Evaluation Request March 5, 2010 |
| Name of Project Proposed Sabine-Neches Waterway Channel Improvement Project | Federal Agency Involved Dept. of the Army-U.S. Army Corps of Engineers |
| Proposed Land Use Texas Ocean Dredged Material Disposal Site | County and State Jefferson/Orange Counties, Texas |
| **PART II** *(To be completed by NRCS)* | Date Request Received By NRCS March 9, 2010 |

| | | | |
|---|---|---|---|
| Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply - do not complete additional parts of this form)* | YES ☐ NO ☒ | Acres Irrigated | Average Farm Size |
| Major Crop(s) | Farmable Land In Govt. Jurisdiction Acres: % | Amount of Farmland As Defined in FPPA Acres: % | |
| Name of Land Evaluation System Used | Name of State or Local Site Assessment System | Date Land Evaluation Returned by NRCS March 10, 2010 | |

| **PART III** *(To be completed by Federal Agency)* | Alternative Site Rating | | | |
|---|---|---|---|---|
| | Site A | Site B | Site C | Site D |
| A. Total Acres To Be Converted Directly | | | | |
| B. Total Acres To Be Converted Indirectly | | | | |
| C. Total Acres In Site | | | | |
| **PART IV** *(To be completed by NRCS)* Land Evaluation Information | | | | |
| A. Total Acres Prime And Unique Farmland | | | | |
| B. Total Acres Statewide Important or Local Important Farmland | | | | |
| C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted | | | | |
| D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value | | | | |
| **PART V** (To be completed by NRCS) Land Evaluation Criterion Relative Value of Farmland To Be Converted (Scale of 0 to 100 Points) | | | | |

| **PART VI** *(To be completed by Federal Agency)* Site Assessment Criteria *(Criteria are explained in 7 CFR 658.5 b. For Corridor project use form NRCS-CPA-106)* | **Maximum Points** | Site A | Site B | Site C | Site D |
|---|---|---|---|---|---|
| 1. Area In Non-urban Use | (15) | | | | |
| 2. Perimeter In Non-urban Use | (10) | | | | |
| 3. Percent Of Site Being Farmed | (20) | | | | |
| 4. Protection Provided By State and Local Government | (20) | | | | |
| 5. Distance From Urban Built-up Area | (15) | | | | |
| 6. Distance To Urban Support Services | (15) | | | | |
| 7. Size Of Present Farm Unit Compared To Average | (10) | | | | |
| 8. Creation Of Non-farmable Farmland | (10) | | | | |
| 9. Availability Of Farm Support Services | (5) | | | | |
| 10. On-Farm Investments | (20) | | | | |
| 11. Effects Of Conversion On Farm Support Services | (10) | | | | |
| 12. Compatibility With Existing Agricultural Use | (10) | | | | |
| TOTAL SITE ASSESSMENT POINTS | 160 | | | | |
| **PART VII** ***(To be completed by Federal Agency)*** | | | | | |
| Relative Value Of Farmland *(From Part V)* | 100 | | | | |
| Total Site Assessment *(From Part VI above or local site assessment)* | 160 | | | | |
| **TOTAL POINTS** ***(Total of above 2 lines)*** | 260 | | | | |

| | | |
|---|---|---|
| Site Selected: | Date Of Selection | Was A Local Site Assessment Used? YES ☐ NO ☐ |

Reason For Selection:

| | |
|---|---|
| Name of Federal agency representative completing this form: | Date: |

***(See Instructions on reverse side)*** **Form AD-1006 (03-02)**

**United States Department of Agriculture**

NRCS

Natural Resources Conservation Service
101 South Main Street
Temple, Texas 76501-7602
Telephone: 254-742-9800 Fax: 254-742-9819

January 14, 2010

Ms. Janelle Stokes
Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Dear Ms. Stokes:

We have reviewed the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Site, as outlined in your letter of December 16, 2009. This is part of the National Environmental Policy Act (NEPA) evaluation for the U.S. Army Corps of Engineers. We are unable to evaluate the proposed areas as required by the Farmland Protection Policy Act (FPPA) until exact locations are identified.

Please find enclosed a Jefferson and Orange Counties Prime Farmland Site Map and a Jefferson and Orange Counties Hydric Rating. If there are other soils criteria needed please let us know and we will send those as well.

If you have any questions, please contact Micki Yoder, state resources inventory coordinator, at (254)-742-9826; Fax (254)-742-9859.

Sincerely,

Donald W. Gohmert

DONALD W. GOHMERT
State Conservationist

Enclosure

**DEPARTMENT OF THE ARMY**
**GALVESTON DISTRICT, CORPS OF ENGINEERS**
**P. O. BOX 1229**
**GALVESTON, TEXAS 77553-1229**

March 4, 2010

Environmental Section

Mr. Donald W. Gohmert
State Conservationist
Natural Resources Conservation Service
101 South Main Street
Temple, Texas 76501-7602

Dear Mr. Gohmert,

As requested by your letter of January 14, 2010, we are hereby providing additional information on the precise location of Tentatively Recommended Plan features for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana. A map is enclosed that locates the navigation channel, placement areas and marsh restoration areas relative to hydric soils and prime farmland in the study area (Enclosure 1). All of the project features are located within existing waterways, unclassified areas, or in hydric soil areas with the exception of 49 acres in proposed Placement Area (PA) 24A, which is classified as "Prime Farmland Soil When Drained."

We have completed Form AD-1006 (Farmland Conversion Impact Rating) and the site has received a total Part VI point score of 37 (Enclosure 2). Neither the site nor the areas around it are currently being farmed, and it is adjacent to urban areas and an existing leveed PA. We are proposing to convert the 49 acres to a leveed PA for the containment of dredged material from the adjacent Sabine-Neches Waterway Navigation Channel.

We request your evaluation of the proposed action's impacts as required under the Farmland Protection Policy Act. If you have any questions, please contact Ms. Janelle Stokes at 409/766-3039.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

CF
Micki Yoder, NRCS

# United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
1001 Indian School Road NW, Suite 348
Albuquerque, New Mexico 87104


TAKE PRIDE IN AMERICA

ER 10/32
File 9043.1

February 5, 2010

Via Electronic Mail

Janelle Stokes
U.S. Army Corps of Engineers
Galveston District
PO Box 1229
Galveston, Texas 77553-1229

Subject: Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Texas and Louisiana

Dear Ms. Stokes:

The U.S. Department of the Interior has reviewed the U.S. Army Corps of Engineers, Galveston District's Draft Feasibility Study (DFS) and Draft Environmental Impact Statement (DEIS) for the proposed Sabine-Neches Waterway Channel Improvement Project. The Corps proposes to deepen and maintain, for 50-years, the existing 64-mile-long by 40 feet-deep inland Sabine-Neches channel to 48 feet-deep with 4 feet of additional advanced and overburden dredging (52 feet-deep total), deepen the existing Sabine-Neches Gulf of Mexico channel from 42 feet-deep to 50-feet-deep with 4 feet of additional advanced and overburden dredging (54 feet-deep total), and dredge a 13.2 mile-long new Gulf of Mexico channel 54-feet-deep by 700-feet-wide. Existing channel widths of 400 to 500 feet-wide for the inland reach and 700 feet-wide for the Gulf reach will not be changed.

Project benefits include more efficient vessel loading/off-loading and reduced navigation delays by accommodating larger vessels. In order to compensate for environmental impacts to fish, wildlife and wetland resources, the project includes beneficial use (BU) of dredged material in a Dredged Material Management Plan (DMMP) in Texas, beneficial use at the Louisiana Point and Texas Point Gulf shorelines, and BU and compensatory mitigation in the form of marsh restoration using dredged material on Sabine National Wildlife Refuge and in marshes north of Black Bayou, LA.

We reviewed the information provided, and offer the following comments in accordance with provisions of the National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 U.S.C. 4321 et seq.), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), the Migratory Bird Treaty Act (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.),

Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d), and the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The draft Feasibility Report and DEIS provide an excellent description of fish and wildlife resources within the study area, the purpose and need for the proposed action, program objectives, critical needs and opportunities, and potential risks and uncertainties. Implementation of the greater than $1.2 billion, 50-year Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) would increase economic shipping efficiency by deepening the existing channel to allow larger vessels (primarily crude oil) to access and dock at the ports of Port Arthur and Beaumont. The Sabine-Neches Waterway (SNWW) provides 12% of the nation's crude oil transportation and an average of 141 million tons of shipping per year (2004-2006). Larger vessels must lighter their loads in the Gulf of Mexico and are prevented from two-way traffic in inland parts of the Sabine-Neches waterway. These practices cause transportation delays and increased costs. 1

The Galveston District established an Interagency Coordination Team (ICT) composed of Federal and state agency representatives from Texas and Louisiana to review the SNWW CIP's environmental impacts and recommend BU and mitigation. The Louisiana and Clear Lake Texas Ecological Services Field Offices represented the U.S. Fish and Wildlife Service on that ICT. The Corps and the ICT evaluated over 120 different combinations of depths (from 43 to 55 feet-deep) and widths. Three alternatives were carried forward after the analysis: the no-action alternative, a deepening and widening alternative, and the preferred alternative. In the no-action alternative, it is assumed that the SNWW enlargement would not be implemented and the existing shipping delays would continue. Channel dredging and disposal activities, including existing beneficial use projects, would continue in accordance with the current Federal standard. The Preferred alternative would increase the existing SNWW channel depth by 12 feet in the inland and Gulf channels (52 feet and 54 feet respectively), including advanced and overdraft dredging.

**Specific Comments**

<u>DEIS 2.4.2 Dredged Material Placement Areas, Page 2-45; 2.4.2.2 DMMP Beneficial Use Features, Page 2-46; 5.5 Recommended Mitigation Plan, Pages 5-21 to 5-26</u> – The FWS recommends the creation of an interagency work group (i.e., Interagency Coordination Team) during post-authorization planning, and continue the work group through the detailed planning and construction phases. The work group would execute important design, inspection, and monitoring functions for habitat creation features. 2

The FWS recommends that the Corps implement a DMMP BU and mitigation monitoring program to consist of aerial photography interpretation, elevation, and vegetation surveys to be conducted periodically during the project life to ensure that the BU and mitigation is successful at offsetting project impacts during the project life. In addition, the FWS recommends the creation and implementation of an invasive species control plan that addresses both invasive flora and fauna in the project area. 3

<u>DEIS 2.4.2 Dredged Material Placement Areas, Pages 2-45 to 2-46; 5.0 Mitigation Plan, Pages 5-20 to 5-26</u> - SNWW Dredged Material Management Plan (DMMP) that will use dredged 4

material from the SNWW channel beneficially, restoring 3,190 acres of marshes adjacent to the lower Neches River and 337 acres at the Texas Point Gulf shoreline, for a net + 3,280 acres (+ 656 AAHUs) benefit in Texas. Louisiana Point Gulf shoreline beneficial use with dredged maintenance material from the SNWW CIP (+ 337 acres), BU and compensatory mitigation [+ 2,783 acres (1,181 AAHUs] yields a net + 2,429 acres (+ 22 AAHUs) in Louisiana. We concur that the beneficial use and compensatory mitigation fully compensates for predicted SNWW CIP impacts to wetlands within the project area.

In accordance with the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the FWS and the Corps, sufficient continuous funding should be provided to the FWS to fulfill our responsibilities under Section 2(b) of the FWCA throughout post-authorization planning and evaluation for individual beneficial use projects. Accordingly, to ensure that optimum fish and wildlife resource benefits are achieved, the FWS will continue to work closely with the Corps and the States of Louisiana and Texas throughout the plan implementation process as a member of the ICT during the detailed design and implementation 5
phase. Our findings and recommendations for each of the mitigation projects approved for implementation will be provided in draft and final supplements to this DEIS under the authority of the FWCA. Fulfillment of Section 7 of the ESA of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) responsibilities would also be accomplished at that time.

DEIS 3.12 Threatened and Endangered Species, Pages 3-94 to 3-95 – The FWS actively participated in the development and review of the Biological Assessment of the SNWW's effects on threatened and endangered species. In the FWS's March 22, 2007, letter, the FWS Lafayette, Louisiana, Field Office concurred with the Corps' determination that the SNWW CIP project would not be likely to adversely affect the threatened Louisiana black bear (*Ursus americanus luteolus*), endangered West Indian manatee (*Trichechus manatus*), endangered brown pelican (*Pelecanus occidentalis*), endangered interior least tern (*Sterna antillarum*), endangered red- 6
cockaded woodpecker (*Picoides borealis*), threatened bald eagle (*Haliaeetus leucocephalus*), and threatened piping plover (*Charadrius melodus*), and its designated critical habitat in Louisiana. Minor project revisions would not result in additional effects to those species beyond what was already considered; therefore our determinations remain unchanged.

Brown pelicans (*Pelecanus occidentalis*) occur throughout the study area and are currently known to nest on Rabbit Island in Calcasieu Lake in southwestern Louisiana. Although no brown pelican nesting sites are known to occur within the proposed project area, they may occasionally use portions of the project area that contain suitable habitat (i.e., Sabine Pass 7
Channel, Louisiana Point) for feeding and/or loafing. The brown pelican was officially removed from the List of Endangered and Threatened Species on December 17, 2009. For additional information please refer to the following links:
http://www.fws.gov/home/feature/2009/pdf/brownpelicanfinaldelisting11-10-09_to_OFR.pdf
http://www.fws.gov/home/feature/2009/pdf/brown_pelicanfactsheet09.pdf.

Although the brown pelican was officially removed from the List of Endangered and Threatened Species, it continues to be protected under the Migratory Bird Treaty Act (MBTA). Accordingly, the FWS recommends all activity in Louisiana occurring within 2,000 feet of a brown pelican rookery be restricted to the non-nesting period (i.e., September 15 through March 8
31). However, nesting periods vary considerably among Louisiana's brown pelican colonies, so it is possible that this activity window could be altered based upon the dynamics of the individual

colony. The Louisiana Department of Wildlife and Fisheries' Fur and Refuge Division should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies. In Texas, the FWS recommends all activity occurring within 1,000 feet of a brown pelican rookery be restricted to the non-nesting season.

The bald eagle (*Haliaeetus leucocephalus*) occurs throughout the study area. Since bald eagles often nest and forage on river channels and reservoirs, steps should be taken to determine whether bald eagles may be nesting within or near the project area. While the bald eagle was officially removed from the List of Endangered and Threatened Species on July 9, 2007, it is still afforded protection under the MBTA and the Bald and Golden Eagle Protection Act. 9

Twenty-three species, including cormorants, pelicans, herons, egrets, spoonbills, gulls, terns, and skimmers, regularly nest in large numbers along the Texas and Louisiana coasts, frequently on both natural and manmade bay islands. The Texas Colonial Waterbird Census indicates that there are 25 documented rookery sites, with an estimated 2,835 nesting pairs annually since 1995, located within the study area. Colonial waterbirds are an important wildlife resource along the Gulf Coast and in the project area because of their abundance, their economic significance to the tourism industry, and their status as indicators of aquatic ecosystem health.

In recent years, the majority of successful Texas colonies have been located on islands wholly or partially maintained by dredged material. The FWS recommends using project-dredged material to construct a 2-to 12-acre, colonial waterbird nesting island located at least 1 mile from the shore in Sabine Lake. This island should include a sloping sand beach protected by a rock breakwater. The FWS can assist in the final design, location and management of the island. 10

DEIS 4.0 Environmental Consequences, Pages 4-1 to 4-81 – Salinity and water level hydrodynamic and Wetland Value Assessment models, reviewed and approved by the ICT, predicted a loss of 691 acres [-1,709 Average Annual Habitat Units (AAHUs)] and – 247 acres (-412 AAHUs) for Louisiana and Texas wetlands adjacent to Sabine Lake over the 50-year project life. Beneficial use and compensatory mitigation plans were developed by the ICT to compensate for these losses. 11

DEIS 4.11.2 Marine; 4.11.2.1.2 Preferred Alternative, Page 4-70 – If oyster reefs are encountered during project implementation, the Galveston Corps should replace any reefs damaged by the project on a 1:1 basis with suitable bottoms within Sabine Pass or in the southern portion of Sabine Lake. Oyster habitat mitigation should be accomplished concurrently with channel construction, and should consist of at least a 1-foot thick layer of shell or suitable cultch material (i.e., limestone or fly-ash rock), and should be followed up at one (1) year post-construction with bottom profiling survey and grab sampling to insure adequate relief (minimum average 0.5 feet above bay and pass bottom) and oyster spat coverage. This mitigation is not needed if no Sabine Lake or Pass oyster habitat is disturbed by project features. 12

DEIS 5.5 Recommended Mitigation Plan, Pages 5-21 to 5-26 - The FWS concurs with Willow Bayou Unit mitigation Alternative "B," restoring marsh on the Sabine NWR through dedicated dredging of material from Sabine Lake and placing that material in open water areas on that Refuge north of the Willow Bayou Canal. However if Alternative "B" should not prove viable, the FWS recommends that Alternative "C," beneficial use of new work material from the SNWW, be used to restore marsh on Sabine NWR, or the rock breakwater shoreline stabilization 13

measures, or Sabine NWR terracing measures be implemented as long as the acres protected/restored and AAHUs gained fully compensate for project impacts.

The FWS recommends that the Corps construct the Sabine-Neches project mitigation at the same time as waterway enlargement construction is performed and that the Corps require protective easements on privately owned lands where Sabine-Neches BU and mitigation is to be performed to ensure that the habitat restoration and enhancement work is not compromised by future development activities. 14

The FWS recommends the construction of tidal creek channels (or trenasses) at least 10 feet-wide and 2 feet-deep in the restored marsh, 6 months to a year, if necessary, after disposal in order to return the area to natural hydrology for tidal movement and estuarine aquatic organism access to the restored marshes. The tidal creeks could be constructed by tracking marsh buggy track-hoes, or similar equipment, over proposed creek channel routes. The dredged material pipeline for marsh restoration (i.e., Willow Bayou and Black Bayou Units mitigation) should be placed in existing canals and waterways to the greatest extent practicable to minimize marsh damage. 15

DEIS 5.51 Willow Bayou Mitigation, Table 5.5-1 Recommended Mitigation Plan, Page 5-22 - The FWS recommends that the Corps review their calculations for volumes of dredged material needed to achieve the listed Louisiana mitigation and questions whether the Corps would be able to achieve the degree of marsh restoration depicted in the recommended mitigation plan with unconfined placement of dredged material. 16

The FWS recommends that the Sabine Lake borrow area be located at least 1,000 feet westward of the eastern Sabine Lake shoreline to minimize borrow area shoreline impacts. The Corps should acquire a refuge Special Use Permit from the Sabine NWR (Don Voros, Manager, Southwest Louisiana Refuges Complex, 1428 Hwy 27, Bell City, LA 70630; 337-598-2216) to coordinate the final planning for the dedicated dredging marsh restoration mitigation on Sabine NWR. 17

DEIS 5.2.2 Agency Participation, Page 154 – The FWS will provide a revised FWCA Report in February 2010, which will provide additional recommendations. Many of the FWS's draft SNWW FWCA recommendations have been addressed in the DFR and DEIS. 18

**Comments from the National Park Service**

The potential environmental impacts that are of concern to Big Thicket National Preserve are that a deeper channel in Sabine Lake and the Neches River will increase the influence of Gulf tides, increase salinity, and raise water surface elevation at Preserve lands within the study area, leading to degradation of freshwater marsh, bottomland hardwood forest habitat, and salinity effects to cypress-tupelo swamps. The effects of the deeper channel, in concert with potential reductions in freshwater in-flows from the Neches River during times of subsistence or dry base flow (i.e., drought) could cause damage to salinity-intolerant species including tupelo trees and benthic macroinvertebrates. 19

Big Thicket National Preserve acquired lands by donation from The Conservation Fund in April 2009 (http://www.conservationfund.org/news/big_thicket_land_gift) including approximately 20

6,000 acres of cypress-tupelo swamp, bottomland hardwood forest, and freshwater marsh that lie below the Saltwater Barrier, at the upper margins of the project study area. The new Preserve lands, which are not identified anywhere in the DEIS as being part of the Preserve, are referred to in the DEIS as hydrologic units "TX-1 North Neches River" and "TX-2 Neches-Lake Bayou." Preserve lands comprise much of these two units, mainly on the east side of the Neches River, extending south to Interstate Highway 10 (I-10). The DEIS notes severely stressed marshes, marsh subsidence, and wetland loss in the Neches River reach between Sabine Lake and I-10, directly adjacent to the Preserve. Our concern is that the Preserve may become the new frontline separating intact and degraded systems, or that worsening conditions and wetland loss may spread northward and engulf areas of Big Thicket National Preserve.

Areas of the Preserve would be influenced by the proposed project according to analysis in the DEIS: the Hydrodynamic-Salinity model (Table 4.6-3) forecasts an increase in salinity in the upper Neches River from 0.1 ppt to 0.26 ppt under low flow conditions; salinities in the cypress- 21
tupelo swamps in the upper Neches reaches are predicted to increase by 0.3 ppt; and surface water elevations are expected to increase an average of 0.8 inch in the upper reaches of the Neches River due to greater tidal influence. These conditions have the potential to reduce primary productivity in Preserve freshwater marsh habitat, reducing biomass, and leading to eventual submergence and loss.

We would like to see discussion of how the channel deepening would affect the magnitude of tidal and storm surge from Tropical storms, greater consideration for mitigation measures to prevent long-term and short-term increases in salinity in the Neches River and adjacent freshwater marsh habitat, and modeling of salinities and freshwater inflows for dry base flow and 22
subsistence flow conditions that are described in the Sabine and Neches Rivers and Sabine Lake Bay, Basin and Bay Expert Science Team Environmental Flows Recommendations Report (November 2009).

On page 3-148 Big Thicket National Preserve should be described as 106,684 acres, and being in 23
portions of seven counties in southeast Texas (Hardin, Jefferson, Orange, Tyler, Polk, Jasper, 24
and Liberty). Throughout the document, Preserve lands should be represented on maps and figures that show refuges and other conservation lands. Additionally, the DEIS was apparently 25
sent to the Preserve at a pre-Hurricane Rita address that is no longer in use. Please send future correspondence to:

Todd W. Brindle, Superintendent
Big Thicket National Preserve
6044 FM 420
Kountze, TX 77625

If you have any questions or if we can be of any further assistance in providing maps or other information, please contact David Roemer, Chief of Resources Management, Big Thicket National Preserve, at (409) 951-6820.

We appreciate the opportunity to comment on the draft SNWW CIP DFR and DEIS. If your staff has questions regarding our comments, please feel free to contact me at (505) 563-3572.

Sincerely,

Stephen R. Spencer
Regional Environmental Officer

cc: Barbara Keeler, EPA Region 6, Dallas, TX
Richard Hartman, NOAA/NMFS, Baton Rouge, LA
Kyle Balkum, LDWF, Baton Rouge, LA
Natural Heritage Program, LDWF, Baton Rouge, LA
David Fruge, Louisiana Office of Coastal Protection and Restoration, Baton Rouge, LA
Greg Ducote, Louisiana Department of Natural Resources, Baton Rouge, LA

Mr. Stephen R. Spencer
Regional Environmental Officer
U.S. Department of the Interior
Office of Environmental Policy and Compliance
1001 Indian School Road NW, Suite 348
Albuquerque, New Mexico 87104

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for your comment. |
| 2 | If the proposed project is approved, U.S. Army Corps of Engineers (USACE) would continue working with the existing Interagency Coordination Team (ICT) during preconstruction, engineering, and design (PED), construction and operation of the project. Specific ICT involvement relative to the design, inspection and monitoring of beneficial use (BU) features and mitigation measures are described in the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) Mitigation and Beneficial Use Monitoring Plan (Final Environmental Impact Statement (FEIS) Appendix J). |
| 3 | FEIS Appendix J presents the SNWW CIP Mitigation and Beneficial Use Monitoring Plan. The frequency and periodicity of aerial photography and interpretation and vegetation surveys are specified in the plan. Construction contracts would ensure that elevations appropriate for marsh survival are achieved by the initial construction. The plan includes monitoring and control of invasive, noxious and/or exotic plants. |
| 4 | The FEIS has been revised to note that the USFWS concurs that the beneficial use features and compensatory mitigation fully compensate for predicted SNWW CIP impacts. |
| 5 | USACE looks forward to continuing our work with the USFWS throughout post authorization planning. The U.S. Fish and Wildlife Service (USFWS) Coordination Act Report (CAR) is presented in FEIS Appendix A3. |
| 6 | The FEIS sections on Endangered Species impacts and coordination have been revised to note that minor project revisions subsequent to the original coordination do not change the March 22, 2007 determination. |
| 7 | The threatened and endangered species section of the FEIS will be updated to reflect the fact that the brown pelican was officially removed from the List of Endangered and Threatened Species on December 17, 2009. |
| 8 | Draft EIS (DEIS) Section 7.7 (Migratory Bird Treaty Act and Migratory Bird Conservation Act) states that construction contracts will include instructions to avoid impacts to migratory birds (including brown pelicans) and their nests from all activities related to the SNWW CIP. During the preparation of plans and specifications, USACE will check with designated state agencies to obtain the most current information about nesting colonies. All construction activity in Louisiana occurring within 2000 ft of a brown pelican rookery will be restricted to the non-nesting period. In Texas, all activity occurring within 1,000 feet of a rookery will be restricted to the non-nesting season. |
| 9 | During the preparation of plans and specifications, USACE will check with state and federal agencies to obtain the most current information about bald eagle nests in the SNWW CIP construction areas. |
| 10 | Creation of a bird island in Sabine Lake using dredged material from the proposed SNWW CIP was evaluated and eliminated from consideration when the cost was found to be about $ 2 million higher than the use of existing placement areas, and since no non-Federal sponsor has been identified to share the incremental cost (see DEIS Section 2.5.3.1). |
| 11 | USACE concurs that project impacts, as determined by the Wetland Value Assessment (WVA) model and reviewed by the ICT, are a predicted loss of 691 acres (-1709 AAHUs) in Louisiana and a loss of 247 acres (-412 Average Annual Habitat Units [AAHUs]) in Texas, prior to application of BU feature benefits and compensatory mitigation (See DEIS Table 2.4-16 and Section 4.1.4.1) |
| 12 | FEIS Section 4.11.2.1.2 evaluates the potential for impacts to oyster reef by the proposed SNWW CIP. No impacts to oyster reef are anticipated in Sabine Pass because the channel is not being widened and no slumping is expected at the top of cut. No impacts to oyster reef in Sabine Lake are |

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| | anticipated because salinities are generally too low to support spat growth, as confirmed by recent survey. Furthermore, as stated in FEIS Section ES.5 and Section 5.5.1, USACE has proposed that a water bottom survey of the borrow and access channel areas in Sabine Lake be conducted during the preconstruction engineering and design (PED) phase of the project. In the unlikely event that oyster reef is encountered, plans will be revised to avoid impacts. |
| 13 | The FEIS has been revised to note that the USFWS concurs with the selected Willow Bayou mitigation plan, which would use material from the dedicated dredging of Sabine Lake. If the proposed SNWW ICT is approved, USACE would continue consultation with the ICT (which includes USFWS) during the PED phase to perform and evaluate geotechnical analyses of the proposed source material. |
| 14 | USACE plans to construct the proposed Willow Bayou, Black Bayou East and first phase of Black Bayou West concurrently with proposed channel deepening. The remaining 5 phases of the Black Bayou West mitigation measure would be completed over approximately the next 30 years in conjunction with maintenance dredging of the Sabine River Channel. The Black Bayou East and West mitigation measures are located on private property. USACE has determined that conservation easements are not required because all restored areas would remain jurisdictional wetlands and would continue to be subject to the navigational servitude (Feasibility Report [FR] Section VIII.E). |
| 15 | The FEIS Section 5.5.1 description of proposed mitigation measures includes tidal creek channels, as recommended by USFWS. USACE will consult with the ICT (which includes USFWS) during PED to minimize impacts to existing marsh during construction of the mitigation measures. |
| 16 | As recommended, USACE has reviewed our calculations for volumes of dredged material required for Louisiana mitigation measures, and it has been determined that the calculations are sufficient for the feasibility level of design. |
| 17 | FEIS Section 5.5.1 states that the borrow trench would be located at least 1000 feet from the SNWR shoreline, and that the exact location of the trench would be determined in consultation with the ICT (which includes USFWS) during PED. USACE has requested a compatibility determination from the SNWR for the proposed Willow Bayou mitigation area. |
| 18 | The USFWS's revised CAR, dated March 2010, is presented in FEIS Appendix A-3. USACE responses to the CAR are presented in the same appendix. |
| 19 | Potential impacts of the deeper navigation channel to hydrounits containing the newly acquired areas of the Big Thicket National Preserve downstream of the Neches River Saltwater Barrier were evaluated by ERDC's Hydrodynamic Salinity modeling (HS model) (Brown and Stokes 2009). This modeling, summarized in FEIS Section 4.1, incorporated Year 2060 future flow projections that are based upon assumptions of the 2007 Texas State Water Plan and projected effects of relative sea level rise. As described in FEIS Sections 4.1.2.2, Table 4.1-1, and Section 4.6.3.2.2, no project impacts are expected during median or low flows. |
| 20 | The new preserve lands were acquired by the National Park Service (NPS) during the final preparation of the DEIS, and thus were not identified in that document. See response to comment 19 concerning potential for proposed SNWW CIP to affect these areas of the Big Thicket National Preserve. |
| 21 | See response to comment 19 above. |
| 22 | A sensitivity analysis using the ADCIRC model was performed to determine what effect the proposed SNWW CIP might have on surge levels in the study area (Wamsley et al., 2010).The results of this analysis are presented in FR Chapter VIII, FEIS Section 4.1.5. Given the fact that impacts of the proposed SNWW CIP are related primarily to salinity intrusion, extensive efforts have already been made to identify effective mitigation measures that could minimize or eliminate the projected increase in salinity. The results of this effort are presented in FEIS Section 5.4.1.1. The HS modeling performed for this study by ERDC employed a state-of-the-art model to evaluate potential salinity impacts for both median and low flows, and the technical adequacy of the HS modeling has been sustained by Agency Technical Review (ATR) and Independent External Peer Review (IEPR). USACE believes that further HS modeling is not warranted. |
| 23 | The acreage of the Big Thicket National Preserve has been changed to reflect this updated information. Text has been changed to clarify that Big Thicket National Preserve is located within portions of Hardin and Orange counties, Texas in the vicinity of the study area. |

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| 24 | New preserve lands have been included in FR/FEIS maps, and are discussed in FR (Chapter 1, Sensitive Areas), FEIS Section 3.9.2, and FEIS Appendix C, Section 1.5.1. |
| 25 | The mail list has been updated to reflect this information. |

TEXAS GENERAL LAND OFFICE

JERRY PATTERSON, COMMISSIONER

February 8, 2010

DCW 10 FEB 2010 TO P.E.M.

Colonel David C. Weston
U. S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

RE: **Sabine Neches Waterway Improvement Project**

Dear Col Weston:

The proposed project consists of the deepening and expanding of navigation channels in the Sabine Neches Waterway and placement of the associated dredge material. Based on the information contained in the Draft Environmental Impact Statement and the Feasibility Report, much of the proposed dredging and dredge material placement is located on state owned submerged lands.

The General Land Office (GLO) and School Land Board are responsible for managing and authorizing the use of state owned submerged land dedicated to the Permanent School Fund. While Navigational Servitude covers the project and no lease or easement will be required, there may be impacts that the GLO will need to address. Based on a review of the project, there appear to be multiple pipelines with easements authorizing their placement on state owned submerged land that will be impacted. Also the project may impact current mineral leases and future mineral leases on state land that are managed by the GLO.

The GLO is requesting an additional 90 days (until May 10, 2010) to review the Draft Environmental Impact Statement to determine the impact the project will have on state mineral leases and pipeline easements, and other possible impacts from the project. The GLO has also been contacted by representatives for the pipeline operators who will be impacted by this project and who are also seeking additional time to evaluate this proposal. This seems like a reasonable request given the amount of state owned submerged land that will be impacted by the project. After a complete review, the GLO may have additional comments and concerns about the project. 1

If you have any questions concerning this request, please contact Deputy Commissioner Rene D. Truan at (512) 463-5200 or by e-mail at rene.truan@glo.state.tx.us .

Sincerely,

JERRY PATTERSON
Commissioner, Texas General Land Office

CC: Larry Laine, General Land Office
Rene Truan, General Land Office
Janelle Stokes, U.S. Army Corps of Engineers

Stephen F. Austin Building • 1700 North Congress Avenue • Austin, Texas 78701-1495
Post Office Box 12873 • Austin, Texas 78711-2873
512-463-5001 • 800-998-4GLO
www.glo.state.tx.us

Mr. Jerry Patterson
Commissioner
Texas General Land Office
Stephen F. Austin Building
1700 North Congress Avenue
Austin, TX 78701-1495

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The comment period was extended an additional 30 days to March 12, 2010. |

# LOWER NECHES VALLEY AUTHORITY

MUNICIPAL • INDUSTRIAL • AGRICULTURAL WATER

February 18, 2010

Ms. Janelle Stokes
Galveston District
U.S. Army Corps of Engineers
CESWG-PE-PR
P. O. Box 1229
Galveston, TX 77553

RE: Resolution Concerning the Sabine-Neches Waterway Channel Project

Dear Ms. Stokes:

The attached Resolution supporting the Sabine-Neches Waterway Channel Project was approved by the Board of Directors at its February 16, 2010 meeting. Please call me at 409-892-4011 if you have any questions or if you need additional information.

Yours very truly,

Scott Hall

Scott Hall, P.E.
General Manager

**Office Location 7850 Eastex Freeway, Beaumont, Texas 77708-2815 • (409) 892-4011**
**Mailing Address P.O. Box 5117, Beaumont, Texas 77726-5117 • FAX (409) 898-2468**
**Internet Address • http://www.lnva.dst.tx.us**

**STATE OF TEXAS** § **LOWER NECHES VALLEY AUTHORITY**

**COUNTY OF JEFFERSON** §

BE IT REMEMBERED at a meeting of BOARD OF DIRECTORS OF THE LOWER NECHES VALLEY AUTHORITY held on the 16th day of February, 2010, on motion made by Director Kathleen Jackson and seconded by Director Jordan Reese, the following Resolution was adopted:

## Resolution Concerning the Sabine-Neches Waterway Channel Project

**WHEREAS,** the U.S. Army Corps of Engineers (USACE), in concert with Sabine-Neches Navigation District has proposed a project to deepen the Sabine-Neches Waterway; and

**WHEREAS,** USACE has prepared a study analyzing the feasibility and environmental impacts of the proposed improvement to the Sabine-Neches Waterway that serves the ports of Beaumont and Port Arthur, Texas and the proposed improvements reasonably accommodate environmental concerns; and

**WHEREAS,** the USACE study clearly demonstrates the necessity for these improvements to provide a safe and efficient waterway that will accommodate the current and future needs of our ports and industry; and

**WHEREAS**, the project is also critical for the National Defense, and the proposed improvements are clearly cost effective and will enable our ports to facilitate the handling of vital military cargo; and

**WHEREAS,** the project would provide a positive economic benefit and would benefit the people of Jefferson County, the State of Texas, and many States beyond our region;

**NOW THEREFORE,** be it resolved that the Board of Directors of the LOWER NECHES VALLEY AUTHORITY urge all elected officials and citizens to support this project and the adoption of the plan for these improvements as proposed.

**AND BE IT FURTHER RESOLVED** that the Corps affirm its plan and submit the plan to its headquarters for finalization.

PASSED AND ADOPTED by the Lower Neches Valley Authority Board of Directors this **16th day of February, 2010.**

President

Secretary

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

FEB 18 2010

Mr. Dolan Dunn
Chief, Planning, Environmental &
Regulatory Division
New Orleans District
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, LA 70160-0267

Dear Mr. Dunn:

In accordance with our responsibilities under Section 309 of the Clean Air Act, the National Environmental Policy Act (NEPA), and the Council on Environmental Quality regulations for implementing NEPA, the U.S. Environmental Protection Agency (EPA) Region 6 office in Dallas, Texas, has completed its review of the Draft Environmental Impact Statement (DEIS) for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the DEIS for the Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Sites Designation.

EPA rates the DEIS as "LO", i.e., EPA has a "Lack of Objections" to the proposed action described in the DEIS. EPA has enclosed detailed comments for further consideration in the development of the Final EIS and asks that these comments be responded to in that document. 1

Our rating of this DEIS will be published in the Federal Register according to our responsibility under Section 309 of the Clean Air Act to inform the public of our views on proposed Federal actions. If you have any questions, please contact me at (214) 665-7451 or by e-mail at jansky.michael@epa.gov.

EPA appreciates the opportunity to review the DEIS. Please send our office two copies of the Final EIS when it is sent to the Office of Federal Activities, EPA (Mail Code 2252A), Ariel Rios Building, 1200 Pennsylvania Ave, N.W., Washington, D.C. 20460.

Sincerely yours,

Cathy Gilmore

Cathy Gilmore, Chief
Office of Planning
and Coordination 6ENXP

Enclosure

**DETAILED COMMENTS**
**ON THE**
**DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE**
**SABINE NECHES WATERWAY CHANNEL**
**IMPROVEMENT PROJECT**
**SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA**

The Region 6 Office of the EPA has reviewed the DEIS and Draft Feasibility Report prepared by the Galveston District of the Corps for the Sabine-Neches Waterway Channel Improvement Project. We currently have only one outstanding issue to raise which is that the Draft U.S. Fish and Wildlife Service Coordination Action Report is pending and the results of that report should be used to make any necessary adjustments to the mitigation and dredged material disposal plans for the tentatively selected plan. 2

Five years ago, EPA Region 6 set up a NEPA Cooperating Agency agreement with the Galveston Corps District for this project. The Corps was starting feasibility studies on a channel expansion and they knew that, in addition to options for widening and deepening, they would look at extending the channel out into the Gulf for 13-17 more miles. That distance would make it expensive to transport material to the four existing Ocean Dredged Material Disposal Sites (ODMDS) and they might propose an additional four more ODMDS's further out and along the expanded channel.

EPA Region 6 and the Galveston District Corps set up a process whereby the Corps' channel improvement DEIS (which would involve a new DMMP devised by an interagency team) would contain an appendix that would essentially be a stand alone ODMDS DEIS, including a Site Management and Monitoring Plan (SMMP). As a NEPA Cooperating Agency and a member of the Interagency Coordination Team and various sub-committees, Region 6 could direct the analyses for the ODMDS work. The thought was that if the Corps did the analyses and NEPA documentation as we instructed, the Region could then basically take a "ready to go" NEPA document prepared by the Corps, make any revisions as necessary, publish it as an EPA ODMDS DEIS (if necessary), and follow with EPA rulemaking. This could optimize project planning and public involvement, as well as making effective use of federal funding.

As a member of the interagency team, Region 6 worked for several years on the dredged material disposal plan (DMMP), beneficial use (BU) options, salinity change analyses, and wetland mitigation issues. The Region has followed the development and analysis of project alternatives. We support the project planning process that was used, which included an evaluation of non-structural alternatives and which applied the principles of Regional Sediment Management in evaluating alternatives and in developing the DMMP for the tentatively selected plan.

The tentatively recommended plan would result in an estimated 98 million cubic yards of new work dredged material and 650 million cubic yards of maintenance material over the 50-year period of analysis. Disposal of this material would be managed in accordance with the new DMMP, which is described in these documents. The DMMP includes an extensive BU plan that

would direct the use of both new work and maintenance dredged material to restore degraded marshes and to nourish Gulf shorelines.

BU features of the DMMP (Neches River and Gulf shoreline features) would minimize and offset all direct and indirect marsh impacts in Texas by creating 2,853 acres of emergent marsh vegetation, improving 871 acres of open water habitat, and nourishing 1,234 acres of existing marsh. Therefore, no compensatory mitigation is proposed to offset projected wetland impacts from the tentatively selected plan in Texas. Unavoidable losses to marshes in Louisiana are fully mitigated, according to WVA analyses, by marsh creation in the Willow Bayou and Black Bayou watersheds east of Sabine Lake. In addition to offsetting projected wetland habitat losses, the mitigation plan would compensate for the projected salinity increase and associated losses in biological function and productivity by marsh creation in the Willow and Black Bayou watersheds.

Region 6 supports the decision not to recommend the creation of a topographic high offshore of Louisiana Point as an additional mitigation measure, using new work material dredged the Sabine Bank and Extension Channels. The ecological benefits of such a feature have not been sufficiently demonstrated and, if the projected benefits were realized, they would be short-lived. Additional information would be needed to justify the associated project feature expense. 3

Additional Comments

On Page I-21, under Outdoor Recreation, the total state revenues from wildlife associated activities in Louisiana should be $3.0 billion with sporting revenues of $1.4 billion and wildlife watching bringing in $1.6 billion. 4

EPA is concerned about salinity increases in the upper Neches and the Blue Elbow Swamp mitigation bank area and other "sensitive" freshwater wetlands along the channels that are subject to tidal influences. We recommend that even though the Corps models indicate only slight increases in salinity due to widening of the channel, that the Corps monitor salinity increases and vegetative response before, during, and after project completion. We are specifically concerned about Baldcypress/Tupelo plant communites that may be sensitive to only slight increases in salinity. EPA suggests a 10-year annual monitoring plan. 5

Finally, the Document appears to adequately address the potential adverse effects of the Ocean Dredged Material Disposal Sites and therefore this EIS will suffice EPA's NEPA responsibilities to use in designating the four ODMDS at a later date. 6

If you have any other questions about this review, please give me a call. Thank you for the opportunity to provide comments at this stage in the process.

Barbara Keeler
Coastal & Wetlands Planning Coordinator
EPA Region 6 6WQ-EC)
1445 Ross Ave.,Suite 1200
Dallas, TX 75202-2733
tel: 214-665-6698
fax: 214-665-6689

Ms. Cathy Gilmore
Chief, Office of Planning and Coordination
U.S Environmental Protection Agency, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The FEIS has been revised to note that the EPA has rated the project as "LO," which means that it has no objections to the proposed SNWW CIP. |
| 2 | The USFWS CAR, dated March 16, 2010, has been included in the FEIS, Appendix A along with USACE responses to the report. USFWS concurred with the USACE mitigation and BU plans for the proposed SNWW CIP. |
| 3 | USACE notes U.S. Environmental Protection Agency (EPA) concurrence in the Ocean Dredged Material Disposal Sites (ODMDS) BU alternatives analysis related to the creation of a topographic high using new work material. USACE did not adopt this alternative. |
| 4 | The text has been revised to correct the total economic impact of wildlife-related activities in Louisiana. |
| 5 | Salinity monitoring is conducted by many state and Federal agencies throughout the SNWW study area. It is expected that this data will be available for use in assessing future conditions within the study area. |
| 6 | USACE will note in the FEIS that EPA has approved the ODMDS FEIS for use in designating the four new ODMDS at a later date. |

BOBBY JINDAL
GOVERNOR

SCOTT A. ANGELLE
SECRETARY

# State of Louisiana

**DEPARTMENT OF NATURAL RESOURCES**

**OFFICE OF COASTAL MANAGEMENT**

February 22, 2010

Dolan Dunn
Chief, Planning, Environmental & Regulator Division
Dept. of the Army
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, TX 77563-1229

RE: **C20090667,** Coastal Zone Consistency
**U. S. Army Corps of Engineers, Galveston District**
Direct Federal Action
Draft EIS for the Sabine-Neches Waterway Improvements Project, Southeast Texas and Southwest, **Louisiana**

Dear Mr. Dunn:

This office has received the above referenced federal application for consistency review with the approved Louisiana Coastal Resources Program in accordance with Section 307(c) of the Federal Coastal Zone Management Act of 1972, as amended. NOAA Regulations on Federal Consistency, at 15 CFR '930.41(a), allow 60 days for the review of Direct Federal Activities, and at '930.41(c)(b) allow additional review time upon mutual agreement between the Federal agency and the State Coastal Zone Program. Please be advised that, by this letter, Interagency Affairs/Field Services Division and the Galveston Corps District have mutually agreed to extend the State review time to March 12, 2010. 1

A final determination will be made within the authorized time period, ending March 12, 2010. If you have any questions please call Brian Marcks of the Consistency Section at (225) 342-7591.

Sincerely yours,

Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division

GJD/JDH/bgm

cc: Janelle Stokes, Galveston COE

Post Office Box 44487 • Baton Rouge, Louisiana 70804-4487
617 North Third Street • 10th Floor • Suite 1078 • Baton Rouge, Louisiana 70802
(225) 342-7591 • Fax (225) 342-9439 • http://www.dnr.louisiana.gov
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Mr. Gregory J. DuCote
Administrator, Interagency Affairs/Field Services Division
State of Louisiana, Department of Natural Resources
Office of Coastal Management
617 North Third Street, 10th Floor, Suite 1078
Baton Rouge, LA 70804-4487

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The Louisiana Department of Natural Resources Office of Coastal Management (LDNR-OCM ) review period for the Federal application for consistency review was extended to March 12, 2010. |

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

March 9, 2010

Ms. Janelle Stokes
U.S. Army Corps of Engineers
Galveston District CESWG-PE-RE
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Sabine-Neches Waterway Channel Improvement Project Draft Feasibility Report and Draft Environmental Impact Statement

Dear Ms. Stokes:

As described in the Public Notice, dated December 18, 2009, the applicant, Sabine Neches Navigation District, proposes the Channel Improvement Project (CIP) to deepen and widen the Sabine-Neches Waterway (SNWW). The project is located along the Texas and Louisiana border, in Jefferson and Orange counties in southeast Texas and Cameron Parish, Louisiana.

In addition to the information contained in the public notice, the following information is needed for review of the proposed project. Responses to this letter may raise other questions that will need to be addressed before a water quality certification determination can be made.

1. Title 30, Texas Administrative Code (TAC), Chapter 279.11(c)(1), states that "No discharge shall be certified if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, . . . ." As noted in the Draft Feasibility Report, the primary environmental concern is increased saltwater intrusion and further degradation of marshes and cypress marshes as a result of the CIP. In addition, the Draft Environmental Impact Statement (DEIS) acknowledges in Section 3.5.3 the accelerated marsh deterioration and increased saltwater intrusion in the Calcasieu/Sabine River Basin. The DEIS identifies approximately 174 structures water control structures that had been constructed as of 1990 to address marsh deterioration, saltwater intrusion, and erosion within the project study area. Please provide a clear demonstration that no practical alternatives exist for the proposed project. Please complete the enclosed 401 Certification Questionnaire and Alternatives Analysis Checklist.

2. Section 3 (Affected Environment) of the DEIS states that there are 19 classified stream segments in Texas within the study area. However, only nine classified segments and their respective water quality standards are listed in Table 3.2-1. It should be noted that Sabine Pass (Segment No. 2411) and Sabine Lake (Segment No. 2412) are also located within the CIP study area and their designated uses are contact recreation, oyster waters, and exceptional and high aquatic life use, respectively. Please provide a complete list of the classified water segments and their appropriate designated uses and water quality criteria for the CIP study area.

3. Section 3.3.1 of the DEIS states that "based on available data, there is no indication of current water or elutriate contaminant problems along the SNWW." However, numerous classified segments (e.g. Segments No. 0501, 0508, 0511, 0701, and 0704) are currently listed as non-supporting on the Clean Water Act Section 303(d) list for impaired waters. Constituents of concern include low dissolved oxygen levels, bacteria, chlorophyll-*a*, ammonia, and nutrients. In addition, Segment 0702 (Intracoastal Waterway Tidal) is listed on the draft 2010 Texas 303(d) list as non-supporting for dioxin in edible tissue and PCBs in edible tissue. Please provide a complete list of the waterbodies (classified and unclassified) in the study are that have been identified as non-supporting or with concerns for non-attainment or screening levels with regard to applicable water quality standards.

4. Section 3.10.2.1 of the DEIS provides a list of the dominant nekton species inhabiting the Sabine Lake estuary. The species list includes white shrimp (*Litopenaeus setiferus*) and the discussion of the nekton assemblage concludes that all the listed species "are ubiquitous along the Texas and Louisiana coast and are unaffected by changes in salinity." However, subsequent paragraphs in this section note the significant decline in the white shrimp fishery and attribute the decline to "changes in freshwater inflow and concurrent isolation of wetlands from Sabine Lake." A current update of the status of this commercially important species and the species' response to salinity variations should be included in both the DEIS and Draft Feasibility Report.

5. Section 4.16 (Cumulative Effects) of the DEIS concludes that "past, existing, and reasonably foreseeable future projects, along with the Preferred Alternative, are not expected to have significant adverse effects within the study area." Quantifiable impacts are summarized in Table 4.16-1 and numerous categories and potential benefits or impacts in the table are noted with an * or ** symbol. The meaning or significance of these symbols is unclear with respect to categories (e.g., Past and Present Actions*) and individual assessments (e.g., NI*, Minimal*, 79 ac**, etc.). Please provide clarification and an explanation of the purpose intended.

6. Texas Commission on Environmental Quality (TCEQ) requires that total suspended solids (TSS) concentrations in effluent associated with dredging activities be controlled to a maximum of 300 milligrams per liter (mg/L). Please provide a list of best management practices (BMPs) and operational procedures that will be used to minimize TSS levels during dredging operations and the placement of dredged material.

7. As noted in the Draft Feasibility Report and DEIS, members of the Interagency Coordination Team (ICT) and the agencies and organizations represented on the ICT, have extended substantial time and resources during the DEIS development process. Please provide an overview and tentative schedule for the inclusion ICT members and organizations in the resolution of outstanding project issues and the development of the Final EIS for the proposed project.

The TCEQ looks forward to receiving and evaluating other agency or public comments. Please provide any agency comments, public comments, as well as the applicant's comments, to Mr. Robert Hansen of the Water Quality Division MC-150, P.O. Box 13087, Austin, Texas 78711-3087. Mr. Hansen may also be contacted by e-mail at *rhansen@tceq.state.tx.us*, or by telephone at (512) 239-4583.

Sincerely,

Charles W. Maguire, Director
Water Quality Division
Texas Commission on Environmental Quality

CWM/RSH/sp

Enclosure

cc: Mr. Ben Rhame, Secretary, Coastal Coordination Council, P.O. Box 12873, Austin, Texas 78711-2873

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

March 19, 2010

Environmental Section

Mr. Charles W. Maguire
Director
Water Quality Division
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Dear Mr. Maguire:

Reference is made to your letter dated March 9, 2010 regarding the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) Draft Feasibility Study and Draft Environmental Impact Statement (DEIS), issued for public and agency review on December 24, 2009. In response to several requests, Galveston District (District) extended the public comment period to March 12, 2010. An Interagency Coordination Team (ICT) comprised of Federal and State resource agency representatives from Texas and Louisiana has assisted Galveston District in modeling and analyzing environmental impacts, and selecting beneficial use (BU) and mitigation measures for the Tentatively Recommended Plan. The Texas Commission on Environmental Quality (TCEQ) has had a representative on the ICT since its inception in 2000 through the last ICT meeting on August 27, 2009. Although TCEQ has been unable to send a representative to most of these meetings, the District has kept your agency apprised of studies and models performed to evaluate potential environmental impacts of the SNWW CIP. We offer the following information to assist you in review of the proposed project.

1. You have requested that Galveston District complete a "401 Certification Questionnaire and Alternatives Analysis Checklist" and demonstrate that no practicable alternatives exist for the proposed project. We understand that TCEQ requires this form to facilitate Section 401 reviews of U.S. Army Corps of Engineers Section 404 permit applications. The Galveston District is not applying for a permit to construct this Federal project, and therefore completion of this form should not be required.

However, we understand that your agency requires information in order for you to complete Section 401 review. All of the questions posed by the certification questionnaire and alternatives analysis checklist are answered by information presented in the Draft Feasibility Report (DFR), the Draft Environmental Impact Statement (DEIS), and DEIS Appendix E (Section 404(b)(1) Evaluation). For example, questions concerning impacts to state surface waters (1.A of the Questionnaire) are answered by information provided by DEIS Appendix E, and the compensatory mitigation plan (Questionnaire 1.B) is described in DEIS Section 5.5. Information regarding the alternatives analysis is provided in DFR Chapter IV and DEIS Chapter 2.0. These

chapters provide a thorough description of the alternative evaluation process, the specific alternatives that were evaluated (including non-structural alternatives, project alternatives with smaller dimensions, and the no-action alternative), and the rationale for selecting the Tentatively Recommended Plan.

A thorough description of salinity control structures that were evaluated in the screening of mitigation alternatives is provided in DEIS Section 5.4. None of the salinity control structures were selected because the net effect of the structures was determined to be negative. Beneficial salinity effects were modest and could not overcome the adverse effects of restrictions to marine organism access. The alternatives analysis provided in the DFR/DEIS clearly demonstrates that there is no practicable alternative to the proposed discharges which would have less adverse impact to the aquatic ecosystem.

2. FEIS Section 3.3 and Table 3.2-1 will be revised to provide a complete list of the classified water segments, their designated uses and water quality criteria. The DEIS reference to 19 classified stream segments refers to the total number of assessment units (sub-segments of the primary stream segments) in the study area. The number is correct, but the text will be corrected to refer to assessment units instead of stream segments. This number already includes Segments 2411 (Sabine Pass) and 2412 (Sabine Lake). Table 3.2-1 currently identifies all of the primary stream segments in the study area, with the exception of Segments 2411 and 2412. Table 3.2-1 will be revised to include Segments 2411 and 2412, their designated uses and water quality criteria.

3. As noted in your comment, Section 3.3.1 of the DEIS states that "...based on available data, there is no indication of current water or elutriate contaminant problems along the SNWW." The SNWW refers to the Sabine-Neches Waterway navigation channel, not the entire study area. We believe that a complete listing of impaired waterbodies in the study area would not be relevant to the assessment of environmental impacts of the Tentatively Recommended Plan. However, we will add the following information to FEIS Section 3.3.1 as clarification. "Stream segments 601, 703, and 2411 comprise the SNWW and none of these segments are classified as non-supporting on the Clean Water Act Section 303(d) list of impaired waters. While several impaired stream segments (0501, 0508, 0511, 0701, 0704) are located within the study area boundaries, they would not be affected by the direct or indirect effects of channel deepening or construction of any project features and, therefore are not evaluated further."

4. The DEIS discusses the decline of the white shrimp fishery in the study area, attributing the decline to "changes in freshwater inflow and concurrent isolation of wetlands from Sabine Lake." The Tentatively Recommended Plan would not affect freshwater inflows or increase the isolation of wetlands from Sabine Lake. The proposed beneficial use feature that restores significant marsh acreage on the Neches River and the marsh restoration proposed as compensatory mitigation east of Sabine Lake would provide a net benefit to marine and estuarine fish and wildlife species. None of the other resource agencies with the expertise and responsibility for marine fisheries and essential fish habitat expressed a concern over the effects

of the projected small salinity increase on white shrimp, and therefore an analysis of this species' responses to salinity variations is not warranted.

5. The superscripts, footnotes and abbreviation of terms for Table 4.16-1 (Impact Summary for Past, Present, and Reasonably Foreseeable Project with Publicly Available Information" will be revised in the FEIS to make the table easier to use. To help you interpret the DEIS table, we offer the following:

> Single asterisks after the column headings "Past or Present Actions" and "Reasonably Foreseeable Actions." refer to the footnote included with the table. "*Although not included in the table, several other projects are included in Section 4.16 Cumulative Impacts." The reason a particular project is not included in the table is provided in the text description of each project.
>
> Single asterisks in table cells referred to a footnote that was inadvertently left out of the table: "*Offset by engineering design, mitigation, data recovery, adaptive management plans/activities based on monitoring, procedures, and project controls." Likewise, double asterisks referred to another absent footnote: **Includes acreages from permit amendment applications.
>
> Cell contents are further explained below:
> "Benefit" or Net Benefit refers to results which have an overall positive effect when compared to the FWOP (baseline, existing) condition of the resource. "Benefit" infers direct benefit and "Net Benefit" infers a culmination of resource-related effects which are advantageous to the resource category as a whole.
> NI = No long-term impacts; NA = Not Applicable; UN = Unavailable; I = Impact

6. The TCEQ requirement that total suspended solid (TSS) concentrations in effluent associated with dredging activities be controlled to a maximum of 300 milligrams per liter could only be met for confined placement areas where outlet structures control the ponding of water and the settling of TSS before release. The management of TSS during the proposed unconfined discharge of dredged material for the Neches River and Gulf Shore BU features cannot meet this standard, but Best Management Practices (BMPs) would be utilized to minimize TSS to the maximum extent practicable. DEIS Appendix E, Part I.f (page E-13) states that BMPs, such as silt curtains, may be implemented where appropriate to control and reduce turbidity during dredging and placement. Part II.c.(4) on page E-19 states that BMPs, such as temporary containment levees/spill boxes or silt curtains could be utilized to minimize impacts during discharged to construct BU marsh restoration features. Galveston District coordination with the ICT (of which TCEQ is a member) of the proposed SNWW CIP would continue after project approval to obtain resource agency input into the identification of BMPs and the development of plans and specifications for BU features and compensatory mitigation measures.

7. All ICT member agencies were provided the opportunity to comment on the Preliminary DEIS (September 29, 2009) and the publically released DEIS (December 24, 2009) to ensure that

resource issues were adequately and appropriately addressed. ICT involvement prior to completion of the Final EIS for the SNWW CIP will be limited to consistency review by representatives from the following Coastal Coordination Council member agencies: Texas General Land Office, Texas Parks and Wildlife Department, Texas Water Development Board, Texas Commission on Environmental Quality and the Texas Department of Transportation. This review will be conducted pursuant to the Coastal Coordination Act's Implementation Rules 31 TAC §506.28 "Guidance for Conducting Consistency Reviews in Coordination with an Interagency Coordination Team," issued on December 11, 2003. Galveston District has requested concurrence that the Tentatively Recommended Plan for the SNWW CIP is consistent, to the maximum extent practicable, with the Texas Coastal Management Program goals and policies. The ICT would remain active through the preconstruction, engineering and design (PED) and project construction phases to provide input during the development of plans and specifications for BU features and mitigation measures, and on BMPs as described in response 6 above. The ICT would continue into the operations phase to ensure that the BU and mitigation measures have been constructed as specified in the DEIS and that the goals of the compensatory mitigation plan have been fully achieved.

In conclusion, we hope this additional information will be helpful in your review. We trust that we have provided sufficient information for you to provide §401 State Water Quality certification. However, we would be happy to meet with you to provide further information if needed. All public and agency comments on the DEIS and our responses will be available for your review when they are presented in the FEIS. Please do not hesitate to contact Ms. Janelle Stokes at 409/766-3039 should you need further assistance.

Sincerely,

for Carolyn Murphy
Chief, Environmental Branch

**BOBBY JINDAL**
GOVERNOR

**SCOTT A. ANGELLE**
SECRETARY

# State of Louisiana

**DEPARTMENT OF NATURAL RESOURCES**

**OFFICE OF COASTAL MANAGEMENT**

March 9, 2010

Dolan Dunn
Chief, Planning, Environmental & Regulator Division
Dept. of the Army
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, TX 77563-1229

RE: **C20090667,** Coastal Zone Consistency
**U. S. Army Corps of Engineers, Galveston District**
Direct Federal Action
Draft EIS for the Sabine-Neches Waterway Improvements Project, Southeast Texas and Southwest, **Louisiana**

Dear Mr. Dunn:

This office has received the above referenced federal application for consistency review with the approved Louisiana Coastal Resources Program in accordance with Section 307(c) of the Federal Coastal Zone Management Act of 1972, as amended. NOAA Regulations on Federal Consistency, at 15 CFR '930.41(a), allow 60 days for the review of Direct Federal Activities, and at '930.41(c)(b) allow additional review time upon mutual agreement between the Federal agency and the State Coastal Zone Program. Please be advised that, by this letter, Interagency Affairs/Field Services Division and the Galveston Corps District have mutually agreed to extend the State review time to March 26, 2010. 1

A final determination will be made within the authorized time period, ending March 26, 2010. If you have any questions please call Brian Marcks of the Consistency Section at (225) 342-7591.

Sincerely yours,

Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division

GJD/JDH/bgm
cc: Janelle Stokes, Galveston COE

Post Office Box 44487 • Baton Rouge, Louisiana 70804-4487
617 North Third Street • 10th Floor • Suite 1078 • Baton Rouge, Louisiana 70802
(225) 342-7591 • Fax (225) 342-9439 • http://www.dnr.louisiana.gov
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Mr. Gregory J. DuCote
Administrator, Interagency Affairs/Field Services Division
State of Louisiana
Department of Natural Resources
Office of Coastal Management
617 North Third Street, 10th Floor, Suite 1078
Baton Rouge, LA 70804-4487

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The LDNR-OCM review period for the Federal application for consistency review was extended to March 12, 2010. |

TEXAS PARKS & WILDLIFE

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Commissioners

Peter M. Holt
Chairman
San Antonio

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Dan Allen Hughes, Jr.
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Margaret Martin
Boerne

S. Reed Morian
Houston

Lee M. Bass
Chairman-Emeritus
Fort Worth

Carter P. Smith
Executive Director

March 11, 2010

Ms. Janelle Stokes
Environmental Section
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Draft Environmental Impact Statement Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Site Designation

Dear Ms. Stokes:

Texas Parks and Wildlife Department (TPWD) staff has reviewed the above referenced documents provided to our agency on December 18, 2009. TPWD staff has also participated in the Interagency Coordination Team (ICT) for this project. Through the ICT process TPWD was able to provide our input into the project design, beneficial use components and mitigation options. As a result of this process, our agency comments have been incorporated into the Draft Environmental Impact Statement and we have no outstanding issues with the project.

Without proper execution of the mitigation plan and beneficial use features, this project would have deleterious impacts on an already significantly altered and fragile Sabine Lake coastal ecosystem. Therefore, we cannot stress enough the importance of continued coordination with our agency through the planning, engineering and design phase, the construction phase, and the maintenance phase of this project. We strongly recommend that the U.S. Army Corps of Engineers and the Sabine Neches Navigation District adopt the Beneficial Use Group model developed for the Houston Ship Channel project to facilitate this coordination. 1

We appreciate the opportunity to participate in the ICT process for this project and fully endorse use of the ICT process to facilitate federal projects that avoid and minimize impacts on the natural resources of Texas.

Questions can be directed to Mr. Jamie Schubert, Upper Coast Ecosystem Assessment Team Leader at (281) 534-0135.

Sincerely,

Ross Melinchuk
Deputy Executive Director, Natural Resources

RM:RR:dh

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.state.tx.us

To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

Mr. Ross Melinchuk
Deputy Executive Director, Natural Resources
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744-3291

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The SNWW ICT will continue into the engineering, design, construction and monitoring phases of the SNWW CIP. Specific ICT involvement relative to the BU features and mitigation measures are described in the SNWW CIP Mitigation and Beneficial Use Monitoring Plan (FEIS Appendix J). |

BOBBY JINDAL
GOVERNOR

State of Louisiana

DEPARTMENT OF WILDLIFE AND FISHERIES
OFFICE OF WILDLIFE

ROBERT J. BARHAM
SECRETARY

JIMMY L. ANTHONY
ASSISTANT SECRETARY

March 11, 2010

Ms. Janelle Stokes
Regional Environmental Specialist
Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553

**RE: Sabine-Neches Waterway Channel Improvement Project – DEIS**

Dear Ms. Stokes:

The professional staff of the Louisiana Department of Wildlife and Fisheries (LDWF) has reviewed the Sabine-Neches Waterway Channel Improvement Project Draft Environmental Impact Statement (EIS). As a Cooperating Agency and a member of the Interagency Coordination Team, LDWF submits the following recommendations. These recommendations shall be given thorough consideration and be individually and adequately addressed in the Final EIS.

**Compensatory Mitigation**

The U.S. Army Corps of Engineers (USACE) intends to restore more marsh in Louisiana than the project is predicted to destroy over the initial 50-year project life. Despite this, there remains a 318 AAHU deficiency in Louisiana. **The 318 AAHU deficiency indicates that project construction, including beneficial use and mitigation measures, is expected to result in an overall loss of fish and wildlife habitat quality in Louisiana.**

USACE proposes to use excess Texas BU benefits to offset this deficiency of compensatory mitigation in Louisiana. **LDWF will not concur in plans to mitigate in Texas for wetland impacts occurring in Louisiana.**

**Therefore, LDWF recommends that additional mitigation measures be implemented in Louisiana to offset the current 318 AAHU deficiency.** 1

**Beneficial Use**

LDWF recommends that new work material from the Sabine Pass Channel and Sabine Pass Jetty Channel be used beneficially to create, restore, or nourish emergent marsh in the vicinity of the project. Instead of using only maintenance material composed of fine-grained sediment, the new work material, composed predominantly of clay, should be placed along the shoreline at Louisiana Point. New work material would have a greater likelihood of remaining in the existing marsh and on the shallow nearshore slope in front of the shoreline than maintenance material. 2

**LDWF License to Dredge; Royalties**

LDWF's legal staff is investigating USACE's claim that the Supremacy Clause of the U.S. Constitution allows USACE to avoid acquiring a license from, and pay royalties to, LDWF for dredging state owned water bottoms. 3

**Public Oyster Areas**

Sabine Lake in Louisiana is a public oyster area and LDWF is mandated to diligently protect and conserve such areas. It has been a long-standing practice that water bottoms associated with a proposed project within a public oyster area must be assessed prior to project implementation, and that compensation is required for impacts to those water bottoms. Adverse impacts to the public oyster area from the mitigation dredging areas, including any access channels, must be assessed. The applicant shall contact LDWF's Heather Finley at 225-765-2956 or hfinley@wlf.la.gov for further information. 4

LDWF has consistently asserted that these recommendations must be satisfactorily addressed by USACE. Unfortunately, the DEIS failed to do so. LDWF will continue to urge USACE to correct the inequitable wetland mitigation plan and to adequately address all other outstanding LDWF concerns. Please do not hesitate to contact LDWF's Kyle Balkum at 225-765-2819 should you need further assistance.

Sincerely,

Robert J. Barham
Secretary

kb

c: Heather Finley, LDWF
Mike Windham, LDWF
Gregory DuCote, LDNR
David Fruge, OCPR
Jeff Harris, LDNR
Richard Hartman, NMFS
Ismail Merhi, OCPR
Darryl Clark, USFWS

Mr. Robert J. Barham
Secretary
Louisiana Department of Wildlife and Fisheries
Office of Wildlife
P.O. Box 98000
Baton Rouge, LA 70898-9000

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Please see USACE response in letter dated March 4, 2010. USACE maintains that all impacts have been fully compensated. Therefore, this will be reported as an unresolved issue in the FEIS. |
| 2 | Please see USACE response in letter dated March 4, 2010. USACE has explained that the beneficial use of new work material was thoroughly explored by the FEIS, and that dredged material would used to the maximum extent practicable in the proposed SNWW CIP. Therefore, this will be reported as an unresolved issue in the FEIS. |
| 3 | Please see USACE response in letter dated March 4, 2010. USACE understands that this issue is still under review by Louisiana Department of Wildlife and Fisheries (LDWF). If it is not resolved prior to publication, it will be reported as an unresolved issue in the FEIS. |
| 4 | Please see USACE response in letter dated March 4, 2010. USACE has proposed that a water bottom survey of the borrow area and access channels be conducted after project approval. In the event that oyster reef is encountered, plans would be revised to avoid impacts. Therefore, this will be reported as an unresolved issue in the FEIS. |

BOBBY JINDAL
GOVERNOR

State of Louisiana

DEPARTMENT OF WILDLIFE AND FISHERIES
OFFICE OF WILDLIFE

ROBERT J. BARHAM
SECRETARY

JIMMY L. ANTHONY
ASSISTANT SECRETARY

October 23, 2009

Ms. Janelle Stokes
Regional Environmental Specialist
Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553

**RE: Sabine-Neches Waterway Feasibility Study DEIS**

Dear Ms. Stokes:

The professional staff of the Louisiana Department of Wildlife and Fisheries (LDWF) has reviewed the preliminary Sabine-Neches Waterway Feasibility Study Draft Environmental Impact Statement (DEIS). Based upon this review, LDWF staff submits the following comments below. These comments, shall require thorough consideration and be individually and adequately addressed in the DEIS.

**Compensatory Mitigation**
Excess Texas BU Benefits are being used to offset a deficiency of compensatory mitigation in Louisiana. **LDWF will not concur in plans to mitigate in Texas for wetland impacts occurring in Louisiana.** LDWF recommends that additional Louisiana mitigation measures be implemented to offset the current 318 AAHU deficiency.

**Beneficial Use**
The tentatively Recommended Plan would result in an estimated 98,000,000 cubic yards of new work material (i.e., material dredged during initial channel deepening and widening). With the exception of a portion of the material dredged from the Neches River Channel in Texas, all new work material would be pumped to upland placement areas and ocean dredged material disposal sites, not used beneficially.

Of particular concern to LDWF is the Sabine Pass Channel segment which begins just north of the jetties and extends 5.6 miles upstream to Mesquite Point, Texas and the Sabine Pass Jetty Channel which begins at the jetties and extends 4.1 miles downstream. All 9,701,000 cubic yards of new work material from these segments (6,723,000 cubic yards from Sabine Pass Channel and 2,978,000 cubic yards from Sabine Pass Jetty Channel) would be pumped to upland placement areas or ocean dredged material disposal sites. **LDWF recommends that new work material from the Sabine Pass Channel and Sabine Pass Jetty Channel be used beneficially to create, restore, or nourish emergent marsh in the vicinity of the project.**

**LDWF License to Dredge; Royalties**
Sabine Lake and Sabine Pass in Louisiana are state owned water bottoms. No fill material shall be dredged from state owned water bottoms without a license issued by LDWF. A royalty payment, based on cubic yards, shall also be made to LDWF. The applicant shall contact LDWF's Mike Windham at 504-284-5268 or cwindham@wlf.la.gov for further information.

**Public Oyster Areas**
Sabine Lake in Louisiana is a public oyster area and LDWF is mandated to diligently protect and conserve such areas. It has been a long-standing practice that water bottoms associated with a proposed project within a public oyster area must be assessed prior to project implementation, and that compensation is required for impacts to those water bottoms. Adverse impacts to the public oyster area from the mitigation dredging areas, including any access channels, must be assessed. The applicant shall contact LDWF's Heather Finley at 225-765-2956 or hfinley@wlf.la.gov for further information.

**LA2-ADD B/LA2-18B**
LDWF needs more information about the access channel and borrow trench for LA2-ADD B/LA2-18B. For instance, why was the proposed route chosen? Why not a more direct route? What is the depth of the channel? What is the depth and length of the borrow trench? What is the distance from shore of the borrow trench? All of these questions are a concern due to the potential to create hypoxic conditions in dredged water bottoms and increase shoreline erosion rates through increased wave energy or sinking of the shoreline to fill the excavated trench.

**WVA Modeling – Submerged Aquatic Vegetation (SAV)**
The WVA model predicts no change in the percentage of SAV cover for either Future Without Project (FWOP) or Future With Project (FWP) condition despite increases in salinity. However, the FWP results in adverse impacts to native SAV in two hydrologic units (i.e., TX 3 and LA 1). Furthermore, the salinity ranges appear high for some of the species and, according to discussions at the August 27, 2009 ICT meeting, some native SAV species were not included in the analysis. More work is necessary to justify the "no change" determination for FWP or else adverse impacts need to be accounted for in the WVA model and adequate and appropriate mitigation provided.

The Louisiana Department of Wildlife and Fisheries appreciates the opportunity to review and provide recommendations to you regarding this proposed activity. Please do not hesitate to contact LDWF's Kyle Balkum at 225-765-2819 should you need further assistance.

Sincerely,

Robert J. Barham
Secretary

kb/hf

c: Heather Finley, LDWF
Mike Windham, LDWF
Gregory DuCote, LDNR
Karl Morgan, LDNR
Ismail Merhi, OCPR
Darryl Clark, USFWS

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

March 4, 2010

Environmental Section

Mr. Robert J. Barham
Secretary
Louisiana Department of Wildlife and Fisheries
Office of Wildlife
P.O. Box 98000
Baton Rouge, Louisiana 70898-9000

Dear Mr. Barham:

Reference is made to the letter dated October 23, 2009 from your agency regarding the preliminary Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) Feasibility Study and Draft Environmental Impact Statement (DEIS). The DEIS, issued for public and agency review on December 24, 2009, included your comments and identified them as unresolved issues in the DEIS Executive Summary (Section ES.5, page ES-10). An Interagency Coordination Team (ICT) comprised of Federal and State resource agency representatives from Texas and Louisiana has assisted Galveston District in modeling and analyzing environmental impacts, and selecting beneficial use (BU) and mitigation measures for the Tentatively Recommended Plan. The Louisiana Department of Wildlife and Fisheries (LDWF) has had a representative on the ICT since its inception in 2000. For your convenience, we are providing responses to each of your comments with this correspondence.

**Compensatory Mitigation**
The proposed mitigation plan would more than compensate for all impacts of the proposed SNWW CIP. Benefits of the BU measures are being used to offset impacts in both Texas and Louisiana. DEIS Table 5.1-2 provides a summary accounting of BU benefits and compensatory mitigation for the proposed project. In Louisiana, the benefits of BU measures offset the loss of 210 average annual habitat units (AAHUs) to private lands along the coast at Louisiana Point, and the loss of 340 AAHUs to Federal land in the Sabine National Wildlife Refuge. Although the net impact of the project as a whole after application of all BU benefits (including significant other BU benefits in Texas) is the loss of 843 AAHUs, the proposed mitigation plan would provide 1,181 AAHUs in order to fully compensate for the loss of 1,499 AAHUs to non-Federal lands in Louisiana. The marsh mitigation measures would compensate for the predicted loss of 691acres in Louisiana over 50 years by the restoration of 2,783 acres of emergent marsh, the improvement of 957 acres of shallow water habitat and the nourishment of 4,355 acres of existing marsh. Since the marsh restoration is several times greater than the predicted marsh loss, there would be no net less of wetlands.

**Beneficial Use**
The ICT participated in an exhaustive search for least-cost beneficial use opportunities throughout the project area. The screening of potential BU measures is described in the DEIS

Section 2.5.3. Given the large amount of dredged material that would be generated from the proposed SNWW CIP, considerable effort was expended to identify areas in both Texas and Louisiana that could benefit from its beneficial use. All degraded marsh areas near the SNWW navigation channels, including the marshes inland from Louisiana Point, were investigated. The ICT identified no interior marsh areas in need of nourishment or restoration adjacent to Sabine Pass in Louisiana. Areas in Louisiana that could benefit from BU measures are all located in marshes east of Sabine Lake. However, these were found to be too distant from the navigation channel to permit cost effective use of dredged material from the SNWW navigation channels.

The tentatively-recommended BU plan includes the only measure in Louisiana that was identified as a least costly method of disposal. The Gulf Shore Nourishment Feature would use material from regular maintenance dredging of the eastern section of the Sabine Pass Channel to nourish eroding marsh along shorelines at Louisiana Point and Texas Point. Maintenance material would be hydraulically-pumped along a 3-mile reach of shoreline (from 0.5 to 3.5 miles from each jetty) during each 3-year dredging cycle. The unconfined placement would alternate between Texas and Louisiana, so that dredged material would be placed on each state's shoreline every 6 years, for a total of 16 placement events over 50 years. Dredging and pumping costs for new work material are higher, and therefore shoreline nourishment during construction in the Sabine Pass Channel would be more expensive than placement in the existing Placement Area (PA) 5. The Sabine Pass Jetty Channel would be dredged by hopper dredge; beneficial use of this material would require double handling and would cost more than placement in the existing Ocean Dredged Material Disposal Site (ODMDS) A. Current Corps of Engineers guidance requires that a cost share sponsor be identified for any environmentally beneficial use of dredged material that is not the least costly method of disposal. No potential non-federal sponsors have been identified for BU measures that are not the least costly method of disposal. The proposed BU plan uses dredged material to the maximum extent practicable to protect and nourish the Gulf shoreline, and existing upland PA5 and ODMDS A would be utilized rather than creating new placement areas.

**LDWF License to Dredge; Royalties**

Galveston District maintains that the United States is not bound by Louisiana statute (R.S. 56:2011) pursuant to the Supremacy Clause of the United States Constitution, Article VI, paragraph 2, and that Louisiana is not entitled to compensation under the Fifth Amendment, pursuant to the doctrine of Navigation Servitude. This servitude gives the Federal Government the right to use the "Navigable Waters" of the United States without compensation for navigation projects. The connection between the navigation project and the proposed removal of fill from Sabine Lake is simple. The removal of fill material for the Willow Bayou marsh mitigation areas would not be necessary but for construction of the proposed project.

**Public Oyster Area**
Galveston District understands that the area proposed for the one-time borrow area and access channel are located within the Sabine Lake Public Oyster Area. While the area is designated as a public oyster area, several recent bay bottom assessments conducted in the vicinity by Department of Army permit applicants have identified no live oyster reefs in the area. Nevertheless, as stated in DEIS Section ES.5 and Section 5.5.1, we propose that a water bottom survey of the borrow and access channel areas be conducted after approval of the Chief of Engineer's report, during the preconstruction engineering and design (PED) phase of the project. In the unlikely event that oyster reef is encountered, plans will be revised to avoid impacts.

**LA2-ADD B/LA2-18B**
DEIS Section 5.5.1 answers many of the questions posed by your letter. "The dedicated dredging would take approximately 3.1 million cubic yards of material from a 1.8-mile-long borrow trench in Sabine Lake. The borrow trench would be located at least 1,000 feet from the Sabine National Wildlife shore and would average 1,030 feet wide by 7.5 feet deep. The borrow trench would be continuous and parallel to the current shoreline, in line with the common long shore circulation pattern in Sabine Lake. The circulation is expected to prevent the development of hypoxic conditions that would be detrimental to aquatic organisms, and would eventually fill the trench with Sabine River sediments. An access channel, approximately 8 miles long, from the GIWW near the mouth of the Sabine River would be needed for the dredge to reach the proposed borrow area. The exact locations of the borrow trench and access channel would be determined in consultation with the ICT after PED bottom surveys of potential locations." The proposed route of the access channel was chosen to keep dredging impacts to a minimum; it takes advantage of deeper water in the center of the lake, thereby minimizing dredging and bottom impacts. The depth of the access channel would be dependent upon water depth and the draft of the dredge. ICT coordination during the PED phase would ensure that LDWF concerns with these features are adequately addressed.

**WVA Modeling – Submerged Aquatic Vegetation (SAV)**
DEIS Appendix C, Section 4.2 describes the WVA modeling of the variable "Percent Submerged Aquatic Vegetation." The WVA model documentation described in DEIS Appendix C, Section 2.6.1.2, defines SAV as any of the diverse array of floating-leaved and submerged aquatic plants that are typically found in a study area. SAV coverage is included as an important model variable because SAV provides important food and cover to a wide variety of fish and wildlife. The model evaluates the percentage of open water that is dominated by aquatic vegetation, without consideration as to whether it is native or invasive. The WVA modeling utilized an inventory of SAV species in the study area that was prepared using recent monitoring reports and other available literature. Potential project impacts would be related to the increase in salinity that would occur with deepening of the SNWW navigation channel. As described in DEIS

Section 4.2.1, one native and one invasive SAV species out of 10 species present in LA 1 would be affected by the predicted salinity change. It is expected that any SAV cover lost due to the gradual salinity change would be replaced by salinity tolerant SAV species continuing to grow within their tolerance ranges. As a result, no actual impact to percent SAV cover would be expected. The best available scientific information was used to establish salinity ranges for the evaluation; differences in scientific opinion regarding these ranges are readily apparent in the literature. No new information has yet been provided by LDWF or any other resource agency and, therefore, we see no reason to revise the WVA modeling at this time.

We hope this additional information will be helpful to your agency in evaluating the SNWW CIP Draft EIS. The issues and area of concern raised by your letter have been individually and adequately addressed in the DEIS. Please do not hesitate to contact Ms. Janelle Stokes at 409/766-3039 should you need further assistance.

Sincerely,

Carolyn Murphy

Carolyn Murphy
Chief, Environmental Section

CF:
Kyle Balkum, LDWF
Heather Finley, LDWF
Gregory DuCote, LDNR
Jeff Harris, LDNR
Ismail Merhi, OCPR
Darryl Clark, USFWS

**Stokes, Janelle S SWG**

**From:** Tammy Brooks [Tammy.Brooks@GLO.STATE.TX.US]
**Sent:** Friday, March 12, 2010 11:11 AM
**To:** rcantu@dot.state.tx.us; Robert Hansen; william.schubert@tpwd.state.tx.us; guthrie.karla@twdb.state.tx.us; Stokes, Janelle S SWG
**Subject:** Re: SNWW -CIP Consistency

Jan,

I request a two-week extension of time (3/26/10) to review the information. 1

Sincerely,
Tammy

Tammy S. Brooks
Coastal Coordination Council Secretary
Consistency Review Coordinator
Coastal Resources
Texas General Land Office
P. O. Box 12873
Austin, TX 78711-2873
(512) 463-9212
(512) 475-0680 fax
tammy.brooks@glo.state.tx.us

>>> "Stokes, Janelle S SWG" <janelle.s.stokes@usace.army.mil> 3/12/2010 10:12 AM >>>
Good morning,

A couple of you requested additional information on the ICT process for consistency concurrence. I'm attaching the 2003 CCC Guidance for ICT Consistency Review. It describes the approved process that we would like to follow for the SNWW CIP. If you have further questions about this, I believe Ms. Tammy Brooks, GLO Coastal Management Program, (512) 463-9212 may be able to provide additional information.

And please don't hesitate to call me if you have any other questions or concerns. <<CCC_Guidance_ICT_Consistency_Review_2003.pdf>>

Janelle Stokes
Regional Environmental Specialist
Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553
409/766-3039
janelle.s.stokes@usace.army.mil

Ms. Tammy Brooks
Coastal Coordination Council Secretary
Consistency Review Coordinator
Coastal Resources
Texas General Land Office
P.O. Box 12873
Austin, TX 78711-2873

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The Texas Coastal Coordination Council (TX CCC) review period for the Federal application for consistency review was extended to March 26, 2010. |

A GOVERNMENT AGENCY
OF THE
State of Texas

(409) 746-2192
FAX (409) 746-3780

SABINE RIVER AUTHORITY
of Texas

P.O. BOX 579
ORANGE, TEXAS
77631

March 12, 2010

Ms. Janelle Stokes, Regional Environmental Specialist
U.S. Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Comments on December 2009 Draft Documents for Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

The Sabine River Authority of Texas (SRA-TX) appreciates this opportunity to provide its comments on the December 2009 draft documents for the Sabine-Neches Waterway Channel Improvement Project. The SRA-TX has been an active participant in the USACE Interagency Coordination Team and is familiar with the proposed project.

The SRA-TX was created by the Legislature in 1949 as an official agency of the State of Texas. SRA-TX was created as conservation and reclamation district with responsibilities to control, store, preserve and distribute the waters of the Sabine River and its tributary streams in Texas for useful purposes. The Texas portion of the Sabine River Basin originates in Texas with headwaters east of Dallas and flows southeast to the Stateline near Logansport, Louisiana where waters are divided equally between the two States. The total drainage area of the Basin is 9,756 square miles which includes all or part of twenty-one counties in Texas (about 76 percent of the basin) and seven parishes in Louisiana (about 24 percent of the basin). The downstream reach ends at the confluence of the Sabine River with Sabine Lake. The STA-TX, the Sabine River Authority, State of Louisiana (SRA-LA) and the Sabine River Compact Administration all have responsibilities relating to the waters of the Sabine Basin.

The SRA-TX has taken an active role in water supply and water quality protection activities for many years, including work with regional state water planning groups, drought planning, and water conservation. As a partner in the Texas Clean Rivers Program since the program's inception, SRA-TX collects water quality data throughout the Sabine River Basin under a state-approved quality assurance project plan and the data is accepted by the state for standards compliance assessment. SRA-TX monitors water quantity and quality for SRA-TX and SRA-LA in Toledo Bend Reservoir and the Lower Sabine River Basin. SRA-TX has actively participated in review of state water quality standards, nutrient standards development, waste load evaluations, and industrial and municipal permit compliance monitoring. SRA-TX is

SABINE RIVER AUTHORITY of Texas

currently gathering available data and conducting studies on the Lower Sabine River relevant to the renewal of its Federal Energy Regulatory Commission (FERC) license for the Toledo Bend Hydropower facility. Other recent environmental flows work includes several years of work with Senate Bill 2, Texas Instream Flow Program and Senate Bill 3, Sabine and Neches Rivers and Sabine Lake Bay Basin and Bay Area Stakeholder Committee and Expert Science Team. As a part of these environmental flows activities, the SRA-TX has maintained that solutions for preservation and protection of the ecology of Sabine Lake and the surrounding wetlands should be based on retarding saltwater intrusion into the wetlands which has resulted from numerous secondary channels in Texas and Louisiana.

Over the past 130 years, secondary channels emanating from the open waters of Sabine Lake, the tidal waters of the lower Sabine and Neches Rivers as well as the Gulf Intracoastal Waterway have exposed the adjacent wetlands (bottomland hardwoods, cypress-tupelo swamps and open marshes) to increased tidal exchange of higher salinity water from the Gulf of Mexico via the Sabine-Neches Waterway to areas such as Bessie Heights, Keith Lake and the Sabine National Wildlife Refuge. SRA-TX agrees that wetlands mitigation/habitat restoration efforts outlined in the report will need the beneficial use of dredged material to re-establish marsh elevations along with revegetation in order to rebuild these areas. However, SRA-TX believes saltwater intrusion into these areas will require more control structures to retard saltwater intrusion and slow freshwater drainage from wetland areas back into Sabine Lake and the lower Sabine and Neches Rivers. In this regard, SRA-TX requests additional consideration be given to such control structures to mitigate wetland loss resulting from secondary channels. 1

Thank you again for this opportunity to submit our comments. We have also attached specific comments for your consideration. Please contact our office if further details or clarification is needed.

Sincerely,

Jack W. Tatum
Water Resources Manager
Sabine River Authority of Texas

Attachment

SRA-TX Comments

Volume I, Draft Feasibility Report for Sabine-Neches Waterway Channel Improvement Project

p. I-11

During periods of normal rainfall, high salinity water transported by the SNWW is buffered by ~~discharges~~ inflows from ~~upstream reservoirs~~the Sabine and Neches Rivers, direct rainfall, and coastal watershed inflows that have little effect on the salinity levels of Sabine Lake and the surrounding marshes. 2

**Comment [JDP1]:** It's inaccurate to describe inflows from the Sabine and Neches Rivers in terms of the reservoirs. 56% of fresh water entering Sabine Lake originated from watersheds and direct precipitation other than flows passing through Sam Rayburn and Toledo Bend dams 147 miles upstream of Sabine Lake.

p. I-14

Table I-2

Totals in bottom right column don't agree with other data in the table.

Summary of Habitat Acreages by State, 2004 3

| | Fresh | Inter-mediate | Brackish | Saline | Total Marsh | Bottomland Hardwood | Swamp | Total Wetlands |
|---|---|---|---|---|---|---|---|---|
| Texas | | | | | | | | |
| Acreage | 13,580 | 30,336 | 24,047 | 4,898 | 72,861 | 5,458 | 10,157 | 88,476 |
| Water | 2,117 | 9,240 | 8,254 | 810 | 20,421 | 0 | 0 | 20,421 |
| Totals | 15,697 | 39,576 | 32,301 | 5,708 | 93,282 | 5,458 | 10,157 | 108,897 |
| Louisiana | | | | | | | | |
| Acreage | 20,336 | 101,405 | 23,112 | 3,551 | 148,404 | 3,206 | 6,641 | 158,251 |
| Water | 4,772 | 31,872 | 2,049 | 586 | 39,279 | 0 | 0 | 39,279 |
| Totals | 25,108 | 133,277 | 25,161 | 4,137 | 187,683 | 3,206 | 6,641 | 197,530 |
| Total | | | | | | | | |
| Acreage | 33,916 | 131,741 | 47,159 | 8,449 | 221,265 | 8,664 | 16,798 | 451,396 |
| Water | 6,889 | 41,112 | 10,303 | 1,396 | 59,700 | 0 | 0 | 119,476 |
| Totals | 40,805 | 172,853 | 57,462 | 9,845 | 280,965 | 8,664 | 16,798 | 570,872 |

Volume II, Draft Environmental Impact Statement for Sabine-Neches Waterway Channel Improvement Project

p.3-28

**3.5.3.1 Flow Diversions**

The area within Calcasieu/Sabine River Basin has experienced accelerated marsh deterioration and conversion to shallow open water as a result of the construction of Calcasieu Ship Channel, the SNWW, ~~and~~ the GIWW, land subsidence from mineral extraction, and relative sea level rise. Efforts to combat the increased flow of saltwater into the area include both structural and vegetative methods. A 1990 inventory of water control structures along the perimeter and interior of the Calcasieu/Sabine River Basin located 174 structures. 4

SRA Comment: The Recommended Plan includes beneficial use of dredge material but doesn't include water control structures such as those listed in section 3.5.3.1 to restrict the flow of saltwater into the marshes. The SRA-TX understands the need for beneficial use of dredge material and recognizes cost/benefits analyses have been done to select mitigation options that are most cost-effective, however these beneficial use areas aren't expected to prevent saltwater from entering the marshes. Marsh perimeter control structures reduce tidal hydraulics and erosion of surface sediments, restrict inflows from Sabine Lake, and retain fresh water from rainfall and local watersheds.

p. 4-112

**4.16.4.6 Toledo Bend Reservoir Relicensing**

Toledo Bend Reservoir is located on the Sabine River in Texas and Louisiana and forms a portion of the boundary between the two states. The reservoir is approximately 65 miles long and inundates land in Newton, Sabine, Shelby, and Panola counties, Texas, and Sabine and DeSoto parishes, Louisiana. Toledo Bend Reservoir has 1,200 shoreline miles, normally covers an area of 185,000 acres, and has a controlled storage capacity of 4,477,000 acre-feet. The reservoir was constructed by Sabine River Authority of Texas and Sabine River Authority, State of Louisiana (SRA-LA) for water ~~conservation~~supply, with secondary uses of

hydroelectric power generation, and recreation. On December 12, 2002, the SRA-TX approved an application to the TCEQ to amend Certificate of Adjudication No. 05-4658 to include the right to divert 293,300 acre-feet per year of the available unappropriated portion of the stored Texas water from Toledo Bend Reservoir for multiple

use (municipal, industrial, agricultural) (SRA-TX and LNVA, 2006). TCEQ is mandated to consider environmental flows (instream and freshwater needs) during permit evaluations for new reservoirs or amended water rights.

The SRA-TX and ~~Louisiana~~ SRA-LA (Authorities, hereafter)
~~propose to revise their FERC license to eliminate~~
~~peaking hydropower generation during the summer months at Toledo Bend Reservoir~~. With this proposed change, water would be used for public water supply.
~~The SRA-TX and LNVA commissioned Sabine~~
~~Lake: Ecological Condition of the Sabine-Neches Estuary report (SRA-TX and LNVA, 2006) to facilitate preparation of the FERC pre-application document for relicensing new operations (an EIS would be required to evaluate the impacts of such a change)~~. If the Toledo Bend Reservoir were to be operated solely as a public water supply, the hydropower operational increase in freshwater inflows to Sabine Lake during the summer months would not occur, resulting in a flow regime similar to pre-reservoir or naturalized conditions (SRA-TX and LNVA, 2006). The current FERC license expires October 14, 2013 (SRA-TX and LNVA, 2006).

The SRA-TX and SRA-LA (Authorities, hereafter) have initiated the process to renew the FERC license which allows the generation of Hydro-electric generation. The current FERC license expires October 14, 2013. The intention of the Authorities is to continue current operations as a hydropower peaking unit during the summer months. However, as water supply sales increase, hydropower generation may be reduced resulting in a flow regime that is more similar to pre-reservoir or naturalized conditions.

5

6

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**Comment [JDP2]:** The new license will not eliminate summertime hydropower peaking.

**Comment [JDP3]:** This document was an important reference in the FERC Pre-Application Document but wasn't commissioned for that purpose.

**Comment [MSH4]:** Alternate paragraph for the power

The SRA-TX recommends long-term salinity monitoring as a part of the Monitoring Plan to evaluate accuracy of the prediction model, subsequent assumptions that were made on the basis of salinity modeling, and the ultimate success potential for adopted mitigation measures. 8

Mr. Jack Tatum
Water Resources Manager
Sabine River Authority of Texas
P.O. Box 579
Orange, TX 77631

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Given the fact that impacts of the proposed SNWW CIP are related primarily to salinity intrusion, extensive efforts have been made to identify effective mitigation measures that could minimize or eliminate the projected increase in salinity and tidal amplitude. The results of this effort are presented in FEIS Section 5.4.1.1. None of the salinity control structures were selected because the net effect of the structures was determined to be negative. Beneficial salinity effects were modest and could not overcome the adverse effects of restrictions to marine organism access. |
| 2 | The FR was revised as suggested. |
| 3 | Totals in FR Table I-2 have been corrected. |
| 4 | The effect of relative sea level rise (which by definition includes subsidence from any cause) on existing interior marshes is discussed in FEIS Section 4.10.1.2.1. Existing coastal marshes appear to have adapted to gradual changes in sea level rise, and in recent years there has been a decrease in the loss rate in the Sabine-Calcasieu area. The text has not been revised. |
| 5 | See USACE response to Comment 1. |
| 6 | The FEIS was revised as suggested. |
| 7 | The FEIS has been revised. |
| 8 | Salinity monitoring is conducted by many state and Federal agencies throughout the SNWW study area. It is expected that this data will be available for use in assessing future conditions within the study area. |

# TEXAS WATER DEVELOPMENT BOARD

James E. Herring, *Chairman*
Lewis H. McMahan, *Member*
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*Executive Administrator*

Jack Hunt, *Vice Chairman*
Thomas Weir Labatt III, *Member*
Joe M. Crutcher, *Member*

March 18, 2010

Janelle Stokes
Regional Environmental Specialist
Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553

Ms. Stokes,

The Texas Water Development Board (TWDB), as a member of the interagency coordination team for the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) and as a member of the Coastal Coordination Council (CCC), concurs that the tentatively recommended plan for the SNWW CIP is consistent with the Texas Coastal Management Program's goals and policies regarding *Dredging and Dredged Material Disposal and Placement* (TAC §501.25).

We have reviewed the analysis of compliance for the goals and policies related to TAC §501.25 *Dredging and Dredged Material Disposal and Placement* (Appendix I-1 of the Draft Environmental Impact Statement) and agree that the plans for beneficial use of dredged material meet the goals and policies of the Texas Coastal Management Plan. If you have further questions, please contact me at 512-936-0825 or at junji.matsumoto@twdb.state.tx.us. 1

Sincerely,

Junji Matsumoto

Junji Matsumoto, Ph.D., P.E.
Engineer, Bays & Estuaries Program

Mr. Junji Matsumoto, Ph.D., P.E.
Engineer, Bays & Estuaries Program
Texas Water Development Board
1700 N. Congress Avenue
Austin, TX 78711-3231

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank-you for your comment. |

BOBBY JINDAL
GOVERNOR

SCOTT A. ANGELLE
SECRETARY

# State of Louisiana

## DEPARTMENT OF NATURAL RESOURCES
## OFFICE OF COASTAL MANAGEMENT

March 25, 2010

Dolan Dunn
Chief, Planning, Environmental & Regulator Division
Dept. of the Army
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, TX 77563-1229

RE: **C20090667,** Coastal Zone Consistency
**U. S. Army Corps of Engineers, Galveston District**
Direct Federal Action
Draft EIS for the Sabine-Neches Waterway Improvements Project, Southeast Texas and Southwest, **Louisiana**

Dear Mr. Dunn:

This office has received the above referenced federal application for consistency review with the approved Louisiana Coastal Resources Program in accordance with Section 307(c) of the Federal Coastal Zone Management Act of 1972, as amended. NOAA Regulations on Federal Consistency, at 15 CFR '930.41(a), allow 60 days for the review of Direct Federal Activities, and at '930.41(c)(b) allow additional review time upon mutual agreement between the Federal agency and the State Coastal Zone Program. Please be advised that, by this letter, Interagency Affairs/Field Services Division and the Galveston Corps District have mutually agreed to extend the State review time to March 31, 2010. 1

A final determination will be made within the authorized time period, ending March 31, 2010. If you have any questions please call Brian Marcks of the Consistency Section at (225) 342-7591.

Sincerely yours,

Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division

GJD/JDH/bgm
cc: Janelle Stokes, Galveston COE

Post Office Box 44487 • Baton Rouge, Louisiana 70804-4487
617 North Third Street • 10th Floor • Suite 1078 • Baton Rouge, Louisiana 70802
(225) 342-7591 • Fax (225) 342-9439 • http://www.dnr.louisiana.gov
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Mr. Gregory J. DuCote
Administrator, Interagency Affairs/Field Services Division
State of Louisiana
Department of Natural Resources
Office of Coastal Management
617 North Third Street, 10th Floor, Suite 1078
Baton Rouge, LA 70804-4487

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The review period for the Federal application for consistency review was extended to March 31, 2010 for LDNR-OCM. |

**Stokes, Janelle S SWG**

**From:** William Schubert [William.Schubert@tpwd.state.tx.us]
**Sent:** Monday, March 29, 2010 12:35 PM
**To:** Stokes, Janelle S SWG
**Subject:** RE: Consistency Determination for SNWW Channel Improvement Project

Jan,

Texas Parks & Wildlife Department concurs that the Tentatively Recommended Plan for the Sabine Neches Waterway Channel Improvement Project is consistent with the goals and policies of the Texas Coastal Management Program. 1

Jamie Schubert

Upper Coast Ecosystem Assessment Team Leader

Texas Parks and Wildlife Department

phone (281)534-0135

fax (281)534-0122

---

From: Stokes, Janelle S SWG [mailto:janelle.s.stokes@usace.army.mil]
Sent: Tuesday, March 09, 2010 2:00 PM
To: Tammy.Brooks@GLO.STATE.TX.US; William Schubert; Junji.Matsumoto@twdb.state.tx.us; Robert Hansen; rcantu@dot.state.tx.us
Cc: Murphy, Carolyn E SWG
Subject: Consistency Determination for SNWW Channel Improvement Project

Dear Tammy/Jamie/Junji/Robert and Raul,

The consistency review for the proposed SNWW CIP project will be conducted pursuant to the Coastal Coordination Act's Implementation Rules 31 TAC §506.28 "Guidance for Conducting Consistency Reviews in Coordination with an Interagency Coordination Team," issued on December 11, 2003. The Corps of Engineers, Galveston District, has established an interagency coordination team (ICT) that includes as voting members representatives from the following Coastal Coordination Council member agencies: Texas General Land Office, Texas Parks and Wildlife Department, Texas Water Development Board, Texas Commission on Environmental Quality and the Texas Department of Transportation.

Please provide by return email your agency's concurrence that the Tentatively Recommended Plan for the SNWW CIP (as described in the Draft Environmental Impact Statement and Draft Feasibility Report, issued on 24 December 2009) is consistent, to the maximum extent practicable, with the Texas Coastal Management Program goals and policies. Please respond to this request as soon as possible because the deadline for receiving comments on the Texas consistency determination is 12 March 2010.

Thank-you

Janelle Stokes
Regional Environmental Specialist
Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553

Mr. Jamie Schubert
Upper Coast Ecosystem Assessment Team
Texas Parks and Wildlife Department
1502 FM 517
Dickinson, TX 77539

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank-you for your comment. |

BOBBY JINDAL
GOVERNOR

PEGGY M. HATCH
SECRETARY

# State of Louisiana

DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SERVICES

MAR 30 2010

U.S. Army Corps of Engineers- Galveston District
CESWG-PE-RE
P.O. Box 1229
Galveston, TX 77553-1229

Attention: Janelle Stokes

RE: Water Quality Certification (WQC 100330-01/AI 104985/CER 20100001)
Sabine-Neches Waterway Channel Improvements Project
Cameron Parish

Dear Ms. Stokes:

We have received notice of your application for a 401 Water Quality Certification to dredge waterbottoms and place spoil material for marine vessel access improvements, along Sabine Pass in southwestern Cameron Parish. Prior to processing the certificate, this office requires:

1. **A proof of publication of the Public Notice in THE ADVOCATE of Baton Rouge.**
2. **A proof of publication of the Public Notice in THE AMERICAN PRESS of Lake Charles.** 1
3. **Assurance that any excavated material will be, to the best of your knowledge, free of contaminants and/or will be disposed of in an approved landfill.** 2
4. **A list of landowners, adjacent to the project site.** 3

Be sure to include our reference number (WQC 100330-01/AI 104985) on all responses. Please send all correspondence to the Louisiana Department of Environmental Quality to the following address:

Louisiana Department of Environmental Quality
Water Permits Division
P.O. Box 4313
Baton Rouge, LA 70821-4313
Attn: Water Quality Certifications

Enclosed are copies of public notices to be published by you one time in the official State Journal, THE ADVOCATE of Baton Rouge and THE AMERICAN PRESS of Lake Charles. (As provided for by LRS 30:2074 A(3), the cost of this publication is to be at your expense). PLEASE REQUEST THAT THESE NEWSPAPERS FURNISH US WITH PROOFS OF PUBLICATION OF THIS NOTICE TO THE FOLLOWING ADDRESS:

Louisiana Department of Environmental Quality
Water Permits Division
P.O. Box 4313
Baton Rouge, LA 70821-4313
Attn: Water Quality Certifications

A ten-day period after the date of publication will allow for public comment. After this ten-day period has expired, a decision as to whether to grant the certificate will be made in accordance with LAC 33:IX.1507.A-E and provisions of Section 401 of the Clean Water Act.

If we haven't received this information within 30 days from the date of this letter, your application will be considered inactive. If you have any questions, please call Jamie Phillippe at 225-219-3003.

Sincerely,

Tom Killeen

Tom Killeen, Environmental Scientist Manager
Municipal and General Water Permits Section

TK/jjp

PUBLIC NOTICE TO BE RUN IN

THE ADVOCATE OF BATON ROUGE
P.O. Box 588
Baton Rouge, LA 70821
Phone: 225-388-0128
Fax: 225-388-0164

Attn: Public Notices

Notice is hereby given that the Corps of Engineers- Galveston District has applied for a 401 Water Quality Certification to dredge waterbottoms and place spoil material for marine vessel access improvements, along Sabine Pass in southwestern Cameron Parish. The applicant is applying to the Louisiana Department of Environmental Quality, Office of Environmental Services for a Water Quality Certification in accordance with statutory authority contained in the LAC 33:IX.1507.A-E and provisions of Section 401 of the Clean Water Act.

Comments concerning this application can be filed with the Water Permits Section within ten days of this notice by referencing WQC 100330-01/AI 104985 to the following address:

Louisiana Department of Environmental Quality
Water Permits Division
P.O. Box 4313
Baton Rouge, LA 70821-4313
Attn: Water Quality Certifications
225-219-3003

A copy of the application is available for inspection and review at the LDEQ Public Records Center, on the first floor of the Galvez Building, Room 127 at 602 North Fifth, Street Baton Rouge, LA 70802 from 8:00 a.m. to 4:30 p.m.

PUBLIC NOTICE TO BE RUN IN

THE AMERICAN PRESS OF LAKE CHARLES
P.O. Box 2893
Lake Charles, LA 70602
Phone: 337-433-3000
Fax: 337-494-4008

Attn: Public Notices

Notice is hereby given that the Corps of Engineers- Galveston District has applied for a 401 Water Quality Certification to dredge waterbottoms and place spoil material for marine vessel access improvements, along Sabine Pass in southwestern Cameron Parish. The applicant is applying to the Louisiana Department of Environmental Quality, Office of Environmental Services for a Water Quality Certification in accordance with statutory authority contained in the LAC 33:IX.1507.A-E and provisions of Section 401 of the Clean Water Act.

Comments concerning this application can be filed with the Water Permits Section within ten days of this notice by referencing WQC 100330-01/AI 104985 to the following address:

Louisiana Department of Environmental Quality
Water Permits Division
P.O. Box 4313
Baton Rouge, LA 70821-4313
Attn: Water Quality Certifications
225-219-3003

A copy of the application is available for inspection and review at the LDEQ Public Records Center, on the first floor of the Galvez Building, Room 127 at 602 North Fifth, Street Baton Rouge, LA 70802 from 8:00 a.m. to 4:30 p.m.

Mr. Jamie Phillippe
Louisiana Department of Environmental Quality
Water Permits Division
P.O. Box 4313
Baton Rouge, LA 70821-4313

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Public notices meeting the requirements of Louisiana Department of Environmental Quality (LDEQ) have been published in the these newspapers. |
| 2 | Information on the potential for contaminants in the dredged material is provided in FEIS Section 3.4 and Section 4.5. In consideration of LDEQ requirements, Sabine Pass sediment was compared to Louisiana's RECAP non-industrial Screening Standards. All detected analytes were below the lowest value for the respective standard. PBS&J also compared water and elutriate results to the Louisiana Water Quality Standards (WQS), and found no exceedances. |
| 3 | Information on adjacent landowners is provided in FEIS Section 5.5.4.2, page 5-28 and FR, Appendix 4, Section 21. |

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

Environmental Section

April 07, 2010

Mr. Jamie Phillippe
Louisiana Department of Environmental Quality
Water Permits Division
P.O. Box 4313
Baton Rouge, LA 70821-4313
Attn: Water Quality Certifications

Dear Mr. Phillippe:

Reference is made to your letter dated March 30, 2010 regarding Galveston District's request for §401 Water Quality Certification for the proposed Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). We offer the following information to assist in your continuing review.

- You requested proof of publication for public notices in THE ADVOCATE of Baton Rouge and THE AMERICAN PRESS of Lake Charles. Upon review, we found that Galveston District's original public notice publications had not included the Baton Rouge newspaper, and had not required that comments concerning water quality certification be sent directly to your agency. Therefore, we have initiated new notices in both newspapers utilizing the draft language you provided. The public notices were published in THE ADVOCATE of Baton Rouge on April 5, 2010, and in THE AMERICAN PRESS of Lake Charles on April 6, 2010. We have requested that both newspapers furnish your office proofs of publication, and the public notice directs that comments be sent directly to you.

- You requested assurance that any excavated material will be, to the best of our knowledge, free of contaminants and/or disposed of in an approved landfill. The SNWW CIP Draft Environmental Impact Statement (DEIS) Section 3.4 and Section 4.5 discuss sediment analyses conducted for the proposed project, and conclude that there are no causes for concern related to contaminants. We have compared the Sabine Pass sediment data presented in the DEIS with the Louisiana RECAP non-industrial Screening Standards. All detected analytes were below the lowest value for the respective standard. The DEIS compared water and elutriate results to the Louisiana water quality standards, and found no exceedances. This information will be added to the SNWW CIP §404(b)(1) evaluation, Section II.d (Contaminant Determinations).

- You requested a list of landowners adjacent to the project site in Louisiana - the Sabine Pass Channel and Placement Area 5 in Cameron Parish. The SNWW CIP DEIS Section 5.5.4.2 and Draft Feasibility Report, Appendix 4 (Real Estate Plan) provide adjacent landowner information.

In conclusion, we hope this additional information will be helpful in your review. We trust that we have provided sufficient information for you to provide §401 State Water Quality certification. However, we would be happy to meet with you to provide further information if needed. Please do not hesitate to contact Ms. Janelle Stokes at 409/766-3039 should you need further assistance.

Sincerely,

Carolyn Murphy

Carolyn Murphy
Chief, Environmental Section

# Coastal Coordination Council

P.O. Box 12873 ♦ Austin, Texas 78711-2873 ♦ (800) 998-4GLO ♦ FAX (512) 475-0680

**Chairman**

**Jerry Patterson**
Texas Land Commissioner

♦

**Members**

**Karen Hixon**
Parks & Wildlife Commission of Texas

**Jose Dodier**
Texas State Soil & Water Conservation Board

**Edward G. Vaughan**
Texas Water Development Board

**Ned Holmes**
Texas Transportation Commission

**Elizabeth Jones**
Railroad Commission of Texas

**H. S. Buddy Garcia**
Texas Commission on Environmental Quality

**Robert R. Stickney**
Sea Grant College Program

**Robert "Bob" Jones**
Coastal Resident Representative

**Jerry Mohn**
Coastal Business Representative

**George Deshotels**
Coastal Government Representative

**Bob McCan**
Agriculture Representative

♦

**Tammy Brooks**
Council Secretary

**Jesse Solis, Jr.**
Permit Service Center
Corpus Christi
1-866-894-3578

Permit Service Center
Galveston
1-866-894-7664

March 30, 2010

Ms. Carolyn Murphy
Chief, Environmental Section
Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553

**Re: Sabine - Neches Waterway Improvements Project**
**CMP # 10-0048-F2**

Dear Ms. Murphy,

As required by 31 T.A.C. § 506.28(b), the Coastal Coordination Council (Council) issues this consistency agreement for the Sabine - Neches Waterway Improvements Project (Project), a federal development project conducted by the US Army Corps of Engineers (USACE).

USACE established an interagency coordination team (ICT) for the Project pursuant to 31 T.A.C. § 506.28(b). Its duties included advising the USACE on the consistency of the Project and included among its voting members a minimum of three Council member agency representatives. A majority of the Council member agency representatives on the ICT found the Project to be consistent, to the maximum extent practicable, with the CMP goals and policies. USACE adopted the ICT consensus position on consistency and submitted it to the Council as its consistency determination for the Project. None of the Council member agency representatives on the ICT objected to USACE's consistency determination in writing within 15 days after the close of the public comment period.

Therefore, the Council accepts and adopts the consistency determination for the Project as submitted by the USACE in accordance with 31 Texas Administrative Code § 506.28(b). 1

Sincerely,

Tammy S. Brooks
Consistency Review Coordinator
Texas General Land Office

Ms. Tammy Brooks
Coastal Coordination Council Secretary
Consistency Review Coordinator
Texas General Land Office
P.O. Box 12873
Austin, TX 78711-2873

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The FEIS has been revised to note that the TX CCC accepts and adopts the consistency determination for the proposed SNWW CIP as submitted by USACE in accordance with 31 Texas Administrative Code § 506.28(b). |

BOBBY JINDAL
GOVERNOR

SCOTT A. ANGELLE
SECRETARY

# State of Louisiana

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF COASTAL RESTORATION AND MANAGEMENT

March 12, 2010

Dolan Dunn
Chief, Planning, Environmental & Regulatory Division
Dept. of the Army
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, TX 77563-1229

**RE: Draft Feasibility Report and Draft EIS for the Sabine – Neches Waterway Improvements Project, Southeast Texas and Southwest Louisiana**

Dear Mr. Dunn:

The Louisiana Department of Natural Resources, Office of Coastal Management (LDNR OCM), has reviewed the above-referenced Draft Feasibility Report and Draft EIS for the Sabine – Neches Waterway Improvements Project, and we offer the following comments. The Consistency Determination submitted by your agency for the proposed activity continues to be under review by this Office; the issues noted below will have to be resolved prior to the construction phase, in order for OCM to concur that the final design is consistent, to the maximum extent practicable, with the Louisiana Coastal Resources Program in accordance with Section 307(c) of the Coastal Zone Management Act of 1972, as amended.

In addition, the Louisiana Office of Coastal Protection and Restoration (OCPR) has commented to LDNR that there are significant uncertainties about the compliance of the Draft Report's Tentatively Recommended Plan (TRP) with the attached "Louisiana's Integrated Ecosystem Restoration and Hurricane Protection: Comprehensive Master Plan for a Sustainable Coast" (Master Plan). Since conformance with the Master Plan is an enforceable policy of the State of Louisiana's coastal management program, it is essential that these uncertainties are addressed so that Master Plan compliance can be more accurately determined prior to final project design.

Storm Surge:

- Effects of the deeper shipping channel, Gulf Intracoastal Waterway (GIWW) deepening, and borrow area excavation in Sabine Lake may be significant and have not been modeled thoroughly enough to identify all potential impacts.
- Upland confined disposal sites on the Texas side of the project may create a barrier to storm surge, redirecting water to Louisiana that under present circumstances goes to Texas. Though

OCM acknowledges that the areas which are threatened by this potential inundation are not heavily populated, storm surge does adversely affect coastal resources.
- Offshore disposal sites from the bar channel dredging may alter storm currents, potentially increasing set-up and erosion on Louisiana shores.

Bar Channel deepening:
- Modeling of potential impacts on wave climate and resulting shoreline impacts was not performed. There is no objective means of estimating potential impacts to the Gulf shoreline due to the bar channel deepening.

Salinity:
- Modeling of potential salinity changes used questionable assumptions and boundary conditions, and data collected over a short and non-representative time period, casting doubt on the reliability of the model results.

Borrow Site in Sabine Lake:
- Specific site locations must be identified.
- Flotation access channel route must be identified.
- Disposal plans for material removed from the access channel route must be described.
- Disposal plans for access channel material and overburden, if any, from borrow site(s) must be described.
- Mitigation must be accomplished for submerged aquatic vegetation and oyster seed ground impacts to the satisfaction of LDWF.
- Effects of excavation on wave and tidal climate and potential shoreline erosion must be more thoroughly modeled and evaluated.
- Geotechnical information on borrow quality should be collected and evaluated.
- Royalty payments and license issues over sediment resources must be resolved with LDWF.

Borrow Site in Gulf Intracoastal Waterway:
- Geotechnical data must be collected and analyzed for sediment suitability.
- Geotechnical data must be collected and analyzed for slope stability.
- Shoreline stabilization plans must be proposed.
- The location and configuration of the channel bottom to be left undisturbed to prevent salt water intrusion must be fully described. Analysis of its response to routine scour as well as storm surge, over the project life, must be presented.

Mitigation:
- In general, the details of proposed mitigation are insufficient to determine whether all potential losses to the coastal resources of Louisiana will be adequately compensated.
- Disposal site final locations and design are not identified.
- Geotechnical data for disposal site design must be collected and evaluated.
- Mitigation project lifetime maintenance and repair must be addressed. Can the Local Sponsor do such work in Louisiana?
- Average Annual Habitat Units (AAHUs) generated by proposed mitigation fall at least 318 AAHUs short of replacing the anticipated habitat losses to Louisiana. Additional mitigation will need to be performed in Louisiana to offset this deficit.
- 210 AAHUs are claimed to be created by the shoreline deposition of bar channel maintenance material onto the Gulf shoreline east of the Sabine jetties. The material has only 18% sand; it

is unlikely that such fine grained material will remain in place for the project life and the DEIS notes that the effects of large storm systems were not included in the consideration. Even with periodic maintenance, the ability of such a deposit to provide 210 AAHUs is questionable. Additional mitigation in Louisiana will be required to make up for those AAHUs unless an acceptable technical justification of the projected benefits is provided.

Pipelines:

* Plats showing all pipelines affected by the deepening of the navigation channel, GIWW, flotation access channel and borrow site must be provided. The Galveston District must also provide a plan for the re-location of any pipelines that might be required as a result of the recommended plan and each of the alternatives.
* Any potential impacts to Louisiana industries as a result of pipeline re-locations or other construction and/or maintenance related activities must be fully evaluated, and minimized and/or mitigated.

As ever, the Office of Coastal Management appreciates the opportunity to comment on this proposed project, and we look forward to working with your staff to resolve these many issues. If you have any questions please call me at (225) 342-5052.

Sincerely yours,

Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division

GJD/JDH/bgm

ATTACHMENT

cc: David Frugé, OCPR
Ismail Merhi, OCPR
Keith Lovell, OCM
Rick Hartman, NMFS
Myles Hebert, Cameron Parish
Rickey Broulliet, OCPR
Kyle Balkum, LDWF
Dave Butler, LDWF
Darryl Clark, USFWS

ATTACHMENT

**Office of Coastal Protection and Restoration Master Plan Consistency Comments on Tentatively Recommended Plan for Sabine-Neches Waterway Channel Improvement Project**

**March 11, 2010**

The U.S. Army Corps of Engineers' (USACE) Galveston District is conducting a feasibility study of the Sabine-Neches Waterway Channel Improvement Project in Southeast Texas and Southwest Louisiana. Louisiana Office of Coastal Protection and Restoration (OCRP) staff reviewed the December 2009 Draft Environmental Impact Statement (EIS) and Draft Feasibility Report (Draft Report), and had telephone conversations with USACE Galveston District personnel about aspects of those documents. That review indicates there are still significant issues and uncertainties relative to the consistency of the Draft Report's Tentatively Recommended Plan (TRP) with "Louisiana's Integrated Ecosystem Restoration and Hurricane Protection: Comprehensive Master Plan for a Sustainable Coast" (Master Plan). While we are not stating at this time that the TRP is inconsistent with the Master Plan, it is essential that these issues and uncertainties be sufficiently addressed prior to final project design so Master Plan consistency can be more accurately determined.

The following comments identify key uncertainties and deficiencies and offer recommendations for addressing them prior to a final consistency determination to be provided by the USACE to the Louisiana Department of Natural Resources pursuant to the Coastal Zone Management Act. These comments are grouped by relevant components of the Master Plan.

**Master Plan Objective #1**

**Reduce economic losses from storm based flooding to residential, public, industrial, and commercial infrastructure, assuring that assets are protected, at a minimum, from a storm surge that has a 1% chance of occurring in any given year.**

OCPR technical staff has serious concerns about the adequacy of the modeling of storm surge impacts on the Louisiana portion of the study area. The current standard for storm surge impacts to still water elevation and waves during tropical storm events uses "coupled" ADCIRC/STWAVE modeling. To date, such evaluations have not been performed for the TRP. Such modeling should include the project's "annual" impacts not only occurring under the "normal" tidal conditions, but also considering statistically based evaluations using appropriate sets of storms to establish the project's impacts for multiple return interval conditions so that the total damages/impacts/benefits are established (integrated over the full realm of return intervals). Verbal communications with USACE personnel suggest that three storms (with two scenarios) will be modeled. OCPR staff does not believe that the number of storms currently planned for

modeling is sufficient to adequately assess impacts. Thus, formal assurances by the USACE are needed, indicating that sufficient modeling of project-related storm surge and wave impacts will be performed prior to completion of final design, and that the results and methodology will be provided to the State of Louisiana for further review.

The USACE modeling has not demonstrated that spoil placement and consequent increased elevation of upland confined disposal sites on the Texas side will not deflect storm surge to the Louisiana side. Such modeling is needed to determine whether project-induced changes to storm surge and wave conditions could cause economic damages to Louisiana infrastructure. Offshore disposal sites created from dredging the bar channel may create partial barriers to storm currents, potentially increasing set-up on Louisiana shores under "normal" annual conditions and under larger tropical storm events.

**Master Plan Objective #3**

**Provide habitats suitable to support an array of commercial and recreational activities coast-wide.**

Adverse habitat impacts are to be offset via restoration of 2,783 acres of marsh, nourishment of 4,355 acres of existing marsh, and improvement of 957 acres of shallow water habitat. However, we are concerned that, under the TRP, adverse impacts to coastal wetlands in Louisiana will not be fully mitigated within Louisiana. The TRP assigns 318 Average Annual Habitat Units (AAHUs) of "excess benefits", resulting from the beneficial use of dredged material in Texas, to Louisiana in order to mitigate impacts to wetlands on the federally owned Sabine National Wildlife Refuge, located in Louisiana. From a Master Plan consistency standpoint, we believe that it is inappropriate to apply "excess benefits" in that manner; those impacts will still occur within Louisiana's boundaries, so the mitigation should occur within those boundaries.

OCPR technical staff also has concerns about the amount of mitigation projected to result from beneficial use of dredged material along the Gulf shoreline near Louisiana Point. Since the involved materials are predominantly clays and silts (less than 20% sand), OCPR technical staff are not convinced this project feature will achieve a net benefit of 210 AAHUs. A full explanation of the calculation of these benefits should be presented, as additional mitigation in Louisiana will be required if those projections cannot be adequately justified.

Elevation surveys and geotechnical information/analysis/design will be required to determine if the borrow quantities and fill areas are adequately designed to help ensure the success of the mitigation plan in fully compensating for project impacts.

Given the above issues and uncertainties, the USACE should provide written assurance that the final mitigation project plans and designs will fully offset project impacts to Louisiana's coastal wetlands (including impacts to federal lands within Louisiana); that assurance should provide for review and concurrence by the State of Louisiana.

The Ecological Model assumes that the marshes in western Cameron Parish will recover to existing conditions following a storm event; based on observations following Hurricane Rita, OCPR technical staff do not believe that assumption is correct.

OCPR has concerns that project's alteration of seafloor, lake and channel topography may result in significant adverse effects on additional marshes in Louisiana if storm surge into those marshes is increased by the project's enlarged channel dimensions.

The Ecological Model states that drainage in the Chenier Plain marshes (under normal conditions) is ". . . impaired by numerous hydrologic modifications such as the GIWW [and] the SNWW." These marshes are primarily brackish and intermediate types. OCPR technical staff has concerns that removal of borrow material for marsh creation from the GIWW channel bottom, as well as some of the borrow excavation within Sabine Lake, will introduce greater levels of salinity into these marshes during normal tidal conditions, possibly resulting in marsh vegetation die-offs and conversion of marsh to open water.

Changes to the tides, storm surge and wave conditions associated with the project could potentially increase shoreline erosion rates, and increase storm surge and salinity-induced changes to surrounding marshes.

Of the 16 total hydrologic monitoring sites, 7 were located in Louisiana. Of those 7 sites, 3 sites (#7, # 9, and #12) experienced equipment malfunctions resulting in 1.5 to 8 months of lost data, thus limiting comparison of the data to other sites.

The salinity model report concludes that the project would result in only a 0 to 2 parts per thousand (ppt) salinity change impact. However, OCPR technical staff has several concerns regarding use of the modeling results referenced in the December 2009 Draft Report to reach conclusions on project impacts and related habitat mitigation needs for the TRP. USACE Galveston District personnel have indicated that there is no plan to perform additional modeling work. Key OCPR concerns include:

1. No access to data reports on which some of the initial and boundary conditions were based.
2. Data collection involved very short periods to judge the effectiveness of model calibration and verification.
3. Modeling used little salinity information outside the channels to perform the calibration and verification.
4. The model generally performed poorly in salinity predictions as compared to salinity measurements in the channels and lakes. In some cases, differences between predicted and measured salinity ranged from 5 to 15 ppt. Attempts were made to reconcile the differences by "introducing salinity" into the modeling effort.

5. The model domain ignored the boundary/interaction between the Calcasieu and Sabine basins.
6. It appears that most of the marsh in Louisiana was not modeled and only limited areas were considered in an ad hoc way (ignoring over-marsh flows); this approach will not capture project impacts on the marsh for larger tropical storm and hurricane salinity impacts.
7. The project will deepen the channel to 48 feet, not including 2 more feet of advanced maintenance and another 2 feet of allowable over-depth. Thus, during larger tidal and tropical storm events the channel could be 52 feet deep rather than 48 feet. Louisiana's marshes are susceptible to damages from salinity increases during larger tropical storms, so it is very likely that this modeling approach will underestimate damages to the marshes resulting from the channel deepening. The modeling effort also ignores the potential impacts associated with major hurricane (Ike/Gustav) years. Complicating the evaluation is the use of future relative sea level rise conditions that tend to "muddy the waters" regarding the estimated project impacts.
8. Pool 3 in Sabine National Wildlife Refuge was not included in the study (p. 4-26) because it has historically been a freshwater impoundment, hydrologically isolated from the surrounding marsh. The containment levees were breached in 2005 as a result of Hurricane Rita. Therefore, this area should be considered in the model since it will be impacted by the project. Because of extensive landscape alterations resulting from Hurricanes Rita and Ike (land loss, vegetation stress and instability of the soils), the conditions in the model may not apply.
9. The modelers were apparently not aware of the existence of Louisiana's Coast Wide Reference Monitoring System. OCPR has 15 CRMS sites in the impacted area. It would be prudent to review the available data to assess the reasonableness of model baseline assumptions compared to the 2007 non-storm and 2008 storm (Ike/Gustav) years.

We recommend that the USACE provide a written commitment to rectify the above deficiencies in their Dec. 2009 salinity modeling not later than the engineering and design phase of the project, and to include language in the final feasibility study report indicating that additional adverse salinity impacts to wetlands anticipated as a result of that additional salinity modeling will be fully mitigated at project cost.

**Master Plan Recommendations**

**The Master Plan recommends stabilizing key areas along the Chenier Plain's bay and lake shorelines that, if breached, would have catastrophic results for the landscape.**

It is not clear that the USACE has evaluated the potential effects of excavating marsh creation material at the proposed borrow sites on shoreline erosion and bank stability. The results of those evaluations should be provided, and included in the impacts and mitigation analyses. The borrow source(s) may need to be moved to eliminate such impacts, depending on the results.

**The Master Plan seeks to maintain the integrity of freshwater resources by fortifying and maintaining spoil banks along the GIWW and placing saltwater barriers at deep draft shipping channels to manage salinity levels**

Potential effects of excavating the GIWW borrow source, such as on shoreline erosion and slope stability, should be evaluated and included in the impacts and mitigation analyses. The recommended project plan should include installing shoreline stabilization measures along the GIWW borrow site, or avoiding use of that site, if those evaluations disclose such a need. The recommended project plan should also ensure the continued function of the salinity plug at the western boundary of the GIWW segment to be used as a borrow site.

BOBBY JINDAL
GOVERNOR

SCOTT A. ANGELLE
SECRETARY

# State of Louisiana

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF COASTAL RESTORATION AND MANAGEMENT

March 31, 2010

Dolan Dunn
Chief, Planning, Environmental and Regulatory Division
Dept. of the Army
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, TX 77563-1229

RE: **C20090667**, Coastal Zone Consistency
Galveston District, Corps of Engineers
Direct Federal Action
Feasibility Study and Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, **Cameron Parish, Louisiana**

Dear Mr. Dunn:

The above referenced project has been reviewed for consistency with the approved Louisiana Coastal Resource Program (LCRP) as required by Section 307 of the Coastal Zone Management Act of 1972, as amended. This office finds that the project, as proposed in the application, is conditionally consistent with the LCRP.

Pursuant to NOAA regulations on federal consistency at 15 CFR 930.4(a)(1), a conditional consistency concurrence must include the conditions which must be satisfied; an explanation of why the conditions are necessary to ensure consistency with specific enforceable policies of the management program, and an identification of the specific enforceable policies.

**Explanation of necessity:**

The Louisiana Department of Natural Resources (LDNR) Office of Coastal Management (OCM) has concluded, based on staff review and comments from the Louisiana Office of Coastal Protection and Restoration, the Louisiana Department of Wildlife and Fisheries, and other agencies, that the Draft Feasibility Study and Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement project is generally consistent with the LCRP provided that the conditions described herein are met. As outlined in our comment letter of March 12, 2010, the project as described lacks many significant details as to design features and locations, potential impacts, and the means by which these impacts will be avoided, reduced, minimized, and compensated for. This would include, but not be limited to, the topics of storm surge, bar channel deepening, salinity, borrow from Sabine Lake, mitigation plans and adequacy, and pipeline relocation. Further, the

adequacy of completed and planned modeling of potential salinity changes, storm surge, and other impacts is of significant concern, and must be conducted in a way in which this State can have full confidence in the analytical results. Please note in particular that your response letter, dated March 19, 2010, does not constitute an adequate resolution to the issues described.

**Conditions:**

In order to be consistent, to the maximum extent practicable with the LCRP, the Corps of Engineers-Galveston District must prepare an additional consistency determination, which will be submitted to LDNR pursuant to 15 CFR 930 Subpart C, when this project has reached a point in the planning or design process where all project elements can be described in detail, but modifications may still be made if necessary to achieve full consistency with the LCRP. This will be no later than the time at which the draft Contract Plans and Specifications are circulated for internal Corps review. This subsequent consistency determination will include the draft Plans and Specifications as well as detailed information sufficient for the evaluation of all proposed actions for consistency with the LCRP and the Master Plan. 1

**Enforceable policies:**

Louisiana's State and Local Coastal Resources Management Act (SLCRMA) and the Louisiana Administrative Code (LAC) address the requirements for information necessary for the review of consistency determinations in several places. Relevant enforceable policies may be found in Coastal Use Guidelines in the Louisiana Administrative Code Title 43, Part I:

**§701 F** Information regarding the following general factors shall be utilized by the permitting authority in evaluating whether the proposed use is in compliance with the guidelines:

1. type, nature, and location of use;
2. elevation, soil, and water conditions and flood and storm hazard characteristics of site;
3. techniques and materials used in construction, operation, and maintenance of use;
4. existing drainage patterns and water regimes of surrounding area including flow, circulation, quality, quantity, and salinity; and impacts on them;
5. availability of feasible alternative sites or methods of implementing the use;
6. designation of the area for certain uses as part of a local program;
7. economic need for use and extent of impacts of use on economy of locality;
8. extent of resulting public and private benefits;
9. extent of coastal water dependency of the use;
10. existence of necessary infrastructure to support the use and public costs resulting from use;
11. extent of impacts on existing and traditional uses of the area and on future uses for which the area is suited;
12. proximity to and extent of impacts on important natural features such as beaches, barrier islands, tidal passes, wildlife and aquatic habitats, and forest lands;

13. the extent to which regional, state, and national interests are served including the national interest in resources and the siting of facilities in the coastal zone as identified in the coastal resources program;

14. proximity to, and extent of impacts on, special areas, particular areas, or other areas of particular concern of the state program or local programs;

15. likelihood of, and extent of impacts of, resulting secondary impacts and cumulative impacts;

16. proximity to and extent of impacts on public lands or works, or historic, recreational, or cultural resources;

17. extent of impacts on navigation, fishing, public access, and recreational opportunities;

18. extent of compatibility with natural and cultural setting;

19. extent of long term benefits or adverse impacts.

G. It is the policy of the coastal resources program to avoid the following adverse impacts. To this end, all uses and activities shall be planned, sited, designed, constructed, operated, and maintained to avoid to the maximum extent practicable significant:

2. adverse economic impacts on the locality of the use and affected governmental bodies;

4. alterations in the natural concentration of oxygen in coastal waters;

5. destruction or adverse alterations of streams, wetland, tidal passes, inshore waters and waterbottoms, beaches, dunes, barrier islands, and other natural biologically valuable areas or protective coastal features;

7. alterations of the natural temperature regime of coastal waters;

8. detrimental changes in existing salinity regimes;

10. adverse effects of cumulative impacts;

11. detrimental discharges of suspended solids into coastal waters, including turbidity resulting from dredging;

15. fostering of detrimental secondary impacts in undisturbed or biologically highly productive wetland areas;

16. adverse alteration or destruction of unique or valuable habitats, critical habitat for endangered species, important wildlife or fishery breeding or nursery areas, designated wildlife management or sanctuary areas, or forestlands;

17. adverse alteration or destruction of public parks, shoreline access points, public works, designated recreation areas, scenic rivers, or other areas of public use and concern;

18. adverse disruptions of coastal wildlife and fishery migratory patterns;

19. land loss, erosion, and subsidence;

20. increases in the potential for flood, hurricane and other storm damage, or increases in the likelihood that damage will occur from such hazards;

21. reduction in the long term biological productivity of the coastal ecosystem.

NOAA Regulations at 15 CFR 930.4(a)(2) state that the Federal agency shall modify its project proposal pursuant to the State agency's conditions. The Federal agency shall immediately notify the State agency if the State agency's conditions are not acceptable. Section 930.4(b) states that, if the requirements of §930.4(a)(1) through (3) are not met, all parties shall treat the State agency's conditional concurrence as an objection pursuant to §930 Subpart C.

Finally, pursuant to §930.63(e), your agency has the opportunity to appeal this conditional concurrence/objection to the Secretary of Commerce within 30 days after receipt of this conditional concurrence/objection.

OCM appreciates the opportunities provided by the Galveston District to review this important project. OCM is fully aware of the importance of navigation to this state and the nation and is committed to working together to enable the project to be completed in a manner which does not adversely affect the coastal resources of the state. We anticipate that our participation in future work by the Interagency Coordination Team (ICT) will identify those specific issues which will require detailed assessment by the Corps prior to our final review for consistency with the LCRP.

If you should have any questions on this matter, please contact me at (225) 342-5052.

Sincerely yours,

Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division

GJD/JDH/bgm

cc: David Frugé, OCPR
Kyle Balkum, LDWF
Dave Butler, LDWF
Darryl Clark, USFWS
Janelle Stokes, COE, Galveston
Rickey Brouillette, OCPR
Keith Lovell, OCM
Rick Hartman, NMFS
Myles Hebert, Cameron Parish

Mr. Gregory J. DuCote
Administrator, Interagency Affairs/Field Services Division
State of Louisiana
Department of Natural Resources
Office of Coastal Management
617 North Third Street, 10th Floor, Suite 1078
Baton Rouge, LA 70804-4487

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | USACE does not consider the condition to be acceptable. USACE has concluded that the proposed SNWW CIP is fully consistent to the maximum extent practicable with the enforceable policies of the Louisiana Coastal Resource Program, though LDNR-OCM objects. This agency has gone to great lengths to demonstrate that we have fulfilled these requirements as demonstrated by nearly ten years of coordination with LDNR and LDWF through the SNWW ICT, and extensive studies and modeling described in our letter of March 19, 2010. |

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

March 19, 2010

Environmental Section

Mr. Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division
Louisiana Department of Natural Resources
Office of Coastal Management
P.O. Box 44487
Baton Rouge, Louisiana 70804-4487

Dear Mr. DuCote,

Reference is made to your letters dated February 5, 2010 and March 12, 2010 regarding the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) Draft Feasibility Study and Draft Environmental Impact Statement (DEIS), issued for public and agency review on December 24, 2009. In response to several requests, Galveston District (District) extended the public comment period to March 12, 2010. An Interagency Coordination Team (ICT) comprised of Federal and State resource agency representatives from Texas and Louisiana has assisted Galveston District in modeling and analyzing environmental impacts, and selecting beneficial use (BU) and mitigation measures for the Tentatively Recommended Plan. The Department of Natural Resources (LDNR) has had a representative on the ICT since its inception in 2000 through the last ICT meeting on August 27, 2009. The District has consulted with LDNR (as a member of the ICT) concerning most of the technical issues raised in these letters, and many issues originally approved by LDNR as a member of the ICT are now being reopened. Nevertheless, we would like to work with you in resolving the concerns of the Louisiana Department of Natural Resources, Office of Coastal Management (LDNR-OCM) and the LDNR Office of Coastal Protection and Restoration (OCPR) and offer the following point-by-point response to issues discussed in both letters.

**Storm Surge**
LDNR asserts that the effects of the deeper shipping channel and the borrow of material from the Gulf Intracoastal Waterway (GIWW) and Sabine Lake may be significant and have not been modeled thoroughly enough to identify all potential impacts. The Coastal Hydraulic Laboratory at the Corps of Engineer's Engineering Research and Development Center (ERDC-CHL) was consulted about the need to model the salinity effect of borrowing material from the GIWW and Sabine Lake relative to salinity impacts. Neither feature was expected to increase salinity impacts and so they were not included in the hydrodynamic salinity (HS) modeling.

ERDC was also consulted on the potential for offshore dredged material disposal sites (ODMDS) to increase wave set-up and erosion on Louisiana shores. In a teleconference on February 5, 2010, ERDC explained to LDNR personnel that the ODMDS sites are located too far from shore and in water too deep to affect the Louisiana shore. Waves of any consequence

present within a few hundred meters of the shoreline are generally depth limited because of the mild nearshore slope and the presence of a soft mud (Pacific International Engineering, 2003, Coastal geomorphology of a non-barrier Gulf of Mexico beach: Analysis for protection of Highway 87 and McFaddin NWR in Jefferson County, Texas). The closest ODMDS (#4) is located between 3.8 and 6 miles from Louisiana in 34-43 ft of water. It is used by the existing project for maintenance dredging of the Sabine Pass Jetty Channel. MDFATE modeling (DEIS Appendix B) has shown that it will accommodate new work and maintenance material from the proposed project with mounding to a maximum of 5 to 7.5 feet at the time of placement. Previous monitoring of this ODMDS and studies of bottom ocean currents in the region have determined that the material would disperse between placement cycles and not accumulate. Therefore the height of material placed in this (and all other) SNWW ODMDS would not affect wave set-up or erosion. Further modeling is not warranted.

ERDC has just completed a sensitivity analysis of potential storm surge impacts from the deeper shipping channel and placement areas (Wamsley, Cialone and McAlpin, 2010, Surge Sensitivity Analysis for Sabine Neches Water Navigation Project, ERDC-CHL). The results of this analysis were also presented to LDNR in the March 3, 2010, teleconference. The analysis clearly and unequivocally identifies no impact to Louisiana from the deflection of storm surges by the higher PA levees or from the deeper navigation channel. Therefore, further modeling to identify impacts is not necessary.

**Bar Channel Deepening.**

LDNR's assertion that modeling of potential impacts on wave climate was not performed is incorrect. Modeling has been performed by ERDC-CHL as reported by Gravens and King (2003, Shoreline impacts study for Sabine-Neches Project) and this fact was communicated to LDNR in the 2/5/2010 teleconference; a link to the report was emailed to them that same day. The report has been presented on SWG's SNWW webpage since 2003, and it is reported in the DEIS in Section 4.6.2.2. Furthermore, the ERDC modeling report was reviewed and approved by ICT (which included LDNR). The Gravens and King (2003) modeling report addressed the changes in the wave climate that would be produced by a deeper and longer offshore channel, including the Outer Bar Channel, to which we assume the comment relates. In the first two miles east of Sabine Pass, the net eastward transport would be slightly reduced (by a maximum of about 1400 $yds^3/yr$), and further east there would be essentially no change. For a 50 ft project, between a half mile and 3-4 miles of the east jetty, the accretion would decrease by less than 0.5 ft/yr, and further from the jetties than that, the change in the shoreline change would decrease to zero. This small impact would be more than offset by the proposed Gulf Shore beneficial use (BU) feature's regular shoreline nourishment at Louisiana Point.

**Salinity**

LDNR asserts that the SNWW salinity modeling used questionable assumptions and boundary conditions, and data collected over a short and non-representative time period. Boundary conditions and assumptions were developed by ERDC and coordinated with the ICT in numerous meetings of the ICT and its modeling workgroup from 2000-2004, and the revised HS

modeling presented at the last ICT meeting on August, 27, 2009. While LDNR participated in most of the Modeling Workgroup Meetings, and all prior ICT meetings, no representatives from LDNR attended the last ICT meeting. The ICT presented no objections to the revised modeling at this meeting. The HS modeling (both original and revised) has been subjected to extensive agency technical review (ATR) and Independent External Peer Review (IEPR). ATR identified no significant concerns. The primary IEPR concern related to the need to include the effects of relative sea level rise. This was added in the revised HS Model analysis (Brown and Stokes, 2009, Numerical Model Study of Potential Salinity Impacts Due to Proposed Navigation Improvements to the Sabine-Neches Waterway, Texas, ERDC-CHL).

**Borrow Site in Sabine Lake**

LDNR lists several types of information that are needed prior to construction. In our February 5, 2010 teleconference, the District stated that we would work with the ICT (which includes LDNR and the Louisiana Department of Wildlife and Fisheries [LDWF]) to obtain all of the information (i.e. geotechnical information on borrow quality, analysis of potential access channels and disposal plans) needed to develop detailed engineering plans during preconstruction, engineering and design (PED). The need for wave climate modeling to support design considerations would be determined at that time. Designs would minimize impacts to the greatest extent possible. The DEIS (Section 5.5.1) fully evaluated potential impacts of the access channels and borrow area and determined that impacts would be minimal and temporary.

LDNR states that mitigation of oyster seed ground impacts must be accomplished to the satisfaction of LDWF. DEIS Section 5.5.1 evaluates the potential impacts by the proposed access route/borrow area. The dedicated dredging would take approximately 3.1 million cubic yards of material from a 1.8-mile-long borrow trench in Sabine Lake. An access channel, approximately 8 miles long, from the GIWW near the mouth of the Sabine River would be needed for the dredge to reach the proposed borrow area. The exact locations of the borrow trench and access channel would be determined in consultation with the ICT after PED bottom surveys of potential locations. The proposed route of the access channel was chosen to keep dredging impacts to a minimum; it takes advantage of deeper water in the center of the lake, thereby minimizing dredging and bottom impacts.

Benthic fauna would be removed when the borrow sediment is excavated; however, benthic organisms can rapidly recolonize and no long-term effects are anticipated. Due to low salinity (1 to 6 parts per thousand [ppt]) in this area of Sabine Lake, live oyster reefs are not likely (Fagerberg, 2003, Field Data Collection Summary Report for the Sabine-Neches Waterway Study, ERDC). A study by T. Baker Smith, Inc. (2006, Oyster Assessment for Proposed Locations, Flow Lines and Facilities to Serve the Ballard Well SL 17131 No. 1 and the MF 102080 Well No. 1, Sabine Lake, Cameron Parish, Louisiana, and Jefferson County, Texas) found no live oyster reefs in this area. Submerged aquatic vegetation (SAV) is not likely to be found in this area due to low salinities and shallow, turbulent water. Nevertheless, as stated in DEIS Section ES.5 and Section 5.5.1 and in our letter dated March 4, 2010 to LDWF, we propose that a water bottom survey of the borrow and access channel areas be conducted after

approval of the Chief of Engineer's report, during the PED phase of the project. In the unlikely event that oyster reef is encountered, plans will be revised to avoid impacts.

LDNR states that mitigation of SAV impacts must be accomplished to the LDWF. In our letter dated March 4, 2010 to LDWF, the District agreed to reevaluate SAV impacts if additional information on potential SAV impacts is provided. To date, no additional information has been provided by LDWF or any other agency. DEIS Appendix C, Section 4.2 describes the Wetland Value Assessment (WVA) modeling of the model variable "Percent Submerged Aquatic Vegetation." The WVA model documentation described in DEIS Appendix C, Section 2.6.1.2, defines SAV as any of the diverse array of floating-leaved and submerged aquatic plants that are typically found in a study area. SAV coverage is included as a model variable because it provides important food and cover to a wide variety of fish and wildlife. The model evaluates the percentage of open water that is dominated by SAV, without consideration as to whether it is native or invasive. The WVA modeling utilized an inventory of SAV species in the study area that was prepared by the District using recent monitoring reports and other available scientific literature. Potential project impacts would be related to the increase in salinity that would occur with deepening of the SNWW navigation channel. As described in DEIS Section 4.2.1, one native and one invasive SAV species out of 10 species present in LA 1 would be affected by the predicted salinity change. It is expected that any SAV cover lost due to the gradual salinity change would be replaced by salinity tolerant SAV species continuing to grow within their tolerance ranges. As a result, no actual impact to percent SAV cover would be expected. The best available scientific information was used to establish salinity ranges for the evaluation; differences in scientific opinion regarding these ranges are readily apparent in the literature. As no new information has yet been provided, we see no reason to revise the WVA modeling at this time.

LDNR asserts that royalty payments and license issues over sediment resources must be resolved with LDWF before the OCM can concur that the final design is consistent, to the maximum extent practicable, with Louisiana Coastal Resources Program. The District maintains that the United States is not bound by Louisiana statute (R.S. 56:2011) pursuant to the Supremacy Clause of the United States Constitution, and that Louisiana is not entitled to compensation under the Fifth Amendment, pursuant to the doctrine of Navigation Servitude. This servitude gives the Federal Government the right to use the "Navigable Waters" of the United States without compensation for navigation projects. The applicability of the Navigation Servitude has been interpreted broadly to include not only traditional navigation projects, such as locks and dams, but also to apply when actions are in furtherance of aesthetic, ecological, environmental, economic or commercial public interests in navigable waterways, United States v. 967.905 Acres in Cook County, 447 F. 2d 764, 771 (8th Cir. Min., 1971). The landmark decision United Transmission Co. v. U.S. Army Corps of Engineers, 772 F. Supp 952 (E.D. Tex., Jul 11, 1991), 7 F. 3d 436 (5th Cir. Tex., Nov 18, 1993, 512 U.S. 1235 (U.S. Jun 27, 1994) Cert. Denied, upheld the Corps' authority to exercise the Navigation Servitude and its "§10 permit authority," as codified in §10 of the Rivers and Harbors Act, 33 U.S.C. §401 et seq., to effect the removal of obstructions to navigation, even though the Federal project was authorized, not for navigation, but for flood control.

Additionally, the State of Louisiana has no compensable interest under the Fifth Amendment, because its interests are subservient to the dominant Navigation Servitude. This is illustrated in a recent case before the United States Court of Appeals, Federal Circuit (July 31, 2009), Northwest Louisiana Fish & Game Preserve Commission v. United States 2009 WL 2341986 (C.A.Fed.) In this case, the State of Louisiana alleged that the U.S. Army Corps of Engineer's construction and operation of the Red River Navigation Project caused a severe hydrilla and coontail infestation in Black/Clear Lake, making some parts of the Lake useless for recreation. The Court held that "the Government's navigational servitude is derived from the principle that all navigable waters in the United States are considered public property, Owen v. United States, 851 F.2d 1404, 1408 (Fed Cir. 1998) (en banc). This court has acknowledged the extraordinary priority given to navigable waters, noting that they are under the 'exclusive control of the federal government.' Id. . . . The dominant servitude defines the limits within which Congress can work to improve navigation without creating an obligation to pay just compensation under the Fifth Amendment." Owen, 851 F.2d at 1408. The Court concluded that "because the Commission's interest is subservient to the Government's dominant servitude, it is not compensable under the Fifth Amendment, 2009 WL 2341986 (C.A.Fed.), p. 5. For the SNWW CIP, an evaluation of the connection between the removal of fill material for the Willow Bayou marsh mitigation areas and the navigation purpose of the underlying project is simple. But for construction of the proposed project, the environmental mitigation and BU marsh restoration would not be necessary.

**Borrow Site in GIWW**

LDNR lists several types of information that are needed prior to construction. In our February 5, 2010 teleconference, the District stated that we would work with ICT (which includes LDNR) to obtain all of the information (i.e. geotechnical information on sediment suitability and slope stability, and complete an analysis of the "salinity plug" in the GIWW at its intersection with the Sabine River) needed to develop detailed engineering plans. Designs would minimize impacts to the greatest extent possible; instability of emergent shorelines is not anticipated because dredging would remove accumulated maintenance material only, as described in DEIS (Section 5.5.2). In situ sediments beside and below the existing GIWW channel would not be disturbed. However, should analyses determine that stabilization of small areas is needed; the District would propose stabilization plans at that time.

**Mitigation**

LDNR asserts that details of the proposed mitigation are insufficient to determine whether all potential losses will be adequately compensated. The District disagrees – mitigation site locations have been finalized despite the LDNR assertion to the contrary and conceptual designs are sufficient to support ecological modeling of the compensatory mitigation. In our February 5, 2010 teleconference, the District stated that we would work with the ICT (which includes LDNR) to obtain all of the information needed to develop detailed engineering plans, including geotechnical data relevant to site design, during PED. LDNR was referred to DEIS Appendix J for a description of the mitigation monitoring and contingency plan, which describes the role and responsibilities of the non-Federal sponsor, the Sabine-Neches Navigation District (SNND).

LDNR asserts that the proposed mitigation plan falls "at least 318 Average Annual Habitat Units (AAHUs) short of replacing the anticipated habitat losses to Louisiana" and that additional mitigation will have to be performed in Louisiana to offset this deficit. The District maintains that the proposed mitigation plan would more than compensate for all impacts of the proposed SNWW CIP. Benefits of the BU measures are being used to offset impacts in both Texas and Louisiana. DEIS Table 5.1-2 provides a summary accounting of BU benefits and compensatory mitigation for the proposed project. In Louisiana, the benefits of BU measures offset the loss of 210 average annual habitat units (AAHUs) to private lands along the coast at Louisiana Point, and the loss of 340 AAHUs to Federal land in the Sabine National Wildlife Refuge. Although the net impact of the project as a whole after application of all BU benefits (including significant other BU benefits in Texas) is the loss of 843 AAHUs, the proposed mitigation plan would provide 1,181 AAHUs in order to fully and separately compensate for the loss of 1,499 AAHUs to non-Federal lands in Louisiana. Exclusion of the Federal lands (i.e. the Sabine National Wildlife Refuge) is based upon the definition of "coastal zone" in the Coastal Zone Management Act of 1972, as amended. "Excluded from the coastal zone are lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers or agents (16 U.S.C. § 1453)." Furthermore, the Louisiana marsh mitigation measures would compensate for the predicted loss of 691 acres in Louisiana over 50 years by the restoration of 2,783 acres of emergent marsh, the improvement of 957 acres of shallow water habitat and the nourishment of 4,355 acres of existing marsh. Since the marsh restoration is several times greater than the predicted marsh loss, there would be no net less of wetlands.

LDNR also questions the benefits of the Gulf Shore BU feature at Louisiana Point, and asserts that additional mitigation in Louisiana will be required unless acceptable technical justification of the projected benefits is provided. The benefits of the BU feature in Louisiana were established by WVA modeling accomplished by the ICT, of which LDWF and LNDR were a part. The technical justification presented in DEIS Appendix C, Section 8.3.1.2 and WVA modeling were reviewed and accepted by the ICT. The monitoring plan (DEIS Appendix J) would determine if benefits are being reached as predicted.

**Pipelines**

All pipelines in project construction areas would be identified during PED. Plans for pipeline relocations would also be developed at that time. Costs of pipeline relocations have been included in the economic analysis of potential project benefits. Direct and indirect economic benefits of the proposed deepening will accrue to all users of the SNWW, including the energy industries, and to the regional economy in Louisiana as established by an independent economic analysis (Martin Associates, 2006, Economic Impacts of the Sabine-Neches Waterway and Economic Benefits of Maintenance Dredging of the Waterway). The District's economic analysis presented in FR Section V.F establishes that there would be a net economic benefit to the country from the proposed project. Minimal impacts to Louisiana industries are anticipated because construction would work around pipeline relocations as needed to accommodate all parties for a safe, effective and minimally disruptive working plan.

**Attachment** "Office of Coastal Protection and Restoration Master Plan Consistency Comments on Tentatively Recommended Plan for Sabine-Neches Waterway Channel Improvement Project, March 11, 2010.

Many of the comments in this attachment repeat or expand on bulleted comments in the letter. Responses below address comments that were not already addressed by responses to LDNR-OCM comments above.

**Master Plan Objective #1**
LDNR states that OCPR technical staff have serious concerns about the adequacy of the storm surge modeling of potential impacts to the Louisiana portion of the study area. The storm surge sensitivity analysis of two "worst case" storms ((Wamsley, Cialone and McAlpin, 2010, Surge Sensitivity Analysis for Sabine Neches Water Navigation Project, ERDC-CHL) was provided to LDNR by email on March 2, 2010. The analysis clearly demonstrates that the proposed project would have no impacts in Louisiana, so there is no need to perform the full scale ADCIRC/STWAVE modeling requested by LDNR. This modeling would be needed to fully evaluate impacts, if impacts had been identified. Since none were identified using a worst-case analysis, further modeling is not justified. The sensitivity analysis clearly demonstrates that the proposed SNWW CIP would not contribute to economic losses in Louisiana from storm based flooding to residential, public, industrial and commercial infrastructure, and thus complies with Master Plan Objective # 1.

**Master Plan Objective #3**
The majority of the LDNR comments under this objective are covered by District responses to the OCM comments. However, the OCPR comment also contains a number of specific questions and assertions regarding the HS salinity modeling, demands for additional salinity modeling, and a demand that the feasibility study include language "indicating that additional adverse salinity impacts to wetlands anticipated as a result of that additional salinity modeling will be fully mitigated at project cost." The District maintains that the HS modeling (Brown and Stokes, 2009) is technically and scientifically sound and that salinity impacts have been adequately addressed by the DEIS. The District would be happy to arrange for ERDC-CHL to present and discuss details of the modeling effort with your staff at your convenience. The HS model has undergone several technical reviews (by the ICT, the US Army Corps of Engineers Center of Deep Draft Navigation, and an independent peer review by outside academics) and we are confident that it is a technically sound tool for the evaluation of project impacts. With the proper execution of the proposed mitigation plan and BU features, the proposed SNWW CIP would not conflict with Objective #3: "provide habitats suitable to support an array of commercial and recreational activities coast-wide."

- LDNR asks that USACE provide written assurance that the final mitigation project plans and designs will fully offset project impacts in Louisiana's coastal wetlands. Additional assurance should not be necessary, as the FEIS and Record of Decision will obligate the

District and non-Federal sponsor to provide the compensatory mitigation described in these documents.

- One of LDNR's assertions relates to the previous HS modeling report (Brown et al., 2006) in which calibration and verification differences were reconciled by "introducing salinity." These problems were resolved by the revised HS modeling (Brown and Stokes, 2009). The LDNR claim that they were not given access to the latest HS modeling report is incorrect. LDNR did not request access to the report and a final version of this report was not available until late February, 2010. A copy of this report is provided with this letter.
- The LDNR comments question issues such as model calibration and verification, the duration and extent of data collection, and the treatment of marshes in the model. ERDC employed a state-of-the-art model to evaluate potential salinity impacts, and the technical adequacy of the HS modeling has been sustained by ATR and IEPR.
- LDNR asserts that "most of the marsh in Louisiana was not modeled." All of affected marsh in Louisiana was modeled, and the ICT (including LDNR representatives) were involved in determining what areas were modeled.
- LDNR asserts that the HS Modeling did not include the actual dredging depth (48 ft plus 2 ft advance maintenance and 2 ft allowable overdepth). This assertion is incorrect. The full 52 ft of potential dredging depth is included in the modeling
- The LDNR asserts that inclusion of predictions of relative sea level rise (RSLR) conditions "tend to muddy the waters" regarding estimated project impacts. Inclusion of RSLR is required to appropriately determine future without project conditions, a requirement of the US Army Corps of Engineers planning process.
- LDNR asserts that Pool 3 in the SNWR must be included in the HS model because breaches to the containment levee caused by Hurricane Ike would result in impacts from the proposed project. In a recent communication with the SNWR and US Fish and Wildlife Service (USFWS) personnel, that agency reports that the only hurricane-caused breach, a 6 to 7 foot opening in the SE corner of Pool 3, was repaired 3 to 4 months ago by an oil company doing work on the SNWR. Two 6-foot wide bays on each of two 14-bay variable crest weir water control structures located in the northwest and eastern containment levees of the Pool are currently left open for fisherman access and rainwater discharge. Salt water intrusion at these locations is not an issue because most of the water flow is discharging out of the Pool and because of the bay's small size (6 feet wide). It is possible for tidal surges from tropical storms or hurricanes to enter the Pool, but on average tides, water can only currently enter via the two 6-foot wide bays per water control structure. These openings are not sufficient to cause salt water intrusion problems in the Pool. There are no current plans for the USFWS to maintain or raise the Pool levees. They have been inspected and future maintenance noted but, to the knowledge of the SNWR manager, the levee maintenance has not been funded.

  The major salt water intrusion route to the Pool is from Calcasieu Lake to the east. This is not an issue because the southeast gap has been repaired and the fisherman boat bays are not significant in size (2, 6-foot wide bays). The projected salinity increases from the

SNWW CIP would not be a threat to increasing salinities from the west into the Pool because of its hydrologic isolation. Pool 3 was originally eliminated from the Sabine-Neches project area because it was, and remains, hydrologically isolated from the west via the Pool levees even though it contains two water control structures operated as weirs. The model predicted that net salinity increase caused by the Sabine-Neches project in the hydrologic units surrounding the Pool would be from 0.5 ppt to 1.0 ppt (Southeast Sabine = 0.5 ppt, Southwest Gum Cove = 0.9 ppt, Sabine Lake Ridges brackish marsh = 0.6 ppt, East Johnsons Bayou = 1.0 ppt). These salinity increases would not be likely to cause saltwater intrusion in the Pool under the current scenario of intact levees with 2, 6-foot wide bays opened at each of 2 water control structures. Therefore, Pool 3 remains hydrologically isolated from the Sabine-Neches influence area. Furthermore, USFWS believes that re-doing the Sabine-Neches hydrologic model for this reason is not warranted.

**Master Plan Recommendations**

The exact location of the proposed borrow trench in Sabine Lake would be determined during PED by the District in consultation with the ICT. It would be sited so as to avoid increasing erosion to the shoreline, and therefore would not result in breaches to the Chenier Plain's bay and lake shorelines. The need for wave climate modeling to support design considerations would be determined in consultation with the ICT during PED.

The proposed SNWW CIP would not adversely affect "spoil banks" along the GIWW or the freshwater resources protected by them. Geotechnical investigations during PED would obtain all information needed to evaluate the stability of the emergent GIWW shoreline during proposed borrow activities. If an adverse effect is identified, the borrow activity would be modified to avoid those impacts. Similarly, geotechnical information would be obtained to support the detailed design of the "salinity plug" in the GIWW near the Sabine River.

In conclusion, I hope this additional information will be helpful in resolving your concerns regarding the proposed SNWW CIP and the studies report in the DEIS. The DEIS has provided sufficient information, including numerous scientific analyses and numerical modeling studies, to demonstrate that the proposed DEIS complies with the National Environmental Policy Act and that the proposed SNWW CIP is in compliance, to the maximum extent practicable, with the Coastal Zone Management Act, and other applicable laws and regulations. Several other state and federal agencies have found that the DEIS provides sufficient information for their reviews. The USFWS (letter dated February 5, 2010), National Marine Fisheries Service (letter dated March 8, 2010), Texas Parks and Wildlife Department (letter dated March 11, 2010), and the Environmental Protection Agency (letter dated February 18, 2000) have expressed no outstanding concerns with the proposed project.

If, after review of the information provided herein, your agency still has concerns, I request that you explain how the proposed activity would be inconsistent with the specific enforceable policies (including citations) of your coastal management program, and provide

alternatives, which if adopted would allow the proposed SNWW CIP to proceed in a manner consistent to the maximum extent practicable with the cited enforceable policies. I would like to reiterate that Galveston District has been working through the ICT process with LDNR and 12 other state and Federal agencies for 10 years to perform the appropriate scientific studies and modeling needed to ensure that the proposed project avoids and minimizes environmental impacts to the greatest extent practicable. We stand ready to continue working with ICT during the PED phase to resolve your concerns and develop detailed designs for the Louisiana mitigation measures and BU feature. Please do not hesitate to contact Ms. Janelle Stokes at 409/766-3039 should you need further assistance.

Sincerely,

Arthur Janecka
Deputy District Engineer,
for Project Management

Enclosure
Report

CF:
David Frugé, OCRP
Rickey Broulliet, OCRP
Ismail Merhi, OCRP
Jeff Harris, OCM
Darryl Clark, USFWS
Rick Hartman, NMFS
Kyle Balkum, LDWF
Dave Butler, LDWF
Myles Hebert, Cameron Parish

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF
Environmental Section

April 26, 2010

Mr. Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division
Louisiana Department of Natural Resources
Office of Coastal Management
P.O. Box 44487
Baton Rouge, Louisiana 70804-4487

Dear Mr. DuCote:

Reference your letter dated March 31, 2010 to Mr. Dolan Dunn of my staff. The letter discusses the Louisiana Coastal Resource Program (LCRP) consistency review of the U.S. Army Corps of Engineers, Galveston District (the District) consistency determination for the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). The Louisiana Department of Natural Resources, Office of Coastal Management (LDNR-OCM) found that the proposed SNWW CIP is conditionally consistent with the LCRP. The finding requires that USACE submit an additional consistency determination no later than the time at which draft contract plans and specifications are circulated for internal District review.

A requirement of the conditional consistency is the submission of additional detailed information on topics that "would include, but not be limited to, the topics of storm surge, bar channel deepening, salinity, borrow from Sabine Lake, mitigation plans and adequacy, and pipeline relocation." The District has gone to great lengths to coordinate the proposed project and supporting environmental studies addressing these issues with LDNR, as demonstrated by nearly ten years of analysis and coordination with LDNR through the SNWW Interagency Coordination Team. Through this coordination process we have successfully resolved numerous issues raised by the State of Louisiana, State of Texas, and Federal agencies that participated in the review of the project.

The District has evaluated the proposed SNWW CIP for consistency with the LCRP, and has concluded that the Recommended Plan is consistent to the maximum extent practicable with the enforceable policies of Louisiana's coastal management program. Conditional consistency as proposed in your letter is not acceptable, and you

are hereby notified that, in compliance with 15 CFR 930.43 (d) (2), this agency finds that the proposed action is consistent to the maximum extent practicable with the enforceable policies of the Louisiana program, and we will proceed with the project.

Sincerely,

David C. Weston
Colonel, Corps of Engineers
District Commander

Copies Furnished:
David Frugé, LDNR-OCPR
Jeff Harris, LDNR-OCM
Randall Reese, SNND
Hubert Oxford, III, SNND

BOBBY JINDAL
GOVERNOR

SCOTT A. ANGELLE
SECRETARY

# State of Louisiana

**DEPARTMENT OF NATURAL RESOURCES**

**OFFICE OF COASTAL MANAGEMENT**

5 February 2010

USACE – Galveston District
Attn: Ms. Janelle Stokes
P. O. Box 1229
Galveston, TX 77553

RE: **U. S. Army Corps of Engineers, Galveston District**
Notice of Public Meeting of the Draft Environmental Impact Statement (DEIS) for Sabine-Neches Waterway Proposed Channel Improvement Project, Southeast Texas and Southwest Louisiana

Dear Ms. Stokes:

This office has received your December 19, 2009, letter stating that the referenced Draft report was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, Section 102(2)(c) as amended. This document is presently under public review, with written comments to be postmarked by February 10, 2010. This Department would like to request to extend the comment period an additional 90 days to May 10, 2010, in order for this Office to fully evaluate the project and all appurtenant documentation. It is a large body of information and we are trying to be very diligent and thorough in our review. We are particularly concerned about modeling for storm surges, and salinity, the proposed mitigation for unavoidable impacts to wetland habitats, and the potential impacts to extant energy infrastructure and any potential for disruption of services/delivery of product that Louisiana's industries rely on. A more detailed, though not necessarily complete, list of areas of concern is attached.

Please let us know as early as possible if such a time extension for our comments meets with your approval.

If you have any questions please contact me at 225.342.5052 or Gregory.ducote@la.gov.

Sincerely yours,

Gregory J. DuCote
Administrator
Interagency Affairs/Field Services Division

Post Office Box 44487 • Baton Rouge, Louisiana 70804-4487
617 North Third Street • 10th Floor • Suite 1078 • Baton Rouge, Louisiana 70802
(225) 342-7591 • Fax (225) 342-9439 • http://www.dnr.louisiana.gov
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Storm Surge:
- Effects of the deeper shipping channel, deeper GIWW, and borrow area in Sabine Lake may be significant and have not been appropriately modeled.
- Upland confined disposal sites on the Texas side of the project may create a barrier to storm surge, redirecting it to Louisiana.
- Offshore disposal sites from the bar channel dredging may create partial barriers to storm currents, potentially increasing set-up on Louisiana shores.

Bar Channel deepening:
- Modeling of potential impacts on wave climate and resulting shoreline impact must be performed.

Salinity:
- Modeling efforts are still under review by staff.
- Existing data from CRMS stations evidently was not used in modeling.
- Input parameters may not have been optimal.

Borrow Site in Sabine Lake:
- Justify the selected floatation access channel route. What alternatives were evaluated?
- Describe the disposal of material removed from the access channel route. Were impacts (e.g., SAVs) evaluated & mitigated?
- Mitigation for SAVs and oyster seed ground impacts is required by LDWF. These must be successfully addressed.
- Effects of excavation on wave climate and potential shoreline erosion should be evaluated.
- Geotechnical information on borrow quality should be collected and evaluated.
- Royalty payments and license issues over sediment resources must be resolved with LDWF.

Mitigation:
- Disposal site design must be presented.
- Geotechnical data for disposal site design must be collected and evaluated.
- Mitigation project lifetime maintenance and repair must be addressed. Who will perform? Can the Local Sponsor (TX) do such work in Louisiana?

GIWW deepening for borrow:
- Geotechnical data must be collected and analyzed for sediment suitability.
- Geotechnical data must be collected and analyzed for slope stability.
- Shoreline stabilization plans must be proposed.
- The design and analysis of the proposed salt water plug must be presented.

Pipelines:
- Plats showing all pipelines affected by the deepening of the navigation channel, GIWW, floatation access channel and borrow site must be provided.
- Discussion of impacts to this energy infrastructure and plan for addressing same
- Impacts to Louisiana industries must be fully evaluated and minimized.

**Stokes, Janelle S SWG**

**From:** Brian Marcks [Brian.Marcks@LA.GOV]
**Sent:** Thursday, February 04, 2010 9:38 AM
**To:** Stokes, Janelle S SWG
**Cc:** Jeff Harris
**Subject:** FW: C20090667 COE- GALV

**Attachments:** Document.pdf

Document.pdf
(615 KB)

Janelle,

Attached please find the LDWF comment letter on the DEIS for the Sabine-Neches Waterway Improvement Channel Project. Our agency has a Memorandum of Understanding with the LDWF whereby this agency requires that the applicant agree to the specifications included in their official comment letter to us to obtain consistency concurrence with our agency on a given project. Please provide information that you will comply with these LDWF specifications, revise the project to meet these specifications, or work with LDWF to resolve any differences you may have with them that are agreeable to LDWF. LDWF normally informs us when they are in agreement with such resolutions of any differences you may have.

Brian Marcks
Consistency Analyst
LDNR/OCM

-----Original Message-----
From: CMDUSER [mailto:CMDUSER@dnr.state.la.us]
Sent: Thursday, February 04, 2010 9:24 AM
To: Brian Marcks
Subject: C20090667 COE- GALV

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Please open the attached document. This document was digitally sent to you using an HP Digital Sending device.

To view this document you need to use the Adobe Acrobat Reader. For more information on the HP MFP Digital Sending Software or a free copy of the Acrobat reader please visit:

http://www.hp.com/go/HP_Digital_Sender_Module.com

BOBBY JINDAL
GOVERNOR

State of Louisiana
DEPARTMENT OF WILDLIFE & FISHERIES

ROBERT J. BARHAM
SECRETARY

**January 29, 2010**

Gregory J. Ducote, Administrator
Louisiana Department of Natural Resources
Coastal Management Division
P.O. Box 44487
Baton Rouge, LA 70804-4487

RE: *Consistency Number: C20090667*
*Applicant: Corps of Engineers - Galveston District*
*Notice Date: December 28, 2009*

Dear Mr. Ducote:

The professional staff of the Louisiana Department of Wildlife and Fisheries (LDWF) has reviewed the Consistency transmittal and preliminary Draft Environmental Impact Statement (EIS) for the Sabine-Neches Waterway Channel Improvement Project. LDWF has also been an active participant on the project Interagency Coordination Team since 2005.

At this time, LDWF has identified several issues that require further consideration by the natural resource and regulatory agencies. These outstanding issues are identified and described in the attached letter, dated October 23, 2009, submitted to Ms. Janelle Stokes.

LDWF requests that you accept this letter and the attached letter as our comments on the proposed project. We believe that each issue shall require thorough consideration and be individually and adequately addressed in the EIS.

The Louisiana Department of Wildlife and Fisheries appreciates the opportunity to review and provide recommendations to you regarding this proposed activity. Please do not hesitate to contact LDWF Permits Coordinator Dave Butler at 225-763-3595 should you need further assistance.

Sincerely,

Jimmy L. Anthony
Assistant Secretary

Attachment

c: Kyle Balkum, LDWF
Chris Davis, LDWF
Heather Finley, LDWF
Mike Windham, LDWF

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

April 15, 2010

Ms. Janelle Stokes
Regional Environmental Specialist
United States Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Re: General conformity concurrence for the Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

This letter provides general conformity concurrence for the proposed Sabine-Neches Waterway Channel Improvement project. The Texas Commission on Environmental Quality (TCEQ) reviewed the project in accordance with Title 40 Code of Federal Regulations Part 93, and Title 30 Texas Administrative Code (TAC) § 101.30 of the TCEQ general rules. The proposed project is located in the Beaumont-Port Arthur (BPA) area and is classified as moderate nonattainment for the 1997 ozone standard, and emissions are expected to be above the 100 tons per year *de minimis* threshold. Therefore, a general conformity analysis is required.

The TCEQ has determined, pursuant to 30 TAC §101.30(h)(1)(E)(i)(I), that emissions from the proposed project will not exceed the emissions from the applicable state implementation plan, the BPA Rate-of-Progress adopted by the TCEQ Commission on October 27, 2004, and approved by the United States Environmental Protection Agency on February 22, 2006. This general conformity determination is based upon information provided in a September 2009 Draft General Conformity Determination prepared for the U.S. Army Corps of Engineers (USACE).

In support of the ozone National Ambient Air Quality Standard, the TCEQ suggests the USACE adopt pollution prevention and/or reduction measures in conjunction with this and future projects, such as the following:

- encourage construction contractors to apply for Texas Emission Reduction Plan grants;
- establish bidding conditions that give preference to clean contractors;
- direct construction contractors to exercise air quality best management practices;
- direct contractors that will use tugboats during construction to use clean fuels;
- direct operators of the assist tugboats used in maneuvering dredge vessels to use clean fuels;
- select assist tugs based on lowest nitrogen oxides ($NO_X$) emissions instead of lowest price; or
- purchase and permanently retire surplus $NO_X$ offsets prior to commencement of operations.

Thank you for providing the necessary information and staff assistance for our review. We would also appreciate update(s), as appropriate, as this project moves forward. I look forward to working with you in the future on any upcoming projects you may have that affect air quality in your district. If you require further assistance on this matter, please contact Mr. Koy Howard at (512) 239-2306 or kohoward@tceq.state.tx.us.

Sincerely,

David Brymer, Director
Air Quality Division

DB/KH/kb

cc: Ruben Velasquez, P.E., PBS&J

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

April 19, 2010

Ms. Janelle Stokes
U.S. Army Corps of Engineers
Galveston District CESWG-PE-RE
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Sabine-Neches Waterway Channel Improvement Project §401 Water Quality Certification

Dear Ms. Stokes:

This letter is in response to the United States Army Corps of Engineers – Galveston District (Corps) correspondence dated March 19, 2010, requesting §401 State Water Quality Certification and the Public Notice dated December 18, 2009, on the Sabine Neches Navigation District proposal to deepen and widen the Sabine-Neches Waterway (SNWW). The SNWW Channel Improvement Project (CIP) is located along the Texas and Louisiana border, in Jefferson and Orange counties in southeast Texas and Cameron Parish, Louisiana.

The Texas Commission on Environmental Quality (TCEQ) has reviewed the public notice and related application information provided by the Corps. On behalf of the Executive Director and based on our evaluation of the information contained in these documents, the TCEQ certifies that there is reasonable assurance that the project will be conducted in a way that will not violate Texas surface water quality standards.

The Sabine Neches Navigation District proposes to increase the authorized depth of the channel from 40 to 48 feet along the entire 64-mile-long existing channel and add a 13.2-mile extension to the offshore channels into the Gulf of Mexico. The purpose of the CIP is to improve the transportation efficiency of the SNWW's deep-draft navigation system and support industry at ports within the SNWW navigation channel system.

SNWW CIP proposed mitigation incorporates the Neches River and Gulf Shore Beneficial Use features of the Dredged Material Management Plan (DMMP) and all components of Best Buy Mitigation Plan 6, including emergent marsh restoration in two areas of Willow Bayou (totaling 607 acres) and three areas in the Black Bayou region (totaling 2,096 acres).

April 19, 2010

The TCEQ has reviewed this proposed action for consistency with the Texas Coastal Management Program (CMP) goals and policies in accordance with the regulations of the Coastal Coordination Council and has determined that the proposed action is consistent with the applicable CMP goals and policies.

This certification was reviewed for consistency with the CMP's development in critical areas policy {Title 31, Texas Administrative Code (TAC), Chapter (§) 501.23} and dredging and dredged material disposal and placement policy {31 TAC §501.25}. This certification complies with the CMP goals {31 TAC §501.12(1, 2, 3, 5)} applicable to these policies.

No review of property rights, location of property lines, nor the distinction between public and private ownership has been made, and this certification may not be used in any way with regard to questions of ownership.

If you require additional information or further assistance, please contact Mr. Robert Hansen, Water Quality Assessment Section, Water Quality Division (MC-150), at (512) 239-4583.

Sincerely,

Charles W. Maguire, Director
Water Quality Division
Texas Commission on Environmental Quality

CWM/RSH/sp

Attachment

cc: Mr. Ben Rhame, Secretary, Coastal Coordination Council, P.O. Box 12873, Austin, Texas 78711-2873

Ms. Janelle Stokes
Attachment 1 – Dredge and Fill Certification
USACE – Sabine-Neches Waterway Draft EIS 124121809
Page 1 of 3
April 19, 2010

**WORK DESCRIPTION:** As described in the public notice dated December 18, 2009, and additional information provided by the Corps, dated March 19, 2010.

**SPECIAL CONDITIONS:** None

**GENERAL:** **This certification, issued pursuant to the requirements of Title 30, Texas Administrative Code, Chapter 279, is restricted to the work described in the December 18, 2009, Draft Environmental Impact Statement and Draft Feasibility Report.** This certification may be extended to any minor revision of the Environmental Impact Statement (EIS) when such change(s) would not result in an impact on water quality. The Texas Commission on Environmental Quality (TCEQ) reserves the right to require full joint public notice on a request for minor revision. The applicant is hereby placed on notice that any activity conducted pursuant to the EIS and COE project authorization which results in a violation of the state's surface water quality standards may result in an enforcement proceeding being initiated by the TCEQ or a successor agency.

**STANDARD PROVISIONS:** These following provisions attach to any permit or project authorization issued by the COE and shall be followed by the permittee or any employee, agent, contractor, or subcontractor of the permittee during any phase of work authorized by the COE.

1. The water quality of wetlands shall be maintained in accordance with all applicable provisions of the Texas Surface Water Quality Standards including the General, Narrative, and Numerical Criteria.

2. The applicant shall not engage in any activity which will cause surface waters to be toxic to man, aquatic life, or terrestrial life.

3. Permittee shall employ measures to control spills of fuels, lubricants, or any other materials to prevent them from entering a watercourse. All spills shall be promptly reported to the TCEQ by calling the State of Texas Environmental Hotline at 1-800-832-8224.

4. Sanitary wastes shall be retained for disposal in some legal manner. Marinas and similar operations which harbor boats equipped with marine sanitation devices shall provide state/federal permitted treatment facilities or pump out facilities for ultimate transfer to a permitted treatment facility. Additionally, marinas shall display signs in appropriate locations advising boat owners that the discharge of sewage from a marine sanitation device to waters in the state is a violation of state and federal law.

5. Materials resulting from the destruction of existing structures shall be removed from the water or areas adjacent to the water and disposed of in some legal manner.

6. A discharge shall not cause substantial and persistent changes from ambient conditions of turbidity or color. The use of silt screens or other appropriate methods is encouraged to confine suspended particulates.

7. The placement of any material in a watercourse or wetlands shall be avoided and placed there only with the approval of the Corps when no other reasonable alternative is available. If work within a wetland is unavoidable, gouging or rutting of the substrate is prohibited. Heavy equipment shall be placed on mats to protect the substrate from gouging and rutting if necessary.

8. Dredged Material Placement: Dredged sediments shall be placed in such a manner as to prevent any sediment runoff onto any adjacent property not owned by the applicant. Liquid runoff from the disposal area shall be retained on-site or shall be filtered and returned to the watercourse from which the dredged materials were removed. Except for material placement authorized by this permit, sediments from the project shall be placed in such a manner as to prevent any sediment runoff into waters in the state, including wetlands.

9. If contaminated spoil that was not anticipated or provided for in the permit application is encountered during dredging, dredging operations shall be immediately terminated and the TCEQ shall be contacted by calling the State of Texas Environmental Hotline at 1-800-832-8224. Dredging activities shall not be resumed until authorized by the Commission.

10. Contaminated water, soil, or any other material shall not be allowed to enter a watercourse. Noncontaminated stormwater from impervious surfaces shall be controlled to prevent the washing of debris into the waterway.

11. Storm water runoff from construction activities that result in a disturbance of one or more acres, or are a part of a common plan of development that will result in the disturbance of one or more acres, must be controlled and authorized under Texas Pollutant Discharge Elimination System (TPDES) general permit TXR150000. A copy of the general permit, application (notice of intent), and additional information is available at: http://www.tceq.state.tx.us/nav/permits/wq_construction.html or by contacting the TCEQ Storm Water & Pretreatment Team at (512) 239-4671.

12. Upon completion of earthwork operations, all temporary fills shall be removed from the watercourse/wetland, and areas disturbed during construction shall be seeded, riprapped, or given some other type of protection to minimize subsequent soil erosion. Any fill material shall be clean and of such composition that it will not adversely affect the biological, chemical, or physical properties of the receiving waters.

13. Disturbance to vegetation will be limited to only what is absolutely necessary. After construction, all disturbed areas will be revegetated to approximate the pre-disturbance native plant assemblage.

14. Where the control of weeds, insects, and other undesirable species is deemed necessary by the permittee, control methods which are nontoxic to aquatic life or human health shall be employed when the activity is located in or in close proximity to water, including wetlands.

15. Concentrations of taste and odor producing substances shall not interfere with the production of potable water by reasonable water treatment methods, impart unpalatable flavor to food fish including shellfish, result in offensive odors arising from the water, or otherwise interfere with reasonable use of the water in the state.

16. Surface water shall be essentially free of floating debris and suspended solids that are conducive to producing adverse responses in aquatic organisms, putrescible sludge deposits, or sediment layers which adversely affect benthic biota or any lawful uses.

17. Surface waters shall be essentially free of settleable solids conducive to changes in flow characteristics of stream channels or the untimely filling of reservoirs, lakes, and bays.

18. The work of the applicant shall be conducted such that surface waters are maintained in an aesthetically attractive condition and foaming or frothing of a persistent nature is avoided. Surface waters shall be maintained so that oil, grease, or related residue will not produce a visible film of oil or globules of grease on the surface or coat the banks or bottoms of the watercourse.

19. This certification shall not be deemed as fulfilling the applicant's/permittee's responsibility to obtain additional authorization/approval from other local, state, or federal regulatory agencies having special/specific authority to preserve and/or protect resources within the area where the work will occur.

BOBBY JINDAL
GOVERNOR

PEGGY M. HATCH
SECRETARY

# State of Louisiana

DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SERVICES

APR 21 2010

U.S. Army Corps of Engineers- Galveston District
CESWG-PE-RE
P.O. Box 1229
Galveston, TX 77553-1229

Attention: Janelle Stokes

RE: Water Quality Certification (WQC 100330-01/AI 104985/CER 20100001)
Sabine-Neches Waterway Channel Improvements Project
Cameron Parish

Dear Ms. Stokes:

The Louisiana Department of Environmental Quality (the Department) has reviewed your application to dredge waterbottoms and place spoil material for marine vessel access improvements, along Sabine Pass in southwestern Cameron Parish.

Based on the information provided in the application, the Department made a determination that the requirements for a Water Quality Certification have been met and concludes that the placement of the fill material will not violate water quality standards of Louisiana as provided for in LAC 33:IX.Chapter 11. Therefore, the Department hereby issues a Water Quality Certification to the U.S. Army Corps of Engineers- Galveston District.

Sincerely,

Melvin C. Mitchell, Sr.
Administrator
Water Permits Division

MCM/jjp

Post Office Box 4313 • Baton Rouge, Louisiana 70821-4313 • Phone 225-219-3181 • Fax 225-219-3309
www.deq.louisiana.gov

# Appendix A2

# Endangered Species Act Correspondence

# State of Louisiana

James H. Jenkins, Jr.
Secretary

Department of Wildlife & Fisheries
Post Office Box 98000
Baton Rouge, LA 70898-9000
(225) 765-2800

M.J. "Mike" Foster, Jr.
Governor

| | |
|---|---|
| ***Name*** | Mr. Dave Munson |
| ***Company*** | PBS&J |
| ***Street Address*** | 206 Wild Basin Road, Suite 300 |
| ***City, State, Zip*** | Austin, Texas 78746 |
| ***Project*** | Sabine-Neches Waterway Feasibility Study and EIS |
| ***Date*** | July 30, 2002 |
| ***Invoice Number*** | 02073001 |

Personnel of the Habitat Section of the Fur and Refuge Division have reviewed the preliminary data for the captioned project. In reviewing our database, many rare, threatened, or endangered species or critical habitats were found within the area of the captioned project that lies in Louisiana. I have attached tables containing the information for these element occurrence records, along with explanations of the data fields. Please refer to the LNHP data utilization agreement for restrictions regarding the use of these data. Element occurrence location information is given as point data and do not reflect the local extent of the occurrence. In addition, the precision of the location information may be limited. Please refer to the precision data field which defines the precision to which the element occurrence as described can be located on a topographic map. Due to the preliminary nature of the request, and the fact that no specific project details were given, the Louisiana Natural Heritage Program is unable to make specific comments concerning the project's impact on these species at this time. It will be necessary for you to contact us as your project progresses and specific project details are available, so that we may make the necessary comments in the future. In addition, please be aware that a manatee (Trichechus manatus) was observed in the Sabine River North of the I-10 Bridge in November of 1999. The manatee is listed as endangered on both the federal and state species lists. Your project area is in the Louisiana Department of Wildlife and Fisheries Sabine Island Wildlife Management Area (WMA). Please Contact the WMA Manager John Robinette at 318-491-2575 to coordinate activity. Your project area is in the USFWS Sabine National Wildlife Refuge. Please contact USFWS Wildlife Biologist Diane Borden-Billiot at 318-762-3816 to coordinate activity. Your project area is in the coastal zone. Contact the State of Louisiana Department of Natural Resources Coastal Management Division to determine if a coastal use permit is required. The Sabine Pass Lighthouse State Commemorative Area occurs in your project area. No other state or federal parks, wildlife refuges, scenic streams, or wildlife management areas are known at the specified site within Louisiana's boundaries.

The Louisiana Natural Heritage Program has compiled data on rare, endangered, or otherwise significant plant and animal species, plant communities, and other natural features throughout the state of Louisiana. Heritage reports summarize the existing information known at the time of the request regarding the

location in question. This report does not address the occurrence of wetlands at the site in question. Heritage reports should not be considered final statements on the biological elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The Louisiana Natural Heritage Program requires that this office be acknowledged in all reports as the source of all data provided here. If you have any questions or need additional information, please call Louisiana Natural Heritage Program Data Manger Jill Kelly at (225) 765-2643.

Sincerely,

Gary Lester, Coordinator
Natural Heritage Program

## LOUISIANA NATURAL HERITAGE PROGRAM (LNHP)

## DATA UTILIZATION AGREEMENT

We are pleased to provide you with information on the occurrence of threatened and endangered species. Do to the dynamic nature of the LNHP database and the sensitivity of some of the information however, some precautions are necessary in your use of the information.

Please sign and date below and return this document if you are in agreement with the conditions listed below for utilization of the LNHP database.

This agreement allows Dave Munson of PBS&J, 206 Wild Basin Road, Suite 300, Austin, Texas 78746 use of the LNHP records, at $20.00 per quad, for the Sabine-Neches Waterway Feasibility Study and EIS. The information supplied by the LNHP shall be used only for this project. As an employee of PBS&J, Dave Munson is authorized to sign this agreement.

PBS&J shall not use computer and hard copy files of LNHP data for any other projects, and PBS&J shall not release any copy of the LNHP data files to another party, without written consent of the LNHP Director.

All maps and graphs generated by PBS&J, using information provided by the LNHP shall reference in the legend the LNHP program as the source of the data. All text generated by PBS&J using information provided by the LNHP shall reference on the title or acknowledgement page the LNHP program as the source of the data, and the date the data were provided.

The quantity and quality of data collected by the LNHP are dependent on the research and observations of many individuals. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in Louisiana have not been surveyed. The LNHP database represents a compilation of information extracted from published and unpublished literature, museums and herbaria, field surveys, personal communications, and other sources. Records for new occurrences of plants and animals are continuously being added to the database and other occurrence records may change as new information is gathered. For these reasons, PBS&J is authorized to use the data for a period of one year from the date the data are received. At that time, PBS&J shall delete all computerized files containing the LNHP data, or enter into another data utilization agreement with the LNHP.

The LNHP cannot provide a definitive statement on the presence, or absence, or condition of biological elements in any part of Louisiana. LNHP reports summarize the existing information known to the LNHP at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments.

The LNHP and the State of Louisiana shall not be liable for any damages or loss whatsoever, to any person or legal entity, or property resulting from the use of the data specified here. PBS&J and/or any person or legal entity which receives said information from PBS&J agrees to indemnify and hold harmless the LNHP and the State of Louisiana from and against any and all claims, demands and causes of action of any description in favor of any person for damage or loss whatsoever to persons, legal entities, or property arising from the use of the data specified herein and/or any person or legal entity which receives said information from PBS&J

Information provided by this database transfer may not be published without prior written approval of the LNHP, and the LNHP must be credited as an information source in these publications.

Gary Lester
Director, Natural Heritage Program
Date: 7-31-02

Dave Munson
PBS&J
Date: 8/7/02

# Louisiana Natural Heritage Program
# Biological Conservation Database Field Definitions

EOCODE – (Element Occurrence Code) Represents a unique code for each element in the database

LONG – Longitude of the centrum of the element occurrence. Element Occurrence data is given as point information for the centrum of the occurrence, at this time we can not supply information about the local extent of the occurrence.

LAT – Latitude of the centrum of the element occurrence. Element Occurrence data is given as point information for the centrum of the occurrence, at this time we can not supply information about the local extent of the occurrence.

PRECISION - Precision to which the element occurrence as described can be located on a topographic map.

S = Seconds (accuracy of locality mappable within a three-second radius)
M – Minute (within a one minute radius, approximately 2 km or 1.5 miles from centerpoint)
G = general (to quad or place name precision only, precision within about 8 km or 5 miles)

SNAME – (State Name) The appropriate element name recognized in the state using standard scientific binomial (or trinomial) nomenclature

SCOMNAME– (State Common Name) Common name of the element that is recognized at the state level

USESA – (United States Endangered Species Act) Appropriate standard abbreviation for the U.S. federal register category for the element as proposed or determined by the U.S. Fish and Wildlife Service or the National Oceanic and Atmospheric Administration (marine species)

GRANK– (Global Rank) The global element rank which best characterizes the relative rarity or endangerment of the element worldwide.

SRANK – (State Rank) The state element rank which best characterizes the relative rarity or endangerment of the element in the state.

LASTOBS – (Last Observation) Date the element occurrence was last observed extant at this site; not necessarily date site was last visited.

## EXPLANATION OF RANKING CATEGORIES EMPLOYED BY NATURAL HERITAGE PROGRAMS NATIONWIDE

Each element is assigned a single global rank as well as a state rank for each state in which it occurs. Global ranking is done under the guidance of NatureServe, Arlington, VA. State ranks are assigned by each state's Natural Heritage Program, thus a rank for a particular element may vary considerably from state to state. Federal ranks are designated by the U.S. Fish & Wildlife Service under the provisions of the Endangered Species Act of 1973.

**FEDERAL RANKS (USESA FIELD):**

LE = Listed Endangered

LT = Listed Threatened

PE = Proposed endangered

PT = Proposed Threatened

C = Candidate

PDL = Proposed for delisting

E (S/A) or T (S/A) = Listed endangered or threatened because of similarity of appearance

XE = Essential experimental population

XN = Nonessential experimental population

No Rank = Usually indicates that the taxon does not have any federal status. However, because of potential lag time between publication in the Federal Register and entry in the central databases and state databases, some taxa may have a status which does not yet appear.

(Rank, Rank) = Combination values in parenthesis = The taxon itself is not named in the Federal Register as having U.S. ESA status; however, all of its infraspecific taxa (worldwide) do have official status. The statuses shown in parentheses indicate the statuses that apply to infraspecific taxa or populations within this taxon. *THE SPECIES IS CONSIDERED TO HAVE A COMBINATION STATUS IN LOUISIANA*

(PS) = partial status= Status in only a portion of the species' range. Typically indicated in a "full" species record where an infraspecific taxon or population has U.S. ESA status, but the entire species does not. *THE SPECIES DOES NOT HAVE A STATUS IN LOUISIANA*

(PS: Rank) = partial status= Status in only a portion of the species' range. The value of that status appears because the entity with status does not have an individual entry in Natureserve. *THE SPECIES MAY HAVE A STATUS IN LOUISIANA*

**GLOBAL ELEMENT RANKS:**

G1 = critically imperiled globally because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extinction

G2 = imperiled globally because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extinction throughout its range

G3 = either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range (21 to 100 known extant populations)

G4 = apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery (100 to 1000 known extant populations)

G5 = demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery (1000+ known extant populations)

GH = of historical occurrence throughout its range; i.e., formerly part of the established biota, with the possibility that it may be rediscovered (e.g., Bachman's Warbler)

GU = possibly in peril range-wide, but status uncertain; need more information

G? = rank uncertain. Or a range (e.g., G3G5) delineates the limits of uncertainty

GQ = uncertain taxonomic status

GX = believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered

T = subspecies or variety rank (e.g., G5T4 applies to a subspecies with a global species rank of G5, but with a subspecies rank of G4)

**STATE ELEMENT RANKS:**

S1 = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation

S2 = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation

S3 = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations)

S4 = apparently secure in Louisiana with many occurrences (100 to 1000 known extant populations)

S5 = demonstrably secure in Louisiana (1000+ known extant populations)

(B or N may be used as qualifier of numeric ranks and indicating whether the occurrence is breeding or nonbreeding)

SA = accidental in Louisiana, including species (usually birds or butterflies) recorded once or twice or only at great intervals hundreds or even thousands of miles outside their usual range

SH = of historical occurrence in Louisiana, but no recent records verified within the last 20 years; formerly part of the established biota, possibly still persisting

SR = reported from Louisiana, but without conclusive evidence to accept or reject the report

SU = possibly in peril in Louisiana, but status uncertain; need more information

SX = believed to be extirpated from Louisiana

SZ = transient species in which no specific consistent area of occurrence is identifiable

LNHP Element Occurrence Data in or surrounding your project area on the Echo 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNKC10010*185*LA | 0934142W | 300743N | HALIAEETUS LEUCOCEPHALUS | BALD EAGLE | (PS:LT,PDL) | G4 | S2N,S3B | S | 1999 |
| AFCJC04010*014*LA | 0934035W | 301245N | CYCLEPTUS ELONGATUS | BLUE SUCKER | | G3G4 | S2S3 | S | 3/27/1996 |

LNHP Element Occurrence Data in or surrounding your project area on the Cameron Farms 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| CPCS000000*002*LA | 0933350W | 300415N | BOTTOMLAND HARDWOOD FOREST | BOTTOMLAND HARDWOOD FOREST | | | S4 | S | -1977 |
| PMCYP090Q0*001*LA | 0933130W | 300300N | ELEOCHARIS FALLAX | CREEPING SPIKE-RUSH | | G4G5 | S1? | M | 4/6/1984 |

LNHP Element Occurrence Data in or surrounding your project area on the Black Lake 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNGE05010*013*LA | 0932333W | 300255N | AJAIA AJAJA | ROSEATE SPOONBILL | | G5 | S3 | M | 5/1/1989 |
| ORKER00000*224*LA | 0932333W | 300255N | WATERBIRD NESTING COLONY | WATERBIRD NESTING COLONY | | | | M | 5/1/1989 |

LNHP Element Occurrence Data in or surrounding your project area on the West of Greens Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| CEA2000000*010*LA | 0934510W | 295715N | BRACKISH MARSH | BRACKISH MARSH | | | S3S4 | S | -1977 |

LNHP Element Occurrence Data in or surrounding your project area on the Greens Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNGE05010*030*LA | 0934436W | 295707N | AJAIA AJAJA | ROSEATE SPOONBILL | | G5 | S3 | S | 5/28/1998 |
| CTB2000000*004*LA | 0934414W | 295652N | COASTAL PRAIRIE | COASTAL PRAIRIE | | G2Q | S1 | S | -1986 |
| CTB2000000*021*LA | 0934234W | 295702N | COASTAL PRAIRIE | COASTAL PRAIRIE | | G2Q | S1 | S | 5/8/1997 |
| ORKER00000*378*LA | 0934430W | 295707N | WATERBIRD NESTING COLONY | WATERBIRD NESTING COLONY | | | | S | 5/20/1996 |

LNHP Element Occurrence Data in or surrounding your project area on the F-R Ranch 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNKD02020*002*LA | 0933108W | 295857N | CARACARA CHERIWAY | CRESTED CARACARA | (PS:LT) | G5 | S1 | M | 4/2/1987 |
| CPA1000000*015*LA | 0933554W | 295911N | FRESHWATER MARSH | FRESHWATER MARSH | | | S1S2 | S | 4/2/1987 |
| ORKER00000*075*LA | 0933300W | 295900N | WATERBIRD NESTING COLONY | WATERBIRD NESTING COLONY | | | | M | 4/26/1990 |

LNHP Element Occurrence Data in or surrounding your project area on the Port Arthur South 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| PMPOA48010*001*LA | 0935334W | 294800N | MONANTHOCHLOE LITTORALIS | SALTFLAT-GRASS | | G4G5 | S1 | M | 7/14/1984 |

Element Occurrence Data in or surrounding your project area on the West of Johnsons Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| CEA2000000*011*LA | 0934727W | 294703N | BRACKISH MARSH | BRACKISH MARSH | | | S3S4 | S | -1977 |
| CTC1000000*001*LA | 0933830W | 294506N | COASTAL LIVE OAK-HACKBERRY FOREST | COASTAL LIVE OAK-HACKBERRY FOREST | | G1G2Q | S1S2 | S | 1984-FALL |

LNHP Element Occurrence Data in or surrounding your project area on the Johnsons Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| PDAST7Z020*001*LA | 0933830W | 294603N | RATIBIDA PEDUNCULARIS | MEXICAN HAT | | G4G5 | S2S3 | S | 9/7/1984 |
| PDBOR0L070*001*LA | 0933836W | 294506N | LITHOSPERMUM INCISUM | NARROW-LEAVED PUCCOON | | G5 | S1 | G | 4/8/1966 |
| PMPOA6S010*007*LA | 0933907W | 294503N | UNIOLA PANICULATA | SEA OATS | | G5 | S2 | M | 9/4/1974 |
| CTC1000000*001*LA | 0933830W | 294506N | COASTAL LIVE OAK-HACKBERRY FOREST | COASTAL LIVE OAK-HACKBERRY FOREST | | G1G2Q | S1S2 | S | 1984-FALL |
| PDFAB1A0C0*004*LA | 0933907W | 294502N | DALEA EMARGINATA | WEDGE-LEAF PRAIRIE-CLOVER | | G5 | S2 | M | 5/8/1982 |

Element Occurrence Data in or surrounding your project area on the Texas Point 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNNB03070*011*LA | 0934644W | 294338N | CHARADRIUS MELODUS | PIPING PLOVER | (LE,LT) | G3 | S2N | S | 2/19/1988 |

Element Occurrence Data in or surrounding your project area on the Smith Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNNB03030*002*LA | 0934024W | 294452N | CHARADRIUS ALEXANDRINUS | SNOWY PLOVER | (PS;LT) | G4 | S1B,S2N | S | 2/9/1991 |
| ABNNB03040*002*LA | 0934442W | 294405N | CHARADRIUS WILSONIA | WILSON'S PLOVER | | G5 | S1S3B,S3N | M | 4/27/1986 |
| ABNNB03070*002*LA | 0934024W | 294452N | CHARADRIUS MELODUS | PIPING PLOVER | (LE,LT) | G3 | S2N | S | 2/9/1991 |
| CTB1000000*013*LA | 0933959W | 294450N | COASTAL DUNE GRASSLAND | COASTAL DUNE GRASSLAND | | | S1S2 | S | 5/2/1989 |
| CTC1000000*001*LA | 0933830W | 294506N | COASTAL LIVE OAK-HACKBERRY FOREST | COASTAL LIVE OAK-HACKBERRY FOREST | | G1G2Q | S1S2 | S | 1984-FALL |
| PDAMA040N0*002*LA | 0933953W | 294457N | AMARANTHUS GREGGII | GREGG'S AMARANTH | | G4? | S2S3 | M | 6/30/1984 |
| PDAST7Z020*006*LA | 0933959W | 294457N | RATIBIDA PEDUNCULARIS | MEXICAN HAT | | G4G5 | S2S3 | S | 5/12/1987 |
| PDFAB0F630*008*LA | 0934321W | 294424N | ASTRAGALUS NUTTALLIANUS | A MILK-VETCH | | G5 | S2S3 | S | 5/2/1989 |
| PDFAB1A0C0*004*LA | 0933907W | 294502N | DALEA EMARGINATA | WEDGE-LEAF PRAIRIE-CLOVER | | G5 | S2 | M | 5/8/1982 |
| PDFAB1A0C0*006*LA | 0933959W | 294457N | DALEA EMARGINATA | WEDGE-LEAF PRAIRIE-CLOVER | | G5 | S2 | S | 5/12/1987 |
| PDFAB1A0C0*007*LA | 0934321W | 294424N | DALEA EMARGINATA | WEDGE-LEAF PRAIRIE-CLOVER | | G5 | S2 | S | 5/2/1989 |
| PDFAB5L0K0*007*LA | 0934321W | 294424N | PEDIOMELUM RHOMBIFOLIUM | ROUNDLEAF SCARF-PEA | | G5 | S2S3 | S | 5/2/1989 |

PBS&J

*An employee-owned company*

September 14, 2004

National Marine Fisheries Service
Southeast Regional Office
Mr. Andreas Mager
9721 Executive Center Drive north
Saint Petersburg, Florida 33702-2449

Dear Mr. Mager,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding federally protected species within the study area. Your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

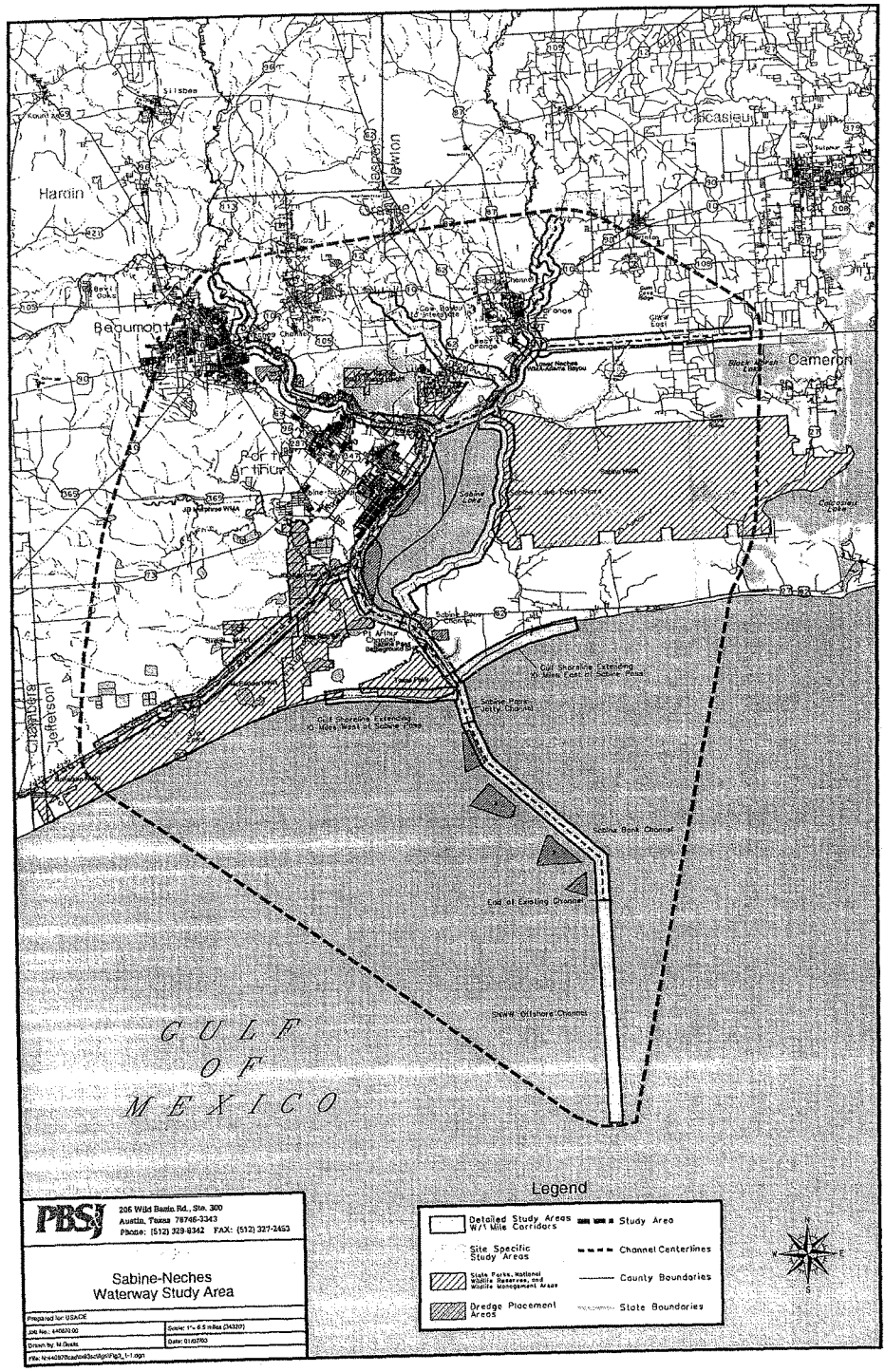
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com


Hardin
Newton
Jasper
Lacassine
Beaumont
Orange
Cameron
Port Arthur
Chambers
Jefferson
Gulf Shoreline Extending 10 Miles East of Sabine Pass
Gulf Shoreline Extending 10 Miles West of Sabine Pass
Sabine Pass Jetty Channel
Sabine Bank Channel
End of Existing Channel
Sabine Offshore Channel
GULF OF MEXICO
Legend
Detailed Study Areas W/1 Mile Corridors
Study Area
Site Specific Study Areas
Channel Centerlines
State Parks, National Wildlife Reserves, and Wildlife Management Areas
County Boundaries
Dredge Placement Areas
State Boundaries
PBSJ
205 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453
Sabine-Neches
Waterway Study Area
Prepared for USACE
Job No.: 4-0620.00
Scale: 1" = 4.5 miles (24320)
Drawn by: M.Deale
Date: 01/02/03

PBS&J

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September 14, 2004

Mr. Darryl Clark
U.S. Fish and Wildlife Service
646 Cajundome Blvd.
Suite 4000
Lafayette, Louisiana 70506

Dear ~~Mr. Clark~~ Darryl,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

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PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding federally protected species within the study area. Please provide written response since your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

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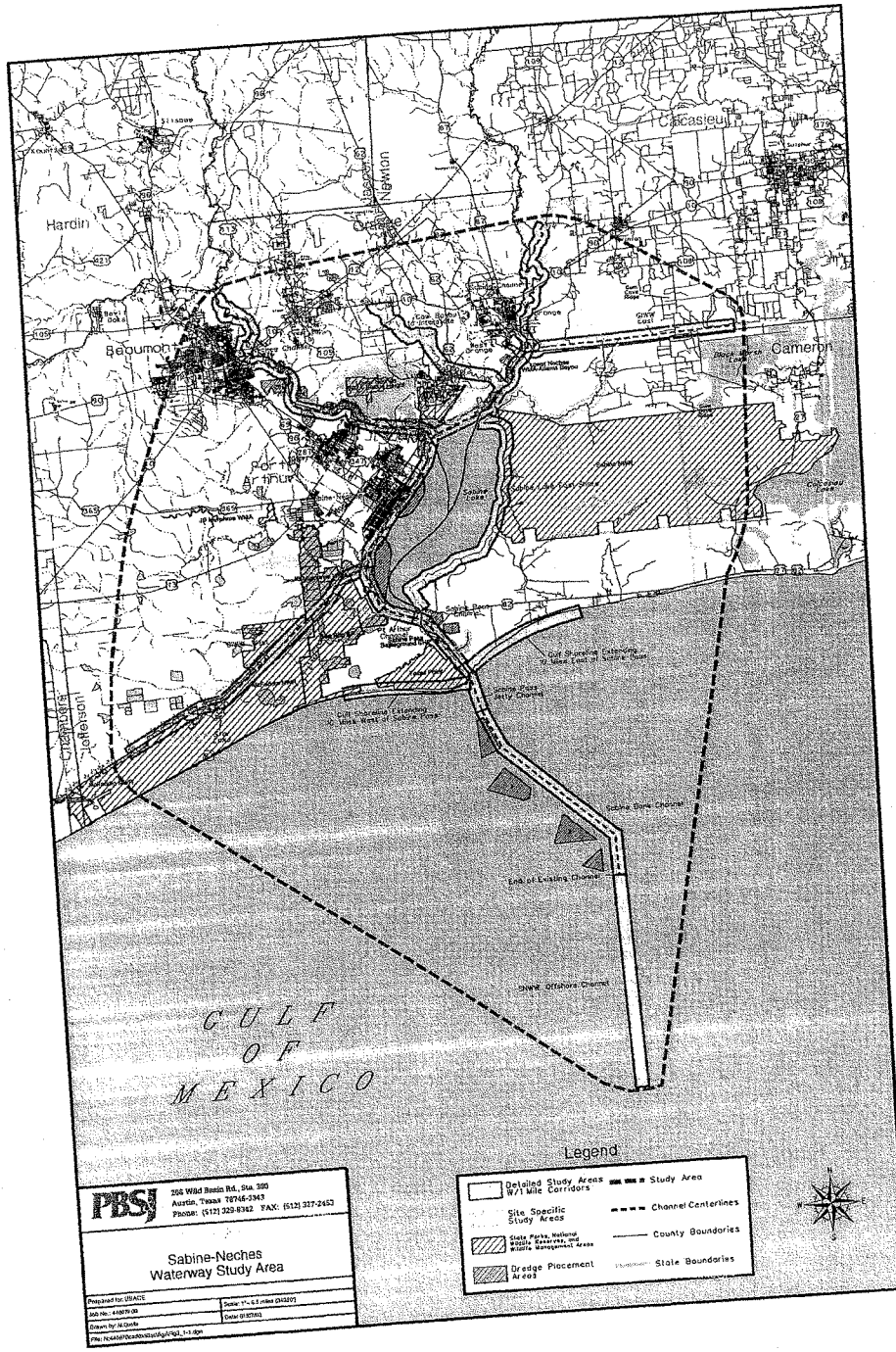
Hardin
Newton
Orange
Calcasieu
Beaumont
Port Arthur
Cameron
Jefferson
Chambers
GULF
OF
MEXICO
Legend
Detailed Study Areas W/1 Mile Corridors
Site Specific Study Areas
State Parks, National Wildlife Reserves, and Wildlife Management Areas
Dredge Placement Areas
Study Area
Channel Centerlines
County Boundaries
State Boundaries
PBSJ
206 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8362 FAX: (512) 327-2453
Sabine-Neches
Waterway Study Area

PBS&J

*An employee-owned company*

September 14, 2004

Ms. Kathy Boydston
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Dear Ms. Boydston,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

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PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding state protected species within the study area. Your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

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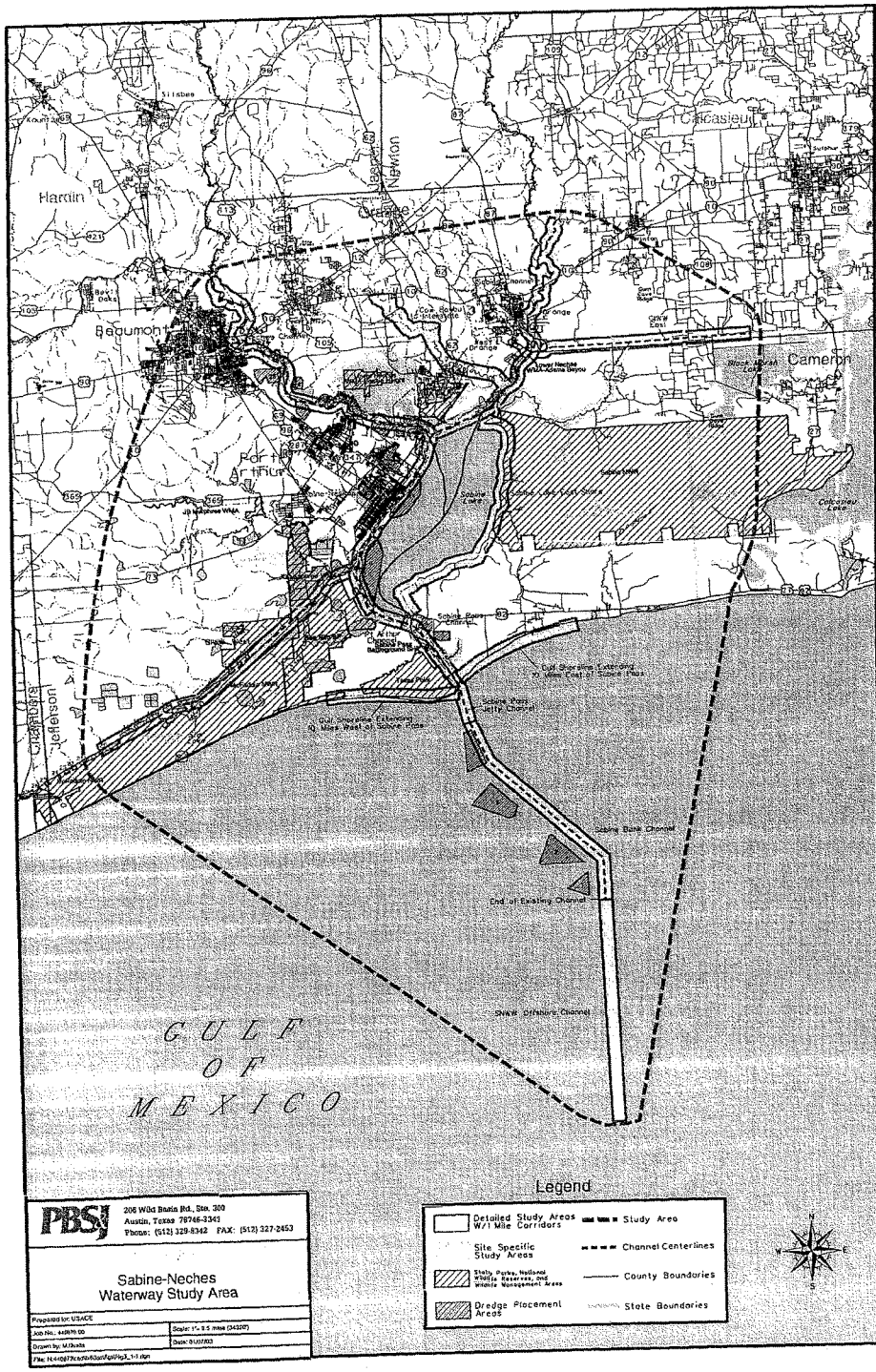
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Sabine Offshore Channel
Cameron
Calcasieu
Chambers
Jefferson
GULF
OF
MEXICO
Legend
Detailed Study Areas W/1 Mile Corridors
Study Area
Site Specific Study Areas
Channel Centerlines
State Parks, National Wildlife Reserves, and Wildlife Management Areas
County Boundaries
Dredge Placement Areas
State Boundaries
PBSJ
206 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453
Sabine-Neches
Waterway Study Area
Prepared for: USACE
Job No.: 44876.00
Scale: 1" = 8.5 miles (34320')
Drawn by: M.Banks
Date: 8/10/03

PBS&J

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September 14, 2004

Ms. Jill Kelly
Louisiana Department of Wildlife and Fisheries
P.O. Box 98000
Baton Rouge, Louisiana 70898

Dear Ms. Kelly,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding state protected species within the study area. Your office (Mr. Gary Lester) initially responded to our data request in 2002 (attached), however, we are currently updating our agency contacts. Please provide written response since your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts. If there has been no change since your 2002 response, please let us know and we will utilize your earlier information.

PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachments

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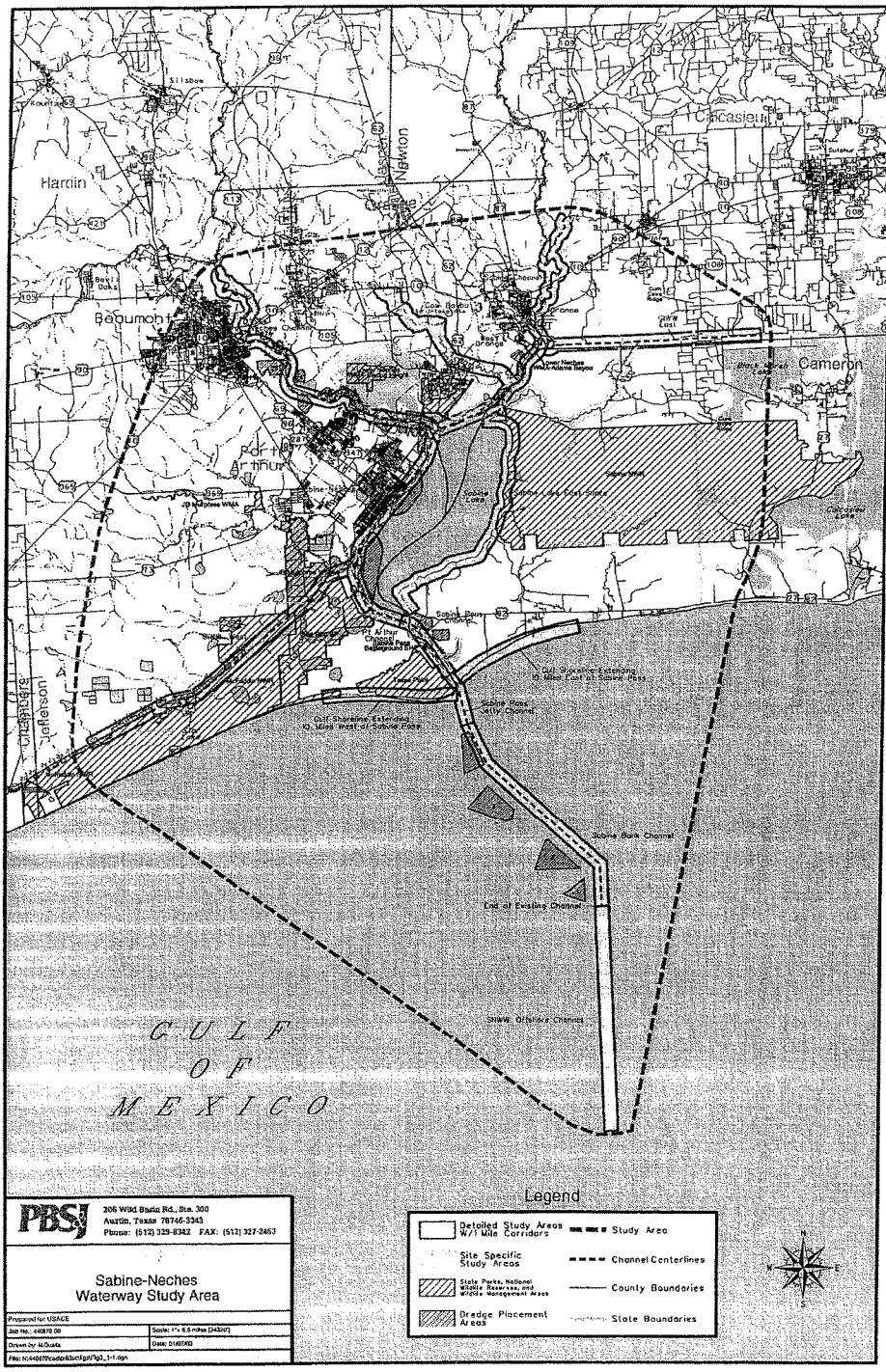
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# United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506


September 29, 2004

Mr. Martin Arhelger
Project Manager
PBS&J
6504 Bridge Point Parkway, Suite 200
Austin, Texas 78730

Dear Mr. Arhelger:

Please reference your September 14, 2004, letter requesting information regarding threatened and endangered species that may occur within the proposed study area for the Sabine-Neches Waterway (SNWW) project. The U.S. Army Corps of Engineers (Corps) has proposed to widen and deepen the SNWW bordering Jefferson and Orange Counties in Texas, and Calcasieu and Cameron Parishes in Louisiana. The proposed project area would include the SNWW from the Gulf of Mexico, passing through the jettied channel at Sabine Pass, the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, and an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The U.S. Fish and Wildlife Service's (Service) Lafayette, Louisiana, Field Office has reviewed the information provided, and offers the following comments on the Louisiana-portion of the proposed project, in accordance with provisions of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Migratory Bird Treaty Act (MBTA; 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.). For information regarding Federal-trust resources in Texas, please contact the Service's Houston, Texas, (i.e., Clear Lake) Field Office (17629 El Camino Real, Suite 211, Houston, TX 77058-3051, phone: 281-286-8282).

West Indian manatees (*Trichechus manatus*) may rarely occur along the Gulf coast in southwestern Louisiana during the summer months (i.e., June through September). They have declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

Bald eagles (*Haliaeetus leucocephalus*) nest in Louisiana from October through mid-May. Although we are not aware of active eagle nests within the proposed project area, there is an inactive nest located on the east side of the Sabine River and south of Interstate Highway 10; nests that are not currently listed in our database may also be present within areas containing suitable habitat. Eagles typically nest in bald cypress trees near fresh to intermediate marshes or open water. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Bald eagles usually return to the same nest year after year, but they may also use alternate nests in the same general vicinity in different years. Bald eagles are most vulnerable to disturbance during courtship, nest building, egg laying, incubation and brooding (roughly the first 12 weeks of the nesting cycle). Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus lessening their chance of survival. Should the proposed project or associated work activities encroach within 1,500 feet of an eagle nest during the nesting season (October through mid-May), further ESA consultation with this office will be necessary. We further caution that the proposed activity should not damage any portion of the eagle nest trees, including their root systems (i.e., through soil compaction or disturbance).

Federally listed as endangered, brown pelicans (*Pelecanus occidentalis*) feed along the southwestern Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance. Should you determine that the proposed project may directly or indirectly affect brown pelicans, further ESA consultation with this office will be necessary.

Federally listed as threatened, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the southwestern Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change.

On July 10, 2001, the U.S. Fish and Wildlife Service designated critical habitat for wintering piping plovers. In Louisiana, the proposed project would be located adjacent to Unit LA-1, a unit which includes ". . . the land from the seaward boundary of mean low low water to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. . ." (50 CFR Part 17, Volume 66, No. 132, Page 36127). Designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to

development, disturbance by humans and pets, and predation. Should you determine that the proposed project may directly or indirectly affect the piping plover or its critical habitat, further ESA consultation with this office will be necessary.

Endangered and threatened sea turtles forage in the near-shore waters, bays and sounds of southwestern Louisiana. The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species. Please contact Mr. Eric Hawk (727/570-5312) in St. Petersburg, Florida, for information concerning those species in the aquatic environment.

The proposed project area may encompass areas containing suitable nesting habitat for colonial wading birds. Colonies that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries may also be present. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed project area for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, depending on species present).

2. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1, depending on species present).

3. We recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and avoid impacting them during the breeding season.

The Service's Sabine National Wildlife Refuge (NWR) is located along the eastern bank of the Sabine Lake. Please be aware that the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd through 668ee) requires that activities on NWRs must be compatible with NWR purposes. Please contact the Sabine NWR Manager at 337/762-3816 for additional information, and to ascertain the need for a NWR Special Use Permit for that portion of the proposed project.

The proposed project may also affect the Black Bayou Hydrologic Restoration (CS-27), Gulf Intracoastal Waterway – Perry Ridge West Bank Stabilization (CS-30), and East Sabine Lake Hydrologic Restoration (CS-32) Projects. Those projects are authorized by the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The Service recommends avoiding direct impacts to specific project features (e.g., canal plugs, rock dikes, levees, water control structures, diversion canals, etc.). The exact locations of specific project features may be obtained at http://www.lacoast.gov/projects/list.asp, which contains detailed information on those CWPPRA projects. Please be aware that Section 303(d) of CWPPRA requires that all Federal activities be

consistent with the purposes of that Act and take into account the need to protect the public investment in the above-listed CWPPRA projects.

We appreciate the opportunity to provide comments during the early planning stages of the proposed action. If you have any questions or require further information on the Louisiana portion of the proposed project, please contact Brigette Firmin (337/291-3108) of this office.

Sincerely,

Russell C. Watson
Supervisor
Louisiana Field Office

cc: FWS, Houston, TX
Sabine NWR, Hackberry, LA
NMFS, St. Petersburg, FL
NMFS, Baton Rouge, LA
LDNR, CMD, Baton Rouge, LA
LDWF, Baton Rouge, LA
LDWF, Natural Heritage Program, Baton Rouge, LA

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

February 21, 2007

Environmental Section

David M. Bernhart
Assistant RA for Protected Resources
Southeast Regional Office
National Marine Fisheries Service
263 13th Avenue South
St. Petersburg, FL 33701

Dear Mr. Bernhart:

This letter is in regard to a proposed Federal project for the widening and deepening of the Sabine-Neches Waterway (SNWW) in Jefferson and Orange Counties, Texas, and Cameron Parish, Louisiana. The Galveston District is currently preparing a draft feasibility report and environmental impact statement which recommends enlargement of the existing navigation project to a proposed 48 x 700 foot channel.

We have prepared a Biological Assessment (BA) for the proposed work as both listed species and critical habitat are located within the affected area. A description of the proposed project is provided in the BA. We have concluded that the proposed project is likely to adversely affect the federally-listed endangered loggerhead, Kemp's ridley, and hawksbill sea turtles, and threatened green sea turtles. The proposed project will have no effect on federally-listed endangered whales and West Indian manatee, or the threatened Gulf sturgeon. The proposed project will have no affect on critical habitat.

Since the proposed project may affect federally-listed species, we request initiation of formal consultation pursuant to 50 CFR 402.14, to evaluate the effects of the proposed project on threatened and endangered sea turtles. In accordance with Section 402.14(g)(5), we also request that a draft copy of the biological opinion be furnished.

We appreciate your continued cooperation in allowing us to fulfill our responsibilities under the Endangered Species Act. Should you require any additional information during review of the enclosed BA, please call Ms. Janelle Stokes at 409/766-3039.

Sincerely,

Carolyn Murphy

Carolyn Murphy
Chief, Environmental Section

Enclosure

CF with enclosure:
Mr. Rusty Swafford
National Marine Fisheries Service
Habitat Conservation Division
4700 Avenue U
Galveston, Texas 77551

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

February 21, 2007

Environmental Section

Steve Parris
Field Supervisor
U.S. Fish and Wildlife Service
Clear Lake Ecological Services Field Office
17629 El Camino Real, Suite 211
Houston, Texas 77058

Dear Mr. Parris:

This letter is in regard to a proposed Federal project for the widening and deepening of the Sabine-Neches Waterway (SNWW) in Jefferson and Orange counties, Texas, and Cameron Parish, Louisiana. The Galveston District is currently preparing a draft feasibility report and environmental impact statement which recommends enlargement of the existing navigation project to a proposed 48 x 700 foot channel.

We have prepared a Biological Assessment (BA) for the proposed work as both listed species and critical habitat are located within the affected area. A description of the proposed project is provided in the BA. We have concluded that the proposed project is not likely to adversely affect the federally-listed, endangered piping plover and its designated critical habitat at Louisiana Point, Louisiana. The piping plover and its critical habitat will experience a beneficial effect from the proposed project resulting from habitat enhancement (i.e., shoreline nourishment) through the beneficial use of dredged material. The proposed project will have no effect on the federally-listed, endangered brown pelican. No other federally-listed species are likely to occur, and no other designated critical habitat is located in the project area.

We are hereby requesting your written concurrence, pursuant to the informal consultation procedures prescribed in 50 CFR 402.13, that the proposed action is not likely to adversely effect federally-listed species or designated critical habitat. We appreciate your continued cooperation in allowing us to fulfill our responsibilities under the Endangered Species Act. Should you require any additional information during review of the enclosed BA, please call Ms. Janelle Stokes at 409/766-3039.

Sincerely,

Carolyn Murphy

Carolyn Murphy
Chief, Environmental Section

Enclosure

CF with enclosure:

Russell Watson
Field Supervisor
U.S. Fish and Wildlife Service
Lafayette Ecological Services Field Office
646 Cajundome Boulevard, Suite 400
Lafayette, LA 70506

**United States Department of the Interior**
FISH AND WILDLIFE SERVICE
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882

March 20, 2007

Carolyn Murphy
Chief, Environmental Section
Department of the Army
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, TX 77553-1229

Dear Ms. Murphy:

This responds to your letter of February 21, 2007, regarding a proposed Federal project to widen and deepen the Sabine-Neches Waterway (SNWW) in Jefferson and Orange counties in Texas, and Cameron Parish in Louisiana. These comments apply only to the proposed project within the borders of the State of Texas.

The proposed project includes deepening the Sabine Pass Jetty Channel, the Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont from 40 to 48 feet; deepening the SNWW Entrance Channel in the Gulf from 42 to 50 feet; widening the Sabine Pass Jetty Channel, the Sabine Pass Channel, and the Port Arthur Canal to the junction with Taylors Bayou from 500 to 700 feet; deepening the Taylors Bayou Navigation Channel and turning basins to 48 feet; dredging two new anchorage basins, two new turning basins, and three turning and anchorage basins on the Neches River Channel. As mitigation, the Dredged Material Management Plan (DMMP) will include the use of dredged material to restore three degraded marsh areas on the Neches River (Rose City, Bessie Heights, and Old River Cove); restore six degraded marsh areas near Willow and Black Bayous, Louisiana; and nourish Gulf shorelines at Texas and Louisiana Points to create new saline marsh along a 3-mile stretch of shore.

The Biological Assessment indicates that a 2006 survey along the proposed shore nourishment areas found no suitable habitat for piping plovers on the Texas side. Placement of dredged material on an eroding bank should create suitable habitat where none currently exists, resulting in a beneficial effect for the species. Therefore, we concur that the proposed project may affect but is not likely to adversely affect the piping plover.

Although the brown pelican is a year-round resident along the upper Texas coast, including Jefferson and Orange counties, no active nesting sites are known to occur in the vicinity of the

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proposed project. Therefore, we concur that the project is not likely to adversely affect the brown pelican.

The Biological Assessment indicates that, as of 2003, no bald eagle nests were known to exist in Jefferson or Orange Counties. Two nesting territories have since been discovered in Orange County, but neither is in the immediate vicinity of the project area. The number of bald eagles nesting in Texas is increasing and often the locations of their nests are not known. Since bald eagles often nest and forage on river channels and reservoirs, steps should be taken to determine whether bald eagles may be nesting within or near the project area. These steps may include talking to local landowners and/or lessees about bald eagle sightings and surveying suitable habitat during the nesting season for bald eagles and their nests.

These comments are provided in accordance with Section 7 of the Endangered Species Act (87 stat. 884 as amended; 16 U.S.C. 1531 et seq.). If the project changes or additional information on the distribution of listed or proposed species becomes available, the project should be reanalyzed for effects not previously considered.

If you have any questions, or if we can be of further assistance, please call Kathy Nemec of my staff at 281/286-8282.

Sincerely,

Stephen D. Parris

Stephen D. Parris
Field Supervisor, Clear Lake ES Field Office

cc: Field Supervisor, Lafayette, LA, ES Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

March 22, 2007

Ms. Carolyn Murphy
Chief, Environmental Section
U.S. Army Corps of Engineers
Post Office Box 1229
Galveston, Texas 77553-1229

Dear Ms. Murphy:

Please reference your February 21, 2007, letter requesting: (1) our review of the U.S. Army Corps of Engineers' (Corps) biological assessment (BA) of the Sabine-Neches Waterway (SNWW) Channel Improvements project, and (2) our concurrence with the Corps' determination that the proposed project is not likely to adversely affect the threatened Louisiana black bear (*Ursus americanus luteolus*), endangered West Indian manatee (*Trichechus manatus*), endangered brown pelican (*Pelecanus occidentalis*), endangered interior least tern (*Sterna antillarum*), endangered red-cockaded woodpecker (RCW, *Picoides borealis*), threatened bald eagle (*Haliaeetus leucocephalus*), and threatened piping plover (*Charadrius melodus*) and its designated critical habitat. The proposed SNWW project would be located in Jefferson and Orange Counties, Texas, and Cameron Parish, Louisiana.

The U.S. Fish and Wildlife Service's (Service) Lafayette, Louisiana, Field Office has reviewed the information you provided, and offers the following comments on the Louisiana portion of the proposed project only, in accordance with provisions of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Please note that the Service's Houston, Texas. (i.e., Clear Lake) Field Office (17629 El Camino Real, Suite 211, Houston, TX 77058-3051. phone: 281-286-8282) is the lead Service point of contact for the proposed project, and should be contacted for information concerning Federal trust fish and wildlife resources within the Texas portion of the proposed project.

According to the BA, the proposed SNWW project would involve:

1. deepening the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the port of Beaumont from 40 to 48 feet;

2. deepening the existing SNWW Entrance Channel in the Gulf of Mexico from 42 to 50 feet, plus advance maintenance and allowable over-depth, and constructing a 13.1-mile-long extension of the offshore entrance channel;

3. widening the Sabine Pass Jetty Channel, the Sabine Pass Channel, and the Port Arthur Canal to its junction with Taylors Bayou from 500 to 700 feet;

4. bending easings in three areas on the Sabine-Neches Canal and three areas on the Neches River Channel;

5. deepening the Taylors Bayou Navigation Channel and turning basins to 48 feet, and widening the entrance and connecting channels to improve vessel maneuverability;

6. dredging two new anchorage basins, two new turning basins, and three turning and anchorage basins on the Neches River Channel, as well as reducing the existing Sabine Pass anchorage basin in size by approximately 50 percent;

7. beneficially using dredged material to restore three degraded marsh areas on the Neches River and nourish Gulf shorelines at Texas and Louisiana Points;

8. restoring six degraded marsh areas near Willow and Black Bayous, Louisiana;

9. adding four new Ocean Dredged Material Disposal sites in the Gulf along the 13-mile-long channel extension; and,

10. using 16 existing upland placement areas and two new expansions of existing placement areas for construction and maintenance of the proposed project.

Dredging in the Sabine Pass Jetty Channel would be conducted by a hopper dredge, while the remaining inshore channels would be constructed with hydraulic pipeline dredges. Direct project effects are those associated with navigation channel improvements and the placement of dredged material, including impacts to benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats; dredging impacts to bottom-feeding and pelagic organisms (e.g., sea turtles); impacts to marshes and upland habitats from the enlargement of placement areas; and, impacts to shorebirds (e.g., brown pelican, piping plover) and their habitat from the regular placement of maintenance material on the Gulf shoreline. Indirect project effects are an anticipated increase in salinity and the projected loss of 716 acres of tidal marsh resulting from its conversion to open water. The Corps does not anticipate any effects to federally listed species as a result of salinity increases or marsh loss.

According to the BA, beneficially using dredged material to nourish a 3-mile-long portion (mile 0.5 to 3.5) of the Gulf shoreline would result in beach nourishment at Louisiana Point every 6 years (i.e., each 3-year dredging cycle would alternate between Texas and Louisiana Points). The material would average 51 percent silt, 31 percent clay, and 18 percent sand, and would be hydraulically pumped via a pipeline into the nearshore zone, such that some material is expected to flow over existing marsh and shoreline while the remainder flows into the nearshore waters. Marsh planting would occur as soon as possible on the inland portion of the emergent berm to assist stabilization of the material. Based on past experience with similar projects, the Corps expects that dredged material will dissipate quickly during a placement event, with 60 percent remaining to form a shelf on the shallow nearshore slope in front of the existing marsh edge. Since the material would be unconsolidated and is prone to erosion, the Corps estimates that 50 percent of the material that remains after each placement event would erode away by the end of

the 6-year cycle. Over the 50-year life of the project, however, beach nourishment activities using maintenance dredging material from the Sabine Pass Channel would result in the creation of new saline marsh and beach habitat at Louisiana Point. Because of natural erosional processes along Louisiana Point and the dynamic coastal/beach system, it is difficult to estimate how many acres of marsh and beach habitat would be created over the life of the project.

The Corps has determined that the proposed SNWW project would not affect the Louisiana black bear, interior least tern, RCW, or bald eagle because those species are unlikely to occur in the project area due to lack of suitable habitat. According to our records, the Service confirms that we do not have records of those species occurring within the proposed project areas in Louisiana; therefore, we concur with the Corps' determination that the proposed project would not affect those species. In addition, our records indicate that the West Indian manatee rarely occurs along the southwestern portion of the Louisiana Gulf coast; therefore, we also concur with the Corps' determination that the proposed project is not likely to adversely affect that species. Specific comments regarding project-related effects to the brown pelican and the piping plover, as well as its designated critical habitat, are discussed below.

Louisiana Point is the southwestern tip of the Louisiana Gulf coast shoreline. It is an uninhabited mixture of marsh and beach shoreline. The area has been heavily eroded by natural processes due to increasing tidal prism, insufficient volumes of sediment supplied by littoral currents, land subsidence, and sea-level rise (Boesch 1982). Although increases in the tidal prism may be primarily responsible for enlargement of tidal passes, the insufficient supply of sand available to rebuild eroded areas has also contributed to increased tidal pass widths and shoreline retreat (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999). Where insufficient supplies of sand prevail, measures to maximize sand retention, such as sand fencing and vegetative planting, are needed to effectively rebuild and maintain these eroded areas.

According to the BA, Louisiana Point currently consists of an eroded shoreline that extends for approximately 2 miles from the east jetty. A sandy beach, varying from 50 to 300 feet in width, begins approximately 2 miles east of the east jetty and extends east beyond the proposed beach nourishment project area. Shoreward of the beach is an eroded shoreline with occasional flats containing extensive stands of dense vegetation. A 1.65-mile-long tidal sand/mudflat is located approximately 1,500 feet offshore of Louisiana Point at its western end, and extends such that it gradually meets the shoreline at its eastern end. A 1-mile-long offshore sand bar that extends from 4,200 feet offshore at its western end to 1,200 feet offshore at its eastern end is also located offshore of Louisiana Point.

As you know, brown pelicans feed in shallow estuarine waters, and use sand spits and offshore sand bars as rest and roost areas. Brown pelicans are currently known to nest on Rabbit Island in Calcasieu Lake in southwestern Louisiana. Although no brown pelican nesting sites are known to occur within the proposed project area, they may occasionally use those portions of the proposed project area that contain suitable habitat (e.g., Sabine Pass Channel, Louisiana Point) for feeding and/or loafing. Any pelicans that may be feeding or loafing in the project area during construction (and future maintenance dredging activities) are likely to be temporarily displaced to nearby suitable habitat, but they would not be permanently excluded from using the project

area. Based on that information, the Service concurs with your determination that the proposed project is not likely to adversely affect the brown pelican.

The threatened piping plover, as well as its designated critical habitat, occur within the beach nourishment portion of the proposed project area. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile-long area.

According to the BA, the Corps would initially require approximately 4.75 years to complete the entire proposed project, with several contractors working simultaneously, and maintenance dredging would occur every 3 years following completion of the initial project features. The beach nourishment portion of the proposed project would temporarily affect approximately 1.5 miles of sandy beach on the Gulf shoreline, and it is the only feature that has the potential to affect piping plovers. Because plovers may be present in the project area for 8 to 10 months on an annual basis, the initial beach nourishment event (and subsequent events every 6 years) would likely occur when wintering piping plovers are present and utilizing suitable habitat at Louisiana Point. According to the BA, an offshore sand bar and an offshore sand/mudflat located less than 1 mile from the proposed beach nourishment area contain suitable piping plover habitat. Suitable piping plover habitat also exists along the Gulf shoreline adjacent to the beach nourishment project area. Although studies indicate that wintering piping plovers generally remain within a 2-mile-long area, sufficient roosting and foraging habitat would be available for them to disperse into on those offshore features or the adjacent shoreline during construction activities and future maintenance dredging. Such disturbance would be temporary in nature and would not permanently exclude piping plovers from utilizing the nearby habitats or the project area. In addition, the proposed project would result in creation of additional suitable habitat (i.e., beach habitat) over the 50-year life of the project. Furthermore, construction activities would also have no long-term effect on the existing water quality conditions within the proposed project areas because any increase in turbidity from dredging and placement of material on/near the shoreline would be temporary in nature, and the site would return to normal turbidity levels shortly after construction is complete. Based on that information, the Service also concurs with the Corps' determination that the proposed project is not likely to adversely affect the piping plover.

On July 10, 2001, the Service designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for wintering piping plovers (66 FR, No. 132). Those areas consist of approximately 165,211 acres of mapped area along the Gulf and Atlantic coasts, as well as margins of interior bays, inlets, and lagoons. Piping plover designated critical habitat identifies specific areas that are essential to the

conservation of the species. The "primary constituent elements" (PCEs) for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. The PCEs of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

The proposed project would be located within Critical Habitat Unit LA-1 which encompasses the Texas/Louisiana border to Cheniere au Tigre (including Louisiana Point). At the time of designation, that Unit consisted of approximately 6,548 acres (approximately 89.87 miles of shoreline). Specifically within the proposed beach nourishment project area, piping plover critical habitat includes ". . . the land from the seaward boundary of mean low low water [MLLW] to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur" (66 FR, No. 132, Page 36127). Because of the dynamic coastal system, the current acreage of the entire Unit is unknown. Nonetheless, the proposed project would temporarily affect and restore approximately 3.0 miles of shoreline, of which 1.5 miles contains PCEs of piping plover critical habitat.

Critical habitat may be adversely affected if the proposed action affects the ability of the PCEs to support foraging, roosting, and sheltering, or the physical features necessary to maintain the natural processes that support those elements. Due to the nature of the proposed activities, temporary effects to existing piping plover critical habitat would occur during the initial beach nourishment event and once every 6 years for future maintenance dredging events. Construction and future periodic maintenance of the proposed project would temporarily impact (i.e., once every 6 years for 50 years), but not eliminate, a total of approximately 1.5 miles of existing piping plover critical habitat. After each beach nourishment event, and over the 50-year life of the project, additional piping plover critical habitat would be created, but due to natural erosional processes and the dynamic coastal/beach system at Louisiana Point, an exact acreage has not been estimated. During the future without the proposed SNWW project, the complete loss of existing piping plover critical habitat within that project area would be expected due to current erosion of the shoreline.

In the short-term (i.e., immediately post-nourishment event), the proposed project area would provide less than ideal habitat over the next few months until wave actions have redistributed the dredged material and wind action has deposited sand within the dynamic coastal/beach environment. Existing and newly created foraging habitat immediately post-construction would not be suitable until benthic organisms recolonize those areas. Meanwhile, adjacent critical habitat on the offshore mudflat, offshore sand bar, and adjacent beach would provide sufficient habitat for the piping plover. In the long-term (i.e., 50 years post-construction) and later, the Corps expects that the proposed project area would mimic existing critical habitat that was formed by natural coastal processes. Therefore, the Corps expects that any temporary impacts to piping plover critical habitat should eventually be restored, and that such restored habitat would

have a longer predictable existence due to increased stability of the shoreline, such that, the overall beach nourishment portion of the proposed project would benefit the piping plover and its designated critical habitat.

According to the BA, the Corps has determined that the proposed project is not likely to adversely affect designated piping plover critical habitat because a portion of the Louisiana Gulf shoreline would be temporarily impacted, but the overall effects of adding sediment to the shoreline would create new critical habitat and extend the longevity and availability of existing piping plover critical habitat within the proposed project area. According to our calculations, the proposed project would impact less than 2 percent of the PCEs within Critical Habitat Unit-LA1, and even less than that of the total designated critical habitat on the Atlantic and Gulf coasts. In addition, over the designed life of the project, the longevity of critical habitat PCEs would be increased by maintenance of the natural processes that support those elements. Based upon the above information, project-related effects to piping plover critical habitat would be insignificant and temporary in nature; therefore, the Service also concurs with the Corps' determination that the proposed project is not likely to adversely affect the piping plover's designated critical habitat.

No further ESA consultation with the Service's Lafayette, Louisiana, Field Office would be required for the proposed action unless there are changes in the scope or location of the project features, or the project has not been initiated within one year. If the proposed action has not been initiated within one year, follow-up consultation should be accomplished with the Service prior to making expenditures to ensure that the threatened and endangered species information is up-to-date. If the scope or location of the proposed action is changed, re-initiation of consultation should occur as soon as such changes are made.

We appreciate the Corps' continued cooperation in the conservation of threatened and endangered species and their designated critical habitat. If you have any questions or require additional information, please contact Brigette Firmin (337/291-3108) of this office.

Sincerely,

James F. Boggs
Acting Supervisor
Louisiana Field Office

cc: FWS, Panama City, FL (Attn: Ms. Patricia Kelly)
FWS, Houston, TX (Attn: Ms. Kathy Nemec)
LDNR, Coastal Management Division, Baton Rouge, LA
LDWF, Baton Rouge, LA (Attn: Mr. Kyle Balkum)
LDWF, Natural Heritage Program, Baton Rouge, LA

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# Appendix A3

# Fish and Wildlife Coordination and Essential Fish Habitat

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702

PER

April 5, 2005 F/SER46/RH,PW:jk
225/389-0508

Colonel Steven P. Haustein
District Engineer, Galveston District
Department of the Army, Corps of Engineers
Post Office Box 1229
Galveston, Texas 77553-1229

Dear Colonel Haustein:

NOAA's National Marine Fisheries Service (NMFS) has been involved with the evaluation of the environmental impacts of the proposed deepening of the Sabine-Netches Waterway (SNWW) led by staff of the Galveston District (GD) under the auspices of the Sabine-Netches Waterway Re-Evaluation Study. Water control structures across numerous hydrologic connections between Sabine Lake and Louisiana wetlands have been proposed as a potential mitigation alternative to compensate for the anticipated wetland loss resulting from the deepening of the SNWW. The NMFS is concerned that the proposed project, and in particular this potential mitigation alternative, may adversely affect essential fish habitat (EFH) and other aquatic resources of national importance.

The GD convened a SNWW Habitat Workgroup that estimated that channel deepening could result in 497 and 468 acres of wetland loss in Louisiana and Texas, respectively. These impacts were based on an average increase in salinity estimated to be 0.78 parts per thousand (ppt) in Louisiana and 0.98 ppt in Texas, as predicted by modeling conducted by the Corps of Engineers' Engineer Research and Development Center. A maximum increase of 2.5 ppt was projected for some wetlands within the overall study area. Water control structures across many of the tidal connections between Sabine Lake and the marshes in Louisiana are being considered as a mitigation alternative to reduce saltwater intrusion in an effort to prevent the estimated wetland loss.

Marine fishery productivity in Louisiana annually rates second only to Alaska in terms of pounds produced and dockside value (NMFS 2004). At least 90 percent of that production is from species that are dependent on coastal wetlands as nursery, resting, and foraging habitats for at least a portion of their life cycle. These wetlands also have been identified under the Magnuson-Stevens Fishery Conservation and Management Act as essential fish habitat (EFH) for a variety of federally managed species, such as brown shrimp, white shrimp, red drum, and Spanish mackerel. In addition, other estuarine-dependent species serve as prey for other fish managed under the Magnuson-Stevens Act by the Gulf of Mexico Fishery Management Council (e.g., mackerels, snapper, and groupers) and highly migratory species managed by the NMFS (e.g., billfishes and sharks).

APR 1

The installation and operation of water control structures has been shown to significantly impact marine fishery access to, use of, and production on, wetlands behind those structures (Herke et al, 1992, Rogers et al. 1992, and Rogers and Herke 1995). While it is still early in the planning stage and the exact type of structures and operational plan for each are unknown, it is likely that a structure which would have a significant impact on the water salinity of the area would not provide an adequate level of fishery access to, and production on, the affected wetlands (Rogers et al. 1994). As such, it is unclear how mitigation that would adversely impact marine fishery production could compensate for an action that also could have negative impacts on habitat supportive of those resources.

The NMFS also is concerned that although the installation of water control structures may buffer salinity changes in the marsh, they also may cause salinities to be higher in managed areas during droughts or following storm surges. Rogers et al. (1994) identified four studies where salinities were slightly higher inside the managed area, two where there were no significant difference in salinities, and three where salinities were buffered. Unpublished data from the Cameron Creole Watershed Project, located on the eastern side of Calcasieu Lake in Louisiana, suggest lake water level and rainfall have a greater influence over water salinities in the marsh than water control structures. Other studies in Louisiana have shown higher water salinities in the marsh interior during droughts or following storm surges (Rogers et al. 1992, Bourgeois 1997). Given such uncertainties, it is unclear how the installation of water control structures can be expected to offset increased salinities that may result from the deepening of the SNWW to a level sufficient to compensate for the induced wetland loss.

The installation of water control structures and implementation of marsh management activities also has been shown to impact factors that help maintain healthy marshes. Monitoring data from the East Mud Lake project, constructed under the auspices of the Coastal Wetlands Planning, Protection, and Restoration Act, showed decreases in marsh vegetation cover, greater subsidence, higher water levels, and longer periods of flooding inside the management area than outside in unmanaged marsh (Weifenbach and Clark 2000). Other studies document similar problems with prolonged flooding and higher salinity, as well as reduced sediment deposition and accretion in managed marsh compared to unmanaged marsh (Boumans and Day 1994; Meeder 1989). These effects can result in reduced wetland plant growth and increased stress in marshhay cordgrass and smooth cordgrass (Koch and Mendelssohn 1989), and contribute to wetland loss (Cahoon and Groat 1990).

Finally, the NMFS is concerned about the cumulative impacts of marsh management activities on the wetlands connected to Sabine Lake and the associated impact to marine fishery productivity. The proposed structures would semi-impound most of the remaining tidally-influenced area between Sabine Lake and Calcasieu Lake. This would contribute to the large cumulative impacts of structural marsh management in the Calcasieu-Sabine estuary on commercial and recreational marine fishery productivity. According to the New Orleans District's analysis of permit data, 98,266 acres of the Calcasieu-Sabine Basin have been affected by completed, partially implemented, or implementable marsh management projects (U.S. Army Corps of Engineers

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1996). That EIS found that nowhere in the Louisiana coastal zone is there such an extensive effort to place an entire sub-basin under some form of hydrologic management. The Science Advisory Board convened by the Environmental Protection Agency found that ecosystem-level cumulative impacts to fisheries productivity could result from multiple structural marsh management projects that reduce available marsh habitat within an estuary (Sanzone and McElroy 1998).

In view of the above, the NMFS urges the GD to consider less environmentally damaging alternatives than structural marsh management to avoid, minimize, or mitigate impacts associated with the proposed deepening of the SNWW. While we do not consider hydrologic management to be a suitable mitigative option, we are committed to continue working cooperatively with the stakeholders to investigate and implement alternative measures to maintain wetland health while sustaining marine fishery productivity.

We appreciate your consideration of our comments.

Sincerely,

Miles M. Croom
Assistant Regional Administrator
Habitat Conservation Division

cc:
FWS, Lafayette
FWS, SNWR
EPA, Dallas
EPA, Ettinger
LA DWF
LA DNR
Sierra Club
LA Wildlife Federation
Coalition for Coastal LA
F/SER46
F/SER4
Files

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PBS&J

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April 24, 2006

Rusty Swafford
National Marine Fisheries Service
Habitat Conservation Division
4700 Avenue U
Galveston, Texas 77551-5997

RE: Sabine-Neches Waterway Project
PBS&J Job Number 440870

Dear Mr. Swafford:

PBS&J has contracted with the Galveston District of the U.S. Army Corps of Engineers (Galveston District) to prepare the EIS for the Sabine-Neches Waterway Project (project) located in Jefferson and Orange Counties, Texas and Calcasieu and Cameron Parish, Louisiana. The Galveston District is engaged in a potential widening and deepening of the Sabine-Neches Waterway. The project sponsor is the Jefferson County Navigation District. Alternatives are in the process of being developed.

PBS&J is collecting data for the EIA. The level of detail for our assessment will be as necessary to describe existing conditions and to provide analysis of future conditions due to project impacts. The project study area is in the vicinity of Beaumont, Port Arthur, and Sabine Pass, Texas and encompasses the entire 75-mile long deep draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to Beaumont and adjacent areas that may be affected by proposed project alternatives.

PBS&J is submitting this letter to request information on Essential Fish Habitat occurring in the project area, which should be addressed for the project, and any conservation recommendations you may have. Please call me at (512) 342-3389 if you have any questions or need additional information.

Sincerely,

Lisa Vitale

Lisa Vitale, FP-C
Marine/Aquatic Biologist
LDV/lv

6504 Bridge Point Parkway • Austin, TX. 78730 • Telephone 512.327.6840 • Fax 512.327.2453 • www.pbsj.com

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
263 13th Avenue S
St. Petersburg, Florida 33701-5511

March 8, 2010

Ms. Carolyn Murphy
Chief, Environmental Section
Department of the Army, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Dear Ms. Murphy:

The NOAA National Marine Fisheries Service has reviewed the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project Southeast Texas and Southwest Louisiana. We have reviewed the proposed plans and associated essential fish habitat assessment and NMFS concurs with the Corps of Engineers' determination that the proposed project will temporary adversely impact essential fish habitats due to physical disruption and increased turbidity during dredging, as well as potentially causing secondary impacts to essential fish habitats from slightly increasing salinities in some areas of the Sabine Lake watershed affect living marine resources. We also concur that the proposed beneficial use of dredged material to mitigate and restore 13,052 acres of tidal marsh habitats, as well as the enhancement of approximately 1,828 acres of open water ponds and 5,589 acres of marsh, will offset the adverse impacts to essential fish habitats and provide a net-benefit to Federally managed fisheries. Therefore, NMFS has no comments to provide regarding the proposed plans and no further consultation under the Magnuson-Stevens Fishery Conservation and Management Act with the NOAA National Marine Fisheries Service is required. 1

If we may be of further assistance, please contact or Mr. Rusty Swafford of our Galveston Facility at (409) 766-3699.

Sincerely,

Miles M. Croom
Assistant Regional Administrator
Habitat Conservation Division

Mr. Miles M. Croom
National Marine Fisheries Service
Southeast Regional Office
263 13th Avenue S
St. Petersburg, FL 33701-5511

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The FEIS has been revised to note that the National Marine Fisheries Service (NMFS) concurs with the FEIS impact evaluation and proposed BU and mitigation plans, and has no further comments. No further consultation under the Magnuson-Stevens Fishery Conservation and Management Act with the National Oceanic and Atmospheric Administration NMFS is required. |

**United States Department of the Interior**
**FISH AND WILDLIFE SERVICE**
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 FAX: 281/488-5882

March 16, 2010

Colonel David C. Weston
U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, Texas 77553

Dear Colonel Weston:

This letter transmits our revised Sabine-Neches Waterway Channel Improvements Project, Jefferson and Orange Counties, Texas and Cameron Parrish, Louisiana, Fish and Wildlife Coordination Act Report that addresses changes in the scope of the project, sea level rise, long term monitoring and mitigation. This report provides the U.S. Fish and Wildlife Service's recommendations for mitigation of unavoidable impacts to important fish and wildlife resources in the Sabine-Neches Waterway area, and recommendations for long-term management of mitigation and beneficial uses sites.

We appreciate the opportunity afforded us to assist in planning this large and important Federal project, and appreciate the efforts of your staff in considering coastal Texas and Louisiana fish and wildlife resources. We are providing copies to the other environmental agencies, including Texas Parks and Wildlife Department, Louisiana Department of Fisheries and Wildlife, Louisiana Department of Natural Resources, National Marine Fisheries Service, U.S. Environmental Protection Agency, Texas General Land Office, and Texas Council on Environmental Quality.

Please contact me or Donna Anderson at 281/286-8282 or Darryl Clark at 337/291-3111 if you have comments or questions. Thank you.

Sincerely,

Edith Erfling

for Steve Parris
Field Supervisor, Clear Lake ES Field Office

TAKE PRIDE IN AMERICA

cc:
Carolyn Murphy, U.S. Army Corps of Engineers, Galveston, TX
Jaime Schubert, Texas Parks and Wildlife Department, Dickinson, TX
Barbara Keeler, U.S. Environmental Protection Agency, Dallas, TX
Robert Barhan, Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA
Scott Angelle, Louisiana Department of Natural Resources, Baton Rouge, LA
Rusty Swafford, National Marine Fisheries Service, Galveston, TX
Robert Hansen, Texas Commission on Environmental Quality, Austin, TX
Tammy Brook, Texas General Land Office, Austin, TX

# SABINE-NECHES WATERWAY CHANNEL IMPROVEMENTS PROJECT, JEFFERSON AND ORANGE COUNTIES, TEXAS, AND CAMERON PARISH, LOUISIANA

## FISH AND WILDLIFE COORDINATION ACT REPORT

PREPARED BY

PHIL GLASS
DARRYL CLARK
DONNA ANDERSON

U.S. FISH AND WILDLIFE SERVICE

ECOLOGICAL SERVICES

CLEAR LAKE, TEXAS

LAFAYETTE, LOUISIANA

ECOLOGICAL SERVICES

SOUTHWEST AND SOUTHEAST REGIONS

March 2010

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# SABINE-NECHES WATERWAY CHANNEL IMPROVEMENTS PROJECT, JEFFERSON AND ORANGE COUNTIES, TEXAS, AND CAMERON PARISH, LOUISIANA

The Sabine-Neches Waterway (SNWW) is a Y-shaped commercial waterway comprised of interlocking natural river channels and manmade canals. The waterway presently extends from the Gulf of Mexico, through the Sabine Jetties, 63.8 miles northward across the western edge of Sabine Lake, at 100 square (sq) miles in area the fifth largest estuary in Texas (White et al. 1987), to Port Arthur and Beaumont on the old Neches River Channel and to Orange on the Old Sabine River Channel (Figure 1). Present dimensions are 42 X 800 feet (ft) in the 22-mile Entrance Channel, 40 X 500 ft in the 5.6-mile Sabine Pass Channel, 40 X 500 ft in the 6.2-mile Port Arthur Canal, 40 X 400 ft in the 11.3-mile Sabine-Neches Canal, and 40 X 400 ft in the 18-mile Neches River Channel. General tonnage moved along the SNWW has generally risen during the 1990's from 38 thousand tons in 1990 to 81 thousand tons in 2000. Primary commodities shipped via the SNWW are crude oil (60,810 tons imported in 2000), gasoline (3,710 tons exported), petroleum coke (3,329 tons exported), fuel oil (2,470 tons exported), sand and gravel (1,056 tons imported), and wheat (753 tons exported) (USACE 2000). Since the 2002 Iraq War, the Ports of Orange and Beaumont have been the largest shippers of military supplies in the country.

This revised report addresses changes in the scope of the project, sea level rise modeling, long term monitoring and mitigation.

## Background and History of the Sabine-Neches Waterway

The United States expanded into and incorporated Texas during the early 1800's. U.S. Army expeditions explored Texas rivers and began rudimentary navigation improvements, mostly removal of long-established log jams. The first survey of the Sabine Pass area, in 1853, found channel depths of 5 ft, but with a soft mud bottom allowing steamships of up to 10 ft draft to pass. Construction began to deepen inland portions of the waterway shortly after the River and Harbors Act of 1875 and continued in segments until 1896, when the mouth of the channel at Sabine Pass was deepened (6 ft-deep by 70-100 ft-wide) and the jetties were constructed to prevent silting (Alperin 1977, Gammill et al. 2002).

Historic records show that, from 1840 through the early 1920's, 32 sawmills operated in the lower Sabine-Neches River areas (PBS&J 2003). Several of the beneficial use wetland sites selected for the current project still show marked effects of logging from this era, including radial "star" logging canals, vast scrub/shrub swamp with numerous old tree stumps, and a few still-barren mud flats.

The discovery of the Spindletop oil field in 1901 increased the demand for deepwater navigation. In 1916, Congress approved the extension of the Port Arthur Canal, and a 25-ft deep channel was completed to Beaumont. Subsequent dredging extended the

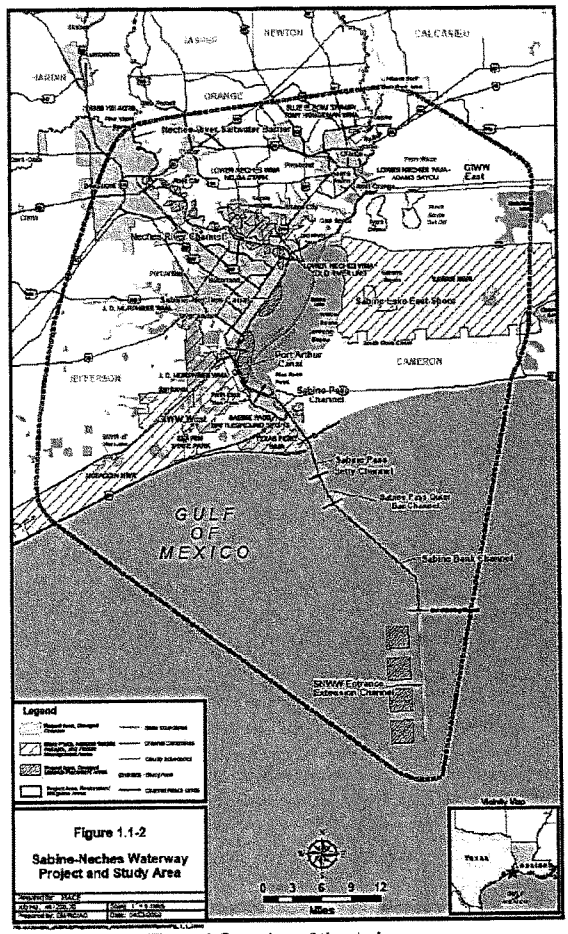


Figure 1 Overview of the study area

waterway to Orange, and by 1972, the present SNWW was complete to 40 X 400 ft (University of Texas 2001). The Gulf Intracoastal Waterway from Port Arthur westward to Galveston Bay was completed in 1943, providing another conduit for high salinity waters to enter previously fresh ecosystems, and interrupting sheetflows and flows of bayous, such as Taylor's Bayou in the project area. Today (2009), demand for increased volumes of petrochemicals to the Beaumont-Port Arthur petrochemical complex, the nation's third largest, is driving the demand for the current project to deepen and widen the channel. This project would allow chemical tankers in the 1,000-ton class to traverse the channel unlightered, thus providing the economic impetus to finance construction.

**Proposed Alternatives for SNWW Deepening Project**

Figure 1 shows the proposed project alignment, existing and proposed new terrestrial disposal areas, mitigation sites, outstanding designated natural areas, and beneficial use features. Shaded channel drawings illustrate proposed new dimensions.

Channel dimensions varying from 43 to 55 ft in depth were analyzed incrementally and in combination by Corps economists to determine feasibility. The selected (National Economic Development or NED) plan is as follows: 2

> Existing Gulf of Mexico Entrance Channel to Beaumont - deepen existing 64-mile channel from 42 to 48 ft within the existing widths, including 2 ft of advanced maintenance and 2 ft of overdepth throughout the waterway, with some isolated segments of additional advanced maintenance.
>
> Extend Gulf of Mexico Channel (13.2 miles) – extend the existing Gulf of Mexico portion of the Sabine-Neches Channel 13.2 miles to a depth of 48 feet, 2 ft of advanced maintenance and 2 ft of overdepth dredging.

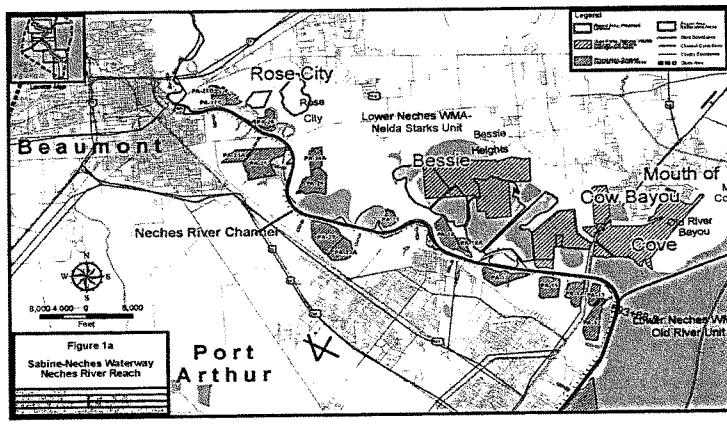


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Figure 2 Placement areas and beneficial use sites

**Description of SNWW Study Area**

The vegetative communities of southeast Texas and southwest Louisiana have been thoroughly described in several authoritative books and numerous technical articles, including O'Neil 1949, Blair 1950, Bezanson 2001, Harcombe and Neaville 1977, Smeins et al. 1991, TNHP 1993, Visser and Sasser 1998, Visser et al. 2000, Gosselink et al. 1979, and Chabreck 1972.

State and Federally-designated natural areas in the project area, important because of the large areas of native fish and wildlife habitat and recreational opportunities they represent as well as their inherent susceptibility to project-induced salinity changes, are shown and discussed as well. We summarize major community types in Texas and Louisiana, provide updated acreage

estimates, update recent changes to the current project and other channelization projects, and provide the U.S. Fish and Wildlife Service's recommendations as to project-related impacts and minimization measures.

**Sabine Lake and Offshore Gulf of Mexico**

At 69 sq miles of open water, Sabine Lake is the smallest of the six major Texas bay systems in both areas and volume. Its 6-ft average depth is similar to other Texas estuaries. However, its 289 sq miles of adjacent marshes composes the largest wetland system in Texas (Fisher et al. 1973). The region's high (55.8 in.) annual rainfall and two large river systems make it, on average, the freshest estuarine system in Texas. Average salinities, as verified by the TABS/MDS modeling effort for this project, ranges from fall lows of 3 parts per thousand (ppt) in the upper portion of the lake at median river flow to highs of 15 ppt in the lower lake. At low flow conditions (average of lowest 20 percent of historic flows), these salinities rise to 12 ppt in the upper lake and 21 ppt in the lower lake. Historic drought conditions have produced salinities in excess of 28 ppt in the lower lake.

Due to this dynamic salinity regime, Sabine Lake supports several rich and diverse fish, plankton, and invertebrate benthic communities. Heavy seasonal growths of both freshwater and marine phytoplankton, mostly diatoms (45 percent total biomass), along with the ubiquitous green algae (36 percent total biomass) occur and are heaviest in the summer (Espey, Huston and Associates 1976). Zooplankton is most abundant during summer and early fall, which is similar to what occurs in Galveston Bay but opposite from what is found in the more southerly and higher salinity mid- and lower coast bays. Copepods are by far the dominant species group (over 95 percent total biomass). Dominant infaunal benthic organisms consist of the *Rangia* clam, capitellid polychaetes, and *Tubificoides* oligochaetes (Vittor and Associates 1997).

Aquatic fauna has changed since the original manmade opening of Sabine Pass from a freshwater system similar to that currently present in the upper Neches and Sabine Rivers portions of the study area, to a saline/brackish system typical of Galveston Bay and other Texas estuaries. Important forage and predator fish are typified by alligator gar (*Lepisosteus spatula*), ladyfish (*Elops saurus*), finescale menhaden (*Brevoortia gunteri*), gizzard shad (*Dorosoma cepedianum*), bay anchovy (*Anchoa mitchilli*), river carpsucker (*Carpiodes carpio*), hardhead catfish (*Arius felis*), channel catfish (*Ictalurus punctatus*), Gulf killifish (*Fundulus grandis*), white bass (*Morone chrysops*), largemouth bass (*Micropterus punctulatus*), black crappie (*Pomoxis nigromaculatus*), crevalle jack (*Caranx hippos*), pigfish (*Orthopristis chrysoptera*), spotted seatrout (*Cynoscion nebulosus*), black drum (*Pogonias cromis*), striped mullet (*Mugil cephalus*), Spanish mackerel (*Scomberomorus maculates*), southern flounder (*Paralichthys lethostigma*),

and lizardfish (*Synodus foetens*). These species represent fresh, marine, and euryhaline assemblages. Commercial finfish harvest is insignificant at only an average of 2,186 pounds worth $1,385 annually. Recreational fish harvest is much more important, with an estimated 500,000 man-hours of fishing and is second only to Galveston Bay (Blackburn et al. 2001).

Important nektonic shellfish are blue crab (*Callinectes sapidus*), white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*), and swamp crayfish (*Procambarus clarkii*). The Sabine Lake blue crab fishery accounts for almost 25 percent of the total Texas commercial landings, with over one million pounds landed annually, for a total value of $665,600 (Texas Parks and Wildlife Department 2007).

Mussel diversity and abundance has substantially declined due to increased salinities caused by ship channel construction, elevated turbidity levels, and hydrologic alterations from upstream reservoir operations (Howells et al. 1996).

Sabine Lake formerly had large, commercially harvested oyster beds. These have been reduced in recent years to Sabine Pass, extreme lower Sabine Lake, Keith Lake Fish Pass and immediately adjacent to Keith Lake. Oysters have not been commercially harvested since the late 1970s.

**Calcasieu-Sabine Basin, LA**

The Calcasieu-Sabine basin is the westernmost of the nine coastal hydrologic basins in Louisiana and comprises the western portion of Louisiana's Chenier Plain. It extends from just east of Calcasieu Lake to Sabine Lake, with the Gulf Intra-Coastal Waterway (GIWW) and Gulf of Mexico forming its northern and southern boundaries. The 630,000-acre Calcasieu-Sabine Basin contained 435,600 acres of coastal wetlands in 1932 (Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993). The Sabine sub-basin includes the area from the western shoreline of Calcasieu Lake westward to Sabine Lake. The western half of the sub-basin is within the influence area of the SNWW.

The largest wetland problem in the basin is the conversion of marshes to open water as a result of human hydrologic alterations (channelization, levees) and natural causes (i.e., subsidence and wave action). Channelization for navigation canals causes saltwater intrusion into fresher intermediate and fresh marshes, which can result in vegetation die-off and conversion of marsh to open water. The Calcasieu-Sabine Basin lost over 122,000 acres (30 percent) of marsh from 1932 to 1990 (Dunbar et al. 1992). The 318,000-acre Sabine sub-basin (220,000 acres of marsh) lost over 84,000 acres of marsh (38.5 percent) since 1932 due to human-induced and natural causes. Another 38,400 acres of Calcasieu-Sabine Basin marshes (12.1 percent) are projected to be lost by 2050, for a total projected loss of 160,400 acres from 1932 to 2050 (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

**Vegetative Communities**

***Freshwater swamp and marsh*** --- Both freshwater swamp and freshwater marsh, often occurring in intermeshing context within large wetland tracts, occur in abundance within the northern half of the project area in both Texas and Louisiana. Table 1 gives approximate acreages of marsh and swamp types, broken down by drainage and habitat type.

Primary swamp type is cypress-tupelo swamp, which is characterized by common baldcypress (*Taxodium distichum*) and tupelo gum (*Nyssa aquatica*) overstory, and numerous aquatic understory species such as bulltongue (*Sagittaria lancifolia*), swamp lily (*Crinum americanum*), pickerel weed (*Pontederia cordata*), smartweed (*Polygonum sp.*), and blue iris (*Iris sp.*). Large tracts of cypress-tupelo swamp occur in permanently and semi-permanently flooded areas along the Neches River north of Interstate (I-) 10 and along the Sabine River north of I-10 and total approximately 16,798 acres in the extended study area (PBS&J 2003).

Swamp scrub and freshwater marsh are often intermixed within cypress-tupelo tracts, either in natural meander scars or in areas completely logged in the past which have not reforested. The 1,750-acre tract immediately east of downtown Beaumont and north of I-10 is a good example of an area crisscrossed by logging ("star") canals dug in the early 1900's for extraction of commercially valuable baldcypress, which has not yet completely reforested and remains in freshwater marsh/scrub-shrub. Primary plant species here are buttonbush (*Cephalanthus occidentalis*), rattlebean (*Sesbania drummondii*), box elder (*Acer negundo*), swamp privet (*Foresteria acuminata*), cattail (*Typha latifolia*), and Virginia tea (*Itea virginica*). Approximately 278 acres of shrub/scrub and 40,805 acres of freshwater marsh (mostly in Louisiana) are in the project area. Beneficial use areas at Rose City Marsh (project hydrologic unit TX3) will target freshwater marsh/scrub shrub habitat, although cypress-tupelo swamp should be the long term goal, due to its high productivity and recreational value to wetland users, primarily waterfowl hunters, fishermen, and birdwatchers.

***Bottomland hardwood forest*** --- Higher, intermittently-flooded strips of land immediately adjacent to the riverine ridge and to meander lakes (oxbows) are often forested by mature bottomland hardwood forest. The largest tracts are at the extreme upper end of the project area, just south of the Neches River saltwater barrier (Figure 1), and along the Sabine River north of I-10, within Sabine Wildlife Management Area (600+ acres). PBS&J (2003) estimated total acreage of this habitat type within the immediate project area at only 323 acres, but approximately 8,664 acres lie within the extended study area. Bottomland hardwood forest has long been identified as one of the most productive habitat types for wildlife in North America, often harboring up to four times the density and diversity of bird, mammal, and herpetofauna species of upland forests. More recently, bottomland hardwood forests in the northern Gulf of Mexico region have been identified as critical fall and spring migrant stopover habitat for huge numbers, perhaps the majority, of the more than 130 species of North America's neotropical migrant songbirds (Gauthreaux 1971).

***Intermediate marsh*** --- This marsh type is located between brackish and fresh marsh. Intermediate marsh has an irregular tidal regime, is oligohaline, and is dominated by narrow-leaved, persistent species such as marshhay cordgrass (*Spartina patens*). Plant diversity and soil organic matter content is higher than in brackish or saline marshes. This marsh is characterized by a diversity of species, many of which are also found in freshwater and brackish marshes. Characteristic species include roseau cane (*Phragmites australis*), bulltongue (*Sagittaria lancifolia*), coastal water hyssop (*Bacopa monnieri*), spikesedge (*Eleocharis* spp.), Olney's bulrush (*Schoenoplectus americanus*), California bulrush (*Schoenoplectus californicus*), American bulrush (*Schoenoplectus pungens*), saltmarsh bulrush (*Bulboschoenus robustus*), deer pea (*Vigna luteola*), seashore paspalum (*Paspalum vaginatum*), switch grass (*Panicum virgatum*), bearded sprangletop (*Leptochloa fascicularis*), camphor-weed (*Pluchea camphorata*), Walter's millet (*Echinochloa walteri*), fragrant flatsedge (*Cyperus odoratus*), alligator weed (*Alternanthera philoxeroides*), southern naiad (*Najas guadalupensis*), big cordgrass (*Spartina cynosuroides*), and gulf cordgrass (*S. spartinae*). Two other major autotrophic groups in intermediate marsh are epiphytic and benthic algae. Intermediate marsh occupies the least acreage of any of the four marsh types. Salinity averages about 3.3 ppt. This marsh type is very productive of many species of wildlife and is important to larval and postlarval marine organisms. This marsh community may change to either fresh or brackish marsh if salinity shifts. An estimated 172,853 acres of intermediate marsh occurs within the project study area (included in project hydrologic units).

***Brackish marsh*** --- This wetland area located between the high-salinity saline marshes near the Gulf of Mexico and the intermediate areas further removed from the Gulf constitutes an estimated 62,000 acres, or 37 percent, of the 169,321 acres of "estuarine" wetland study area. Brackish marsh is generally considered "slightly salty"; with salinity levels varying over a wide range from location to location. In coastal Louisiana and Texas, the typical brackish marsh vegetation pattern occurs in areas within approximately the 4 to 15 ppt normal salinity range. Common, usually dominant, vegetation in these areas is saltmarsh bulrush (*Bulboschoenus robustus*), seashore saltgrass (*Distichlis spicata*), marshhay cordgrass (*Spartina patens*), dwarf spikerush (*Eleocharis parvula*), waterhemp (*Amaranthus australis*), and marsh pea (*Vigna luteola*). Large tracts of brackish marsh occur in the (formerly fresh) lower Neches River basin, on both the J.D. Murphree Wildlife Management Area (WMA) and McFaddin National Wildlife Refuge (NWR) south of the GIWW and north of State Highway (SH) 87, and on the Sabine NWR east of Sabine Lake. Brackish marsh areas have cyclically high waterfowl populations, especially in years following high-salinity events when freshwater levels return to normal and periodic "blooms" of prime food plants such as widgeongrass (*Ruppia maritima*) and *Paspalum* sp. occur. Furbearers such as muskrat, formerly an important commercially-harvested animal in the project area, also occur in cyclically high numbers. Brackish marshes have suffered some of the highest rates of marsh loss due to subsidence and loss of organic materials as formerly fresh areas are subjected to salinity intrusion, resulting in plant loss.

***Saline marsh*** --- Salt marsh covers an estimated 9,845 acres within the project area, largely along the Gulf shorelines and adjacent to Sabine Pass, lower Sabine Lake, the GIWW nearest the SNWW and some areas in the lower Neches River. Dominant plants in the salt marsh are smooth cordgrass (*Spartina alterniflora*), seashore saltgrass, blackrush (*Juncus romerianus*), saltmarsh aster (*Aster tenuifolius*), and glasswort (*Salicornia* sp.). Gulf coastal salt marshes are often almost exclusively smooth cordgrass-dominated and comprise important marine nursery habitat, probably due to its ready access to estuaries, though wildlife populations are less diverse than in nearby intermediate and freshwater marshes.

**Table 1 Acreages of major wetland types in SNWW project area (modified by USFWS from PBS&J 2003)**

| **Wetland type** | **Ac. within 5,000 ft. of SNWW, tributary Channels, and Sabine Lake** | **Ac. within major study area** |
|---|---|---|
| Bottomland hardwood and scrub | 975 | 4,862 |
| Estuarine (saline and brackish) marsh | 13,530 | 169,321 |
| Fresh marsh | 13,812 | 146,417 |
| Aquatic beds, fresh or estuarine | 404 | 4,433 |
| Cypress or cypress-tupelo swamp | 1,110 | 3,265 |
| Open water | 35,182 | 206,894 |
| **TOTAL** | **65,013** | **535,192** |

4

**Fish and Wildlife Resources**

***Fish and Shellfish*** --- Project-area marshes and associated open-water habitats provide important habitat (i.e., nursery, escape cover, feeding grounds) for a variety of freshwater and estuarine-dependent fish and shellfish. Most of the economically important saltwater fishes and crustaceans harvested in Louisiana spawn offshore and then use estuarine areas for nursery habitat (Herke 1995). Nekton use of estuaries is largely governed by the seasons (Day et al. 1989). Different species use the same locations in different seasons, and different life stages of the same species use different locations. Aquatic species diversity peaks in the spring and summer, and is typically low in the winter. Some marine species which use estuaries as nursery habitat also have estuarine dependent life stages, typically larvae and juveniles. Larvae or juveniles immigrate into the project area during incoming tides and take advantage of the high productivity of the estuary.

Species typical of low-salinity areas include largemouth bass (*Micropterus salmoides*), crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), gar (*Lepisosteus spatula*), and blue catfish (*Ictalurus furcatus*). Species found in higher salinity areas, such as the project area, include Atlantic croaker (*Micropogonias undulates*), Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), southern flounder (*Paralichthys lethostigma*), blue crab (*Callinectes sapidus*), Gulf stone crab (*Menippe adina*), brown shrimp (*Penaeus aztecus*), and white shrimp (*Penaeus setiferus*) (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

***Waterfowl*** --- Southeast Texas (Jefferson and Orange Counties) and southwest Louisiana (Cameron Parish) contain some of the most important and heavily utilized waterfowl habitats remaining on the Gulf coast, with many of these areas located adjacent to or a short distance from the SNWW. Important Texas habitat tracts are located within Texas Point NWR, McFaddin NWR, J. D. Murphree WMA, and on privately owned marsh and swamp tracts along the Neches River. Important Louisiana tracts are located within Sabine NWR east of Sabine Lake, the Cameron Prairie NWR east of Calcasieu Lake and Rockefeller State Wildlife Refuge at Grand Chenier. More detailed descriptions of these publicly-owned refuges are provided in the *Protected (State and Federal) Natural Sites in Project Area* section of this report.

Waterfowl use and economic impacts from hunting and outdoor-related activities in the immediate project area are impressive. The U. S. Fish and Wildlife Service's Mid-Winter Waterfowl Census numbers for 2004-2005 were very low compared to previous years, probably due to high-salinity marsh conditions. January 2005 flight lines over McFaddin NWR and Texas Point NWR counted 27,964 geese and 12,688 ducks. Peak 2005 estimates for Sabine NWR were 125,000 geese and 200,000 ducks (McFaddin/Sea Rim NWR files). McFaddin NWR hosted 1,470 hunter-days who harvested 3,694 ducks and 76 geese during the 2005-2006 season. Texas Point NWR hosted 338 hunter-days who took 501 ducks and 28 geese during the 2005-2006 season. J.D. Murphree WMA hosted 1,997 hunter-days taking 5,014 ducks and 93 geese for the 2005-2006 season. The 2.5 birds per hunter-day was one of the highest ratios of any Texas public hunting area. Sabine and Cameron Prairie NWRs did not have recent hunting statistics readily available, but did have 2006 waterfowl survey data. Cameron Prairie NWR flight(s) during January 2006 counted 63,198 ducks, and Sabine NWR flight(s) counted 143,455. Total southwest Louisiana refuge flight(s), which include Lacassine NWR (58 miles east of Sabine Lake) counted an impressive 523,454 ducks, an almost 100 percent increase over January 2005 counts and indicative of the improving conditions in coastal marshes following Hurricane Rita in September 2005. The (small) Sabine Island WMA hosted 114 hunter-days during 2005-2006, taking "approximately" 50 ducks (Robinette 2007). Numerous waterfowl guides in Texas and Louisiana host hunters on private marshes, rice fields, and coastal marshes in the Jefferson County/Cameron Parish area. Private lands hunters almost certainly account for more hunting days and greater harvest than those on public areas.

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USDOI 2003) show hunter participation and expenditures by state, but not by county or region. In 2001, 1.2 million hunters in Texas (both resident and non-resident) spent 14.2 million days afield and an estimated $1.5 billion. Of these, approximately 500,000 hunters, or 42 percent, hunted migratory birds, primarily waterfowl. While these statistics are not compiled by county, a large proportion of waterfowl hunters have historically used the marshes within the SNWW project area.

Cameron Parish, Louisiana is one of the most popular waterfowl hunting regions of the U.S., both in terms of numbers of hunters and hunter success. In 2001, an estimated 333,000 Louisiana hunters spent approximately $446 million. Approximately 144,000 or 44 percent of these were migratory bird hunters, and of these, a sizeable proportion hunted in Cameron Parish.

***Colonial Waterbirds***---Twenty-three species of cormorant, pelican, heron, egret, spoonbill, gull, tern, and skimmer regularly nest in large numbers along the Texas and Louisiana coasts, frequently on bay islands, both natural and manmade. In recent years, the majority of successful

Texas colonies have been located on islands wholly or partially maintained by dredged material (Glass 1994). Colonial waterbirds are an important wildlife resource on the Gulf Coast and in the project area because of their abundance (an estimated 2,835 nesting pairs annually since 1995 in the project area), their economic significance to the tourism industry, and their status as indicators of aquatic ecosystem health. Since 1973, the Texas Colonial Waterbird Society has conducted annual censuses of all coastal Texas colonies and maintains a comprehensive database which provides annual census numbers and colony locations (TCWC 2006).

While locations of most important Texas colonies are on small offshore islands (TCWC 2006), most of those in the SNWW project area are in semi-protected industrial sites and other semi-urban sites. Sydney Island, a formerly important nesting island in upper Sabine Lake, has become inactive in recent years, probably due to predator invasion (Bailey, personal communication).

Regional waterbird population trends are a more accurate picture of waterbird population health than comparing individual colony counts from specific years, since nesting populations are known to shift frequently in response to predation, habitat conditions, parasite levels, and human disturbance. For purposes of comparison, Jefferson and Orange Counties, Texas, and Cameron Parish, Louisiana are considered the project area, and county (parish) dimensions are probably appropriate considering known waterbird home ranges and habitat use (Custer et al. 1978). In 2005, Jefferson and Orange Counties contained 10 known colonies with a total estimated population of 8,462 nesting pairs belonging to 13 species. Only one species of gull or tern was present, in comparison to Galveston Bay, where most years the laughing gull comprises over 50 percent of the nesting pairs (TCWC 2006). Most of the nesting birds belong to the heron, egret and ibis families, which are important components of freshwater marsh and swamp systems.

Nearby coastal Louisiana, while replete with excellent wading bird and other waterbird habitat (124,511 marsh acres in Sabine NWR alone), is devoid of even mid-sized (100 nesting pairs or greater) colony sites. Because we do not have a yearly coastal Louisiana dataset comparable to the TCWC, we used the May/June 2000 USGS colonial waterbird flight survey summary (Michot et al. 2004). This survey, conducted by Federal and state wildlife personnel at infrequent intervals since 1980, located only two small colonies totaling an estimated 106 nesting pairs belonging to four species. Waterbird experts have long concluded that successful nesting habitat must be geographically isolated and free from land-based predators (Soots and Landin 1978).

Because of the lack of large, multi-species waterbird colonies within huge habitat tracts in the project area, it seems logical that new, well-protected and managed offshore islands would be utilized by nesting colonial waterbirds. Recent experience in Galveston, Matagorda, Corpus Christi, and Nueces Bays supports this supposition.

**Protected (State and Federal) Natural Sites in Project Area**

The unique geographic location of the project study area at the confluence of the Central and Mississippi migratory bird flyways and its inherent natural diversity is reflected in the fact that six major state or Federally-protected parks and refuges are located here. Figures 3 and 4 show these protected areas. This list does not include private, city, or county parks and refuges.

*McFaddin National Wildlife Refuge* --- This 55,000-acre U.S. Fish and Wildlife Service (Service) refuge was established in 1980 and contains the largest tracts of coastal freshwater marsh remaining in Texas. The 5,400-acre White Marsh tract was added in 2000. Most of McFaddin NWR is saline to brackish marsh. It was probably was a freshwater marsh prior to GIWW construction in the 1940's and erosion and subsidence in the 1970's. Large freshwater areas still exist in interior areas west of Clam Lake (Figure 2). McFaddin NWR hosts approximately 10,000 visitors annually, including 2,400 annual hunter-days of waterfowl hunting. The degradation of SH 87 along the coastline during a 1993 hurricane has reduced visitation.

*Texas Point National Wildlife Refuge* --- Managed as a unit of McFaddin NWR, this 8,900-acre tract lies entirely between the Gulf of Mexico beach and SH 87 and to the west of Sabine Pass. It is almost entirely saline marsh, brackish marsh, and moist saline (*Spartina patens* or marsh hay) prairie. The small brackish to saline lakes and large marsh hay meadows attract seasonally large duck and goose populations. SNWW project hydrologic unit TX-8 (Figure 1) is entirely within Texas Point NWR.

*Sea Rim State Park* --- This Texas Parks and Wildlife Department (TPWD)-administered, 4,141-acre tract lies south and east of McFaddin NWR. The headquarters is located and most visitations occur within the 5.2-mile long Gulf beach frontage tract located to the south of SH 87. This state park contains important beach dune, backdune marsh and prairie, and freshwater wetlands and is especially important as spring neotropic migrant songbird and waterbird habitat due to its location. Dedicated in 1977, it has been closed awaiting repairs since Hurricane Rita in September 2005.

*J.D. Murphree Wildlife Management Area* --- This State of Texas WMA is composed of three separate tracts (Big Hill, Hillebrandt, and Lost Lake Units) totaling 24,250 acres lying east of McFaddin NWR and on both the north and south sides of the GIWW. It was purchased from the McFaddin family in 1950. The fresh, intermediate, and brackish marshes of this WMA are some of the most important migrant and stopover habitat in the Central Flyway and host upwards of 50,000 ducks per year. Some marsh tracts are managed to maintain intermediate to freshwater marsh characteristics optimum for waterfowl. Round Lake, a 500-acre natural lake within a protective levee system constructed in the 1960s when salinity intrusion first became a serious problem, contains some of the highest-quality freshwater aquatic habitat remaining on the upper Texas coast. Large flocks of canvasback (*Aythya valisneria*) traditionally use this area on a seasonal basis (Sutherlin 1996). J.D. Murphree is in project hydrological units TX-7 and TX-9.

*Lower Neches Wildlife Management Area* --- The 7,998-acre Nelda Starks Unit and the Old River Unit are located along the Neches River north of the SH 87 (Rainbow) bridge, immediately north of the confluence of the Neches River and Sabine Lake. These brackish marshes have suffered considerable losses, accelerated during the 1960s from land subsidence and salinity intrusion into formerly freshwater systems. Two projects at Bessie Heights have restored over 250 acres of subsided open water habitat back to emergent marsh, a hopeful sign that this trend is being reversed. The WMA is in project hydrological unit TX-10.

*Sabine Island Wildlife Area* – This 8,743-acre unit is on the east side of the lower Sabine River, just upstream from IH-10 and the GIWW. It is managed by the Louisiana Department of Wildlife & Fisheries. It is heavily forested with primarily cypress-tupelo swamp intermixed with

pine-hardwood ridges and oak-hickory-pecan bottomland forest. Numerous creeks, sloughs, and backwater swamps cross the area. As with all the forested portions of the project area, it provides invaluable spring stopover habitat for neotropical migrant songbirds. It lies within project hydrological unit LA-/TX-1.

*Sabine National Wildlife Refuge* --- This huge (124,511-acre) Louisiana refuge lies immediately east of Sabine Lake. It is important to the project due to its large size, wetland diversity, and its potential for protecting the sensitive intermediate marsh systems located within one mile of the eastern Sabine Lake shoreline from the negative impacts of increased salinities (see *Project Impacts* chapter). An interesting portion of the refuge is Sabine Pool #3, a 26,000-acre, leveed impoundment which is managed to support entirely freshwater marshes. The type of fresh marsh system enclosed within the completely leveed Sabine Pool #3, with its inherent high diversity of aquatic plants and bird life, would have been much more widespread in the project area before the SNWW and GIWW intruded into these systems.

Sabine NWR is comprised of seven management units containing fresh, intermediate, brackish, and saline marsh. Hydrologic management on the refuge is focused primarily on controlling salinity and minimizing tidal fluctuations through the construction and operation of levees, weirs, and gated structures. Managers strive to achieve a balance between reducing wetland plant waterlogging and saltwater intrusion stresses, and providing access for estuarine fish and shellfish organisms to interior marshes during critical life-cycle events.

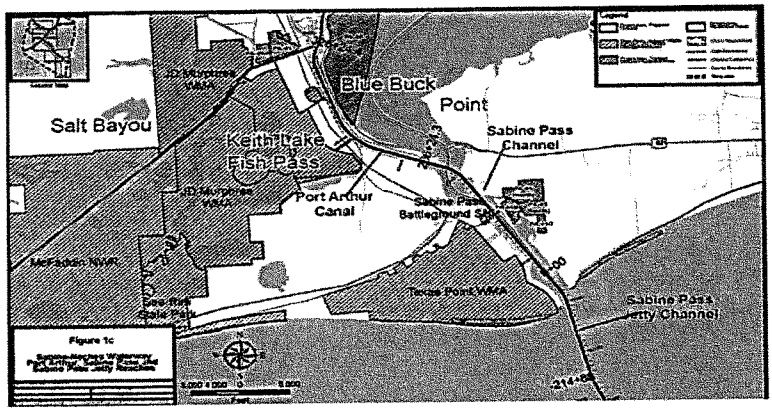


**Figure 3 Federal and State protected areas within study area – Sabine Pass**

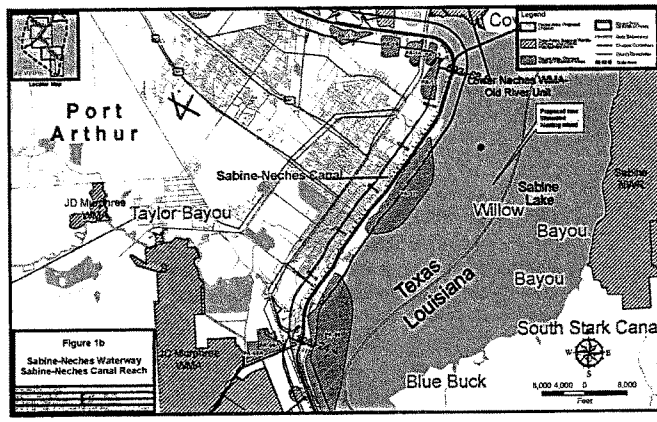


**Figure 4 Federal and State protected areas within study area – Mid Sabine Lake**

**Existing SNWW Disposal Areas**

Thirteen (13) existing, designated, or proposed dredged material disposal areas lie alongside the 67-mile SNWW right-of-way (Figure 1). Habitat within these areas ranges from offshore Gulf of Mexico marine habitat (disposal areas (DA) 1-4), high-quality intermediate marsh (DA 16A), relatively undisturbed *Spartina patens* wet meadow (DA 14A), leveed scrub-shrub partially wetland community (DA 23A), and several previously used, wholly or partially-leveed sites with somewhat disturbed upland and wetland communities (DAs 24A, 26, 27A, 27C, and 27D).

Disposal areas 1-4 lie four to 30 miles offshore to the west of the SNWW channel. Dredged material has been placed in these areas repeatedly during the past 40 years. However, winnowing and ocean currents tend to redistribute placed sediments, and bottom composition ranges from coarse sands to soft muds. Typical bottom invertebrate communities consist of *Polychaete* and *Oligochaete* worms, clams (*Mercenaria sp.*), arks (*Anadara sp.*), sand dollar (*Mellita quinquiesperforata*), brittle stars (*Hemipholis sp.*), blue crab (*Callinectes sapidus*), and box crab (*Calappa sulcata*). Nektonic invertebrates include white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*), and peppermint shrimp (*Lysmanta wurdemannta*). Important and common fish are Gulf trout (*Cynoscion nothus*), Lane snapper (*Lutjanus synagris*), Spanish mackerel (*Scomberomorus maculatus*), and cobia (*Rachycentron canadum*).

Dominant wetland plants in intermediate marsh sites such as at DA 16A are salt-marsh bulrush, Olney's bulrush (*Schoenoplectus americanus*), California bulrush (*Schoenoplectus californicus*), black needlerush (*Juncus roemerianus*), marsh-hay cordgrass (*Spartina patens*), *Paspalum vaginatum*, narrow-leaf cattail (*Typha angustifolia*) and widgeon-grass (*Ruppia maritima*). These dominants and the circulation pattern and elevation are indicative of relatively undisturbed high-quality intermediate marsh. As such, this area provides excellent wetland habitat for furbearing mammals, native reptiles, resident waterbirds, and migrant waterfowl, in addition to providing nursery habitat and detrital input for marine fisheries. 6

Wet shrub/scrub communities, such as at DA 14, are of mixed successional states, indicating altered and fluctuating water regimes. Typical understory plants include ferns, common reed (*Juncus sp.)*, California bulrush (*Schoenoplectus californicus*), frogfruit (*Phyla lanceolata*), blackberry (*Rubus sp.*), and *Aster* sp. The lack of large open-water areas or natural circulation patterns and the dense thicket-like forest structure inhibit this site's value for native wildlife. However, it has potential for management and contains some native wildlife habitat values for mid-story songbirds such as *Empidonax* flycatcher, cardinal, yellow-rumped warbler, and common blackbird, and small numbers of waterfowl such as wood duck.

**Methods of Study**

*Project Area Wetland Analysis*

Early in project planning, Service biologists delineated and quantified wetland communities adjacent to the SNWW channel and mapped tributaries, including relatively small creeks and sloughs, which could serve as conduits for salinity intrusion into sensitive aquatic communities. This information can be used to measure future impacts from salinity increases into fresh or intermediate systems, after hydrodynamic/salinity modeling results became available. It can also be used to identify potential wetland impacts from channel enlargement and potential sites of salinity intrusion that would need to be corrected or mitigated.

*Corps of Engineers Hydrodynamic/Salinity Model*

The SNWW project presented a complicated and difficult set of conditions for estimating project-related impacts to fish and wildlife resources and to wetland communities. The potentially affected ecosystem is huge, complex (both in terms of its hydrology and its biology), and interconnected. Within the 1,035,154-acre vegetated portion (including agricultural lands) of the study area (Table 1), six major wetland types (including special aquatic sites such as beaches) total 706,632 acres or approximately 68 percent of all lands exclusive of development (PBS&J 2003). Wetlands and special aquatic sites can be categorized into six major vegetative community types (Table 1).

Six major hydrological features in the project area potentially allow high-salinity Gulf of Mexico waters to enter ecologically sensitive ecosystems: Sabine Pass, Sabine-Neches and Port Arthur Canals, Gulf Intracoastal Waterway, Sabine River, Neches River, and Sabine Lake (Figure 1).

The entire SNWW system exhibits complex circulation and salinity patterns. This is due to the two large and numerous small freshwater rivers and tributary streams, the huge storage basins (including the 43,978-acre Sabine Lake, the 11,363-acre Bessie Heights Marsh, and the 5,817acre Rose City basin) which serve as salinity-retention basins, the numerous smaller circulation channels into adjacent ecosystems, the deep manmade canal systems, and the large active tidal pass (Sabine Pass).

Because of these factors, the Interagency Coordination Team (ICT) determined that a state-of-the-art numerical model calculating salinity and hydrodynamic changes from channel modifications would be necessary to estimate project impacts. The TABS-MDS model was extensively modified from its original format, the RMA 10 model by Resource Management Associates (King 1993), to compute hydrodynamics, salinity transport, and sediment transport for alterations to large-scale waterways from navigation projects such as the Houston-Galveston Navigation Channels, Texas. The TABS-MDS Hydrodynamic/Salinity Model (HS) was used to predict salinity changes for each project hydrological unit.

The ICT utilized the model to develop the present, future without project, and future with project salinity scenarios essential for the predictive Wetland Values Assessment (WVA) methodology. Because WVA methodology incorporates salinity changes in assessing habitat quality, it is appropriate for this project, because salinity impacts to important freshwater systems upstream from channel enlargement are considered among the most serious potential project impacts.

The project area "profile" incorporated into the TABS/MDS model matrix included 15 hydrologic sampling stations, which were sampled for the nine-month period from January to September 2002, and 38 H/S model nodes, or mathematical model calculation "output" points. The physical sampling stations were at: 1) Pine Island Bayou, 2) Neches River at Rose City, 3) Neches River at Bessie Heights, 4) Mouth of Sabine River at GIWW, 5) Sabine River at I-10 bridge, 6) Pleasure Island MLK bridge, 7) Texas Point, 8) upper Sabine Lake at Black Bayou, 9) lower Sabine Lake at Buck Point, 10) Black Bayou at East Pass, 11) Black Bayou at GIWW, 12) Star Lake at GIWW, 13) Johnson's Bayou inside mouth, 14) Keith Lake Fish Pass, and 15) Willow Bayou inside mouth. The planned offshore Gulf of Mexico sensor was not deployed due to sea conditions, but background Gulf data was readily available from NOAA sources. The 38 H/S model "output" nodes ranged from the Neches River Saltwater Barrier south to Johnson's Bayou in Louisiana, and included Cow Bayou, Adams Bayou, Black Bayou, the GIWW west to Taylor's Bayou and east to Black Bayou and 14 stations in the vast, and potentially sensitive, marsh tracts east of Sabine Lake. This frequency of model "output" nodes allowed the ICT to refine estimates of salinity changes to relatively small aquatic habitat tracts.

Changes to salinity were incorporated into habitat productivity change calculations for each of the three aquatic habitat types as one of five variables, with salinity negatively affecting productivity, thus accelerating interior marsh loss. Since the TABS-MDS code was designed to measure alterations to salinity from channel modifications, it was considered the best tool to use for the present project. Other models were considered, including the Sabine Basin-Calcasieu Ship Channel Hydrodynamic Model developed by Dr. Ehab Meselhe of the University of Louisiana-Lafayette. However, the TABS-MDS model as developed by Corps' Engineer Research and Development Center (ERDC-WES) was considered the most sensitive and appropriate.

*Sea Level Rise*

Sea level rise in the Sabine Neches estuary systems is very uncertain. In the fall of 2008, the Corps began to incorporate relative sea level rise (RSLR) into the SNWW HS modeling. This report used "most likely" scenarios of 0.5 meter, 1.0 meter and 1.5 meters over a 100 year period for possible changes for projects. The National Research Council (NRC) committee recommended that these rates be revisited every decade to incorporate additional data. The 2008

modeling efforts used the NRC II curve as it presented the most likely sea level rise changes for the project (Table 2).

On July 1, 2009, the Corps issued new guidance that requires that relative sea level rise changes be incorporated into all Corps coastal activities. In addition, the Corps reviewed sea level rise predictions suggested by the Intergovernmental Panel on Climate Change (IPCC 2007). The IPCC 2007 report assumes sea level rise on the premise that thermal expansion contributes to 70-75 percent of the rise. Should the ice sheets in Greenland and Antarctica melt faster than the current rate, these sea level projections will be obsolete. Table 2 illustrates predicted sea level rise by the NRC and the IPCC.

**Table 2 National Research Council and Intergovernmental Panel on Climate Change rates of sea level rise**

| Eustatic Sea Level Rise Estimates | 50 years | 100 years |
|---|---|---|
| Existing rate | 60 mm (1.2 mm/yr) | 120 mm (1.2 mm/yr) |
| NRC I | 130 mm (2.6 mm/yr) | 400 mm (4.0 mm/yr) |
| NRC II<br>NRC III | 225 mm (4.5 mm/yr)<br>322.5 mm (6.45 mm/yr) | 780 mm (7.8 mm/yr)<br>1125 mm (11.25 mm/yr) |
| IPCC AR4 - Scenario B1: lower end of range | 90 mm (1.8 mm/yr) | 180 mm (1.8 mm/yr) |
| IPCC AR4 - Scenario A1B: mid range of all scenarios | 190 mm (3.8 mm/yr) | 380 mm (3.8 mm/yr) |
| IPCC AR4 - Scenario A1F1: high end of range | 295 mm (5.9 mm/yr) | 590 mm (5.9 mm/yr) |

(Corps 2009b)

Under these new guidelines, several changes were made to the existing Wetland Value Assessment (WVA) model (discussed in the next section) to account for RSLR. Shoreline recession, interior marsh loss, salinity, marsh edge, percent shallow water and depth and duration of tidal flooding data were all incorporated into the model. For a full discussion of the variables, see USACE 2009a.

After further consideration, the Corps used a 1.1 foot RSLR as a most likely scenario. After the model had been run with the additional parameters and variables, results showed that swamps and bottomland hardwoods within the project area would experience an increase in depth and duration of tidal flooding as well as the substrate being exposed at low tide and longer seasonally. Additionally, the model showed that marsh elevation would maintain equilibrium with rising sea level and the interior marshes would not be submerged. Further, results showed that in Texas 86 acres of fresh marsh would be converted to upland and almost 39,000 acres would experience lower productivity and higher land loss rates from the indirect effects of increased salinity. Future without project (FWOP) land loss would increase from 7.5 percent to 8.2 percent through Time Year (TY) 65 and there would be a net loss of 412 Annual Average Habitat Units (AAHUs). In Louisiana, there would be no direct impacts to oyster reefs. Indirect impacts of higher salinity over 182,000 acres would result in lower productivity and higher land

loss. The FWOP land loss through TY 65 would increase from 10.5 percent to 11.5 percent and there would be a net loss of 1,709 AAHUs.

**Wetland Value Assessment (WVA) Ecological Model(s)**
The Wetland Values Assessment (WVA) methodology was developed in the early 1990's in Louisiana for assessment and rating of wetland restoration projects by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Environmental Work Group interagency team. The WVA methodology (USFWS 2002a and 2002b) was considered appropriate for SNWW project analysis by the ICT because it incorporates large-scale measurements of predicted changes to salinity and vegetation of coastal Louisiana habitats identical to those of the project area. The WVA methodology has been certified by the Corps for use in the ecological evaluation of the SNWW project and is currently under review for acceptance nationwide as an evaluation model to evaluate the impacts and benefits of Corps public works projects.

The WVA methodology requires predictions within model units, including predictions of future changes to land loss rates. Therefore, the interagency team determined historic land loss rates for each wetland habitat type within each project hydrologic unit by GIS comparison of historic aerials from the past 20 to 25 years. From this, FWOP land loss rates, then a FWP (future with project) land loss rate and projected historical rates over the 50-year project life were established using the Productivity-based Land Loss Increase Method modified from Visser et al. 2004a and 2004b. This salinity-effect information was then used in the WVA models (USFWS 2002b) by marsh habitat type. This method is based on a direct linear correlation between decreased primary productivity due to salinity increases with increased land losses due to the project. There was some concern, based on knowledge of specific Louisiana coastal marsh tracts for which detailed historic information was available, that Visser's methods might underestimate losses when salinities exceed "optimal" ranges for a particular marsh type. However the interagency evaluation group agreed to use the Visser productivity method because it was science based. Tables 3 and 4 show the estimated salinity changes and habitat losses for the Texas and Louisiana hydrologic units, respectively. The Corps and the ICT members agreed early in project planning that habitat losses should be tabulated and mitigated, if required, independently for Texas and Louisiana resources (Tables 3 and 4). Figure 5 shows locations of the HU's. Numbering proceeds generally from north to south.

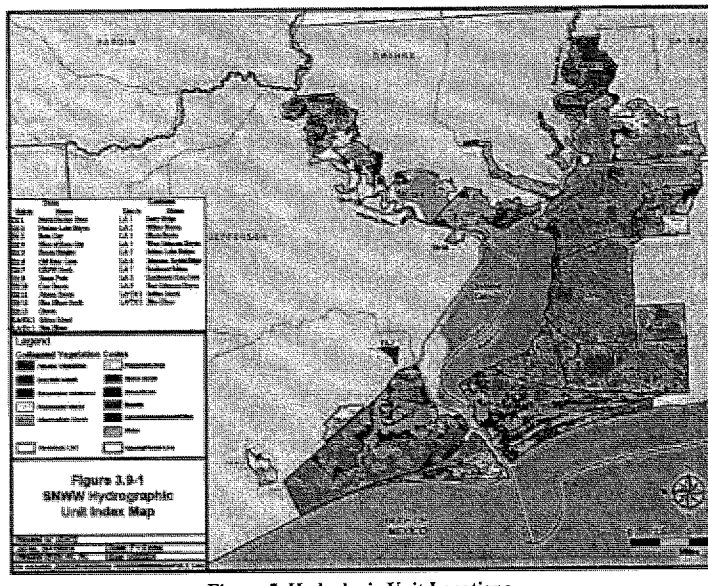


**Figure 5 Hydrologic Unit Locations**

In July 2009, the Corps received new compliance items to be incorporated into the both the HS and WVA models. RSLR and fresh water inflows were to be integrated into both models. The WVA model assessment was performed to comply with the new Corps model certification regulations.

The WVA methodology incorporates seven community habitats: 1) fresh/intermediate marsh, 2) brackish marsh, 3) saline marsh, 4) bottomland hardwood forest, 5) barrier headland, 6) freshwater swamp, and 7) coastal Chenier/ridge. The three marsh models, the freshwater swamp model, and the bottomland hardwood model were used for project analysis. Table 3 summarizes place names, habitat classifications, and approximate acreages of habitat tracts analyzed under each WVA habitat classification, with findings. Results are expressed in average annual habitat units (AAHU's) and acreages (+ or -) and are used to compute required mitigation and benefits of beneficial use (BU) features.

It should be noted that, as with any numerical model of ecological functions, exact numerical output should be interpreted with caution. Positive and negative habitat trends, as judged from known historic responses to similar causes, should be considered in addition to model outputs. The ICT reviewed the literature to determine past responses to salinity changes and erosion within large marsh tracts, such as at Bessie Heights, Keith Lake, and Black Bayou, to determine if changes predicted by the model were reasonable. The Service considered model output in terms of acres affected to be more significant than AAHUs, therefore acres were given more weight in selecting mitigation. In all cases, the mitigation and BU plan compensate for projected AAHU and habitat losses for each project hydrologic unit, for each wetland habitat type, and within each state. Table 5 summarizes project impacts by habitat type.

**Table 3 Texas net salinity changes, AAHU and total acreage by HU and habitat type**

| HU # | Hydrologic Unit | Habitat Type | FWP Net Change Total Acres | FWP Net Change AAHUs | FWP Net Salinity Change (ppt) |
|---|---|---|---|---|---|
| | | | | | |
| LA/TX 1 | Sabine Island | Cypress/Tupelo Swamp | 0 | 0 | 0.0 |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0 | 0 | 0.0 |
| LA/TX 2 | Blue Elbow | Cypress/Tupelo Swamp (BH lumped) | 0 | 0 | 0.3 |
| TX 1 | North Neches River | Cypress/Tupelo Swamp | 0 | 0 | 0.0 |
| TX 1 | North Neches River | Fresh Marsh | 0 | 0 | 0.0 |
| TX 1 | North Neches River | Bottomland Hardwood | 0 | 0 | 0.0 |
| TX 2 | Neches-Lake Bayou | Cypress/Tupelo Swamp | 0 | 0 | 0.0 |
| TX 2 | Neches-Lake Bayou | Fresh Marsh | 0 | 0 | 0.1 |
| TX 2 | Neches-Lake Bayou | Bottomland Hardwood | 0 | 0 | 0.0 |
| TX 3 | Rose City PA24A | Fresh Marsh | -86 | -32 | 0.3 |
| TX 3 | Rose City | Fresh Marsh | -3 | -1 | 0.3 |
| TX 3 | Rose City | Cypress/Tupelo Swamp | 0 | 0 | 0.3 |
| TX 3 | Rose City | Bottomland Hardwood | 0 | 0 | 0.3 |
| TX 4 | West of Rose City | Fresh Marsh | -1 | 0 | 0.4 |
| TX 5 | Bessie Heights | Intermediate (Brackish lumped) | -1 | -14 | 0.3 |
| TX 5 | Bessie Heights | Fresh Marsh | -2 | 0 | 0.5 |
| TX 5 | Bessie Heights | Bottomland Hardwood | 0 | 0 | 0.5 |
| TX 6 | Old River Cove | Brackish Marsh | -46 | -116 | 1.8 |
| TX 6 | Old River Cove | Bottomland Hardwood | 0 | 0 | 0.5 |
| TX 7 | GIWW North | Fresh (Intermediate lumped) | -63 | -140 | 1.6 |
| TX 7 | GIWW North | Brackish Marsh | -2 | -8 | 1.6 |
| TX 8 | Texas Point | Intermediate (Fresh lumped) | -6 | -19 | 0.8 |
| TX 8 | Texas Point | Brackish Marsh | -5 | -7 | 0.8 |
| TX 8 | Texas Point | Saline Marsh | -17 | -5 | 0.8 |
| TX 10 | Cow Bayou | Fresh Marsh | -6 | -18 | 1.0 |
| TX 10 | Cow Bayou | Intermediate Marsh | -3 | -12 | 1.0 |
| TX 10 | Cow Bayou | Cypress/Tupelo Swamp | 0 | 0 | 1.0 |
| TX 10 | Cow Bayou | Bottomland Hardwood | 0 | 0 | 1.0 |
| TX 11 | Adams Bayou | Fresh Marsh | -3 | -15 | 1.5 |
| TX 11 | Adams Bayou | Cypress/Tupelo Swamp | 0 | -4 | 0.8 |
| TX 11 | Adams Bayou | Bottomland Hardwood | 0 | 0 | 0.8 |
| TX 12 | Blue Elbow South | Cypress/Tupelo Swamp | 0 | -18 | 0.6 |
| TX 13 | Groves | Intermediate Marsh | -3 | -3 | 1.0 |
| | Totals | | -247 | -412 | |

(Corps 2009)

Note: WVA analysis assumes continued land loss w/o project at historic (30-year) rates
* TX9 Salt Bayou salinity impacts to be evaluated and (potentially) avoided under Keith Lake Fish Pass Continuing Authority Section 1135 Project

**Table 4 Net Changes to Louisiana Aquatic Habitats with 48-Foot Project by WVA Model AAHU's, Acreage, and Habitat Type**

| HU # | Hydrologic Unit | Habitat Type | FWOP Net Change Acres | FWP Net Change Total Acres | FWP Net Change AAHUs | FWP Net Salinity Change (ppt) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| LA 3 | Black Bayou | Intermediate Marsh | -1,713 | -130 | -509 | 1.1 |
| LA 2 | Willow Bayou | Intermediate (Brackish lumped) | -2,116 | -102 | -328 | 0.9 |
| LA 4 | West Johnsons Bayou | Intermediate Marsh | -1,703 | -142 | -269 | 1.2 |
| LA 5 | Sabine Lake Ridges | Intermediate Marsh | -1,103 | -93 | -218 | 1.2 |
| LA 9 | East Johnsons Bayou | Intermediate Marsh | -895 | -46 | -190 | 1.0 |
| LA 1 | Perry Ridge | Fresh Marsh | -921 | -50 | -65 | 0.3 |
| LA 1 | Perry Ridge | Intermediate Marsh | -191 | -12 | -53 | 0.3 |
| LA 5 | Sabine Lake Ridges | Saline Marsh | -398 | -10 | -35 | 1.4 |
| LA 8 | Southwest Gum Cove | Fresh Marsh | -152 | -8 | -14 | 0.9 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh | -2,567 | -43 | -14 | 0.6 |
| LA 7 | Southeast Sabine | Fresh Marsh | -40 | 0 | -11 | 0.5 |
| LA 6 | Johnsons Bayou Ridge | Brackish Marsh | -707 | -22 | -6 | 0.7 |
| LA 8 | Southwest Gum Cove | Intermediate (Brackish lumped) | -233 | -15 | -4 | 0.9 |
| LA 6 | Johnsons Bayou Ridge | Saline Marsh | -93 | -5 | -2 | 1.8 |
| LA 3 | Black Bayou | Brackish Marsh | -803 | -4 | -1 | 0.8 |
| LA 4 | West Johnsons Bayou | Brackish Marsh | -1,189 | -6 | -1 | 0.7 |
| LA 2 | Willow Bayou | Brackish Marsh | -695 | -2 | -1 | 1.4 |
| LA/TX 1 | Sabine Island | Cypress/Tupelo Swamp | 0 | 0 | 0 | 0.4 |
| LA/TX 2 | Blue Elbow | Cypress/Tupelo Swamp (BH lumped) | 0 | 0 | 0 | 0.6 |
| LA 7 | Southeast Sabine | Intermediate (Brackish lumped) | -96 | -1 | 0 | 0.2 |
| LA 1 | Perry Ridge | Bottomland Hardwood | 0 | 0 | 0 | 0.3 |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0 | 0 | 0 | 0.4 |
| Total | | | -15,615 | -691 | -1,721 | |

(Corps 2009)

Eighty-two percent of the Sabine-Neches Enlargement project Texas AAHU impacts are predicted to occur in fresh (-206 AAHUs) (50 percent) and brackish marshes (-131 AAHUs) (32 percent). Seventy-eight percent of the acreage (541 acres) and 91 percent of the AAHU impacts (1,571 AAHUs) are predicted to occur in Louisiana intermediate marshes. Few to no impacts are expected in swamp and bottomland hardwood habitats in Texas (0 acres, -22 AAHUs swamp), and Louisiana (0 acres, -44 AAHUs swamp). Eleven and 8.4 percent of the Louisiana acreage impacts are predicted to occur in brackish and fresh marshes, respectively (Table 5).

Table 5 WVA Ecological Modeling Results Summary

| Habitat | Texas (acres) | Texas (AAHUs) | Louisiana (acres) | LA (AAHUs) |
|---|---|---|---|---|
| Saline marsh | -17 | -5 | -15 | -37 |
| Brackish marsh | -53 | -131 (32%) | -77 (11%) | -23 |
| Intermediate marsh | -13 | -48 | -541 (78%) | -1,571 (91%) |
| Fresh marsh | -164 | -206 (50%) | -58 (8.4%) | -90 |
| Swamp | 0 | -22 | 0 | 0 |
| Bottomland hardwood | 0 | 0 | 0 | 0 |
| **TOTAL** | **-247** | **- 412** | **-691** | **-1,721** |

9

**SNWW Project Impacts**

***General salinity-related impacts to aquatic communities (Texas and Louisiana)***

In the initial phases of project planning and interagency coordination, the Service and the other resource agencies expressed concerns that further salinity intrusion into the largest remaining tracts of high-quality fresh, intermediate, and brackish marshes on the Texas and Louisiana Gulf coast would likely be the SNWW project's greatest negative impact (USACE 2009).

Further, the Service considered alterations of salinities in the upper Neches and upper Sabine watersheds to be of higher concern than alterations of salinity to the higher-salinity, lower watershed marshes adjacent to Gulf of Mexico and GIWW waters. This is because undisturbed swamps and fresh marshes are composed of diverse assemblages of aquatic plants adapted to fresh water. These communities are tolerant of only a very few parts per thousand of salt over a very short time period. They are acutely affected by the sudden addition of only a few parts per thousand of salt (Reid and Wood 1976). For example, cypress-tupelo swamps on the lower Neches River system, in the vicinity of what is now Bessie Heights Marsh, disappeared within only a few years of original SNWW and GIWW construction, almost certainly from acute rises in salinity levels (Sutherlin 2005). This is typical for fresh to intermediate swamp and marsh systems (Brown and Montz 1986). Of course, concurrent localized events related to oilfield brine water discharges and logging directly impacted these forests also.

The brackish to saline marshes south of the GIWW in Texas and within a mile or so of Sabine Lake and the Gulf of Mexico in Louisiana are generally less diverse, are composed of plant species adapted to a wider range of salinities and are capable of tolerating salinities above 6 ppt on a semi-permanent basis. Increased salinities have been shown to be deleterious to brackish and even saline marsh by decreasing plant productivity, diversity, and by indirectly increasing marsh erosion (Visser et al. 2004b), and should be mitigated. However, they are not considered as sensitive to salinity changes as the fresher aquatic systems further upstream because salinity-induced plant stress in those locations is less likely to result in immediate marsh die-off.

Many scientific literature reports have concluded that increased salinities are detrimental to most fresh, intermediate and some brackish species of wetland vegetation (Hester et al. 2002). Hester et al. (2002) reviewed over 100 scientific studies concerning the salinity and water logging effects on 22 wetland species. All specimens of *Leersia oryzoides* died at salinities of 6, 9, and 12 ppt (Flynn et al 1995). Salinities of 15 ppt were lethal to both *Leersia oryzoides* and *Panicum hemitomon* (maidencane) in the field (McKee and Mendelssohn 1989). *Panicum hemitomon* stem height was reduced at 6 ppt and aboveground tissue mortality was seen in maidencane at

salinities of 12 ppt in greenhouse treatments (Howard and Mendelssohn 1999a). *Panicum hemitomon* was not able to recover total and below ground biomass associated with increased salinities (Howard and Mendelssohn 1999b). Hester et al. (1998) reported lethal salinity levels from 7.6 to 12 ppt for *P. hemitomon*. Bulltongue (*Sagittaria lancifolia*), a dominant fresh marsh species, is found at average salinities of 0.3 ppt (White 1983). *Sagittaria lancifolia* biomass was reduced at 6 ppt (Baldwin and Mendelssohn 1998), tissue damage occurred at 4.8 ppt (McKee and Mendelssohn 1989), growth decreased at 4 ppt (La Peyre 2001), and 2.9 ppt decreased photosynthesis and was lethal (Pezeshki et al. 1987a). Duck potato (*Sagittaria latifolia*), a common arrowhead, experienced tissue wilting and chlorosis at 6 ppt (Holm and Sasser 2001).

Marshhay cordgrass (*Spartina patens*), the most common intermediate and low salinity brackish marsh grass species, has a salinity range of 0 to 4 ppt (Taylor et al. 1997). As salinity increased from < 1 ppt to 6 ppt, net photosynthesis, leaf conductivity, and root and shoot dry weights decreased (Bandyopadhyay et al. 1993). Salinities of 15 to 25 ppt decreased *S. patens* height, foliage and root dry weight (Pezeshki and DeLaune 1991), increased salinities from 0 to 22 ppt decreased stomatal conductance by 54 percent and net photosynthesis by 43 percent (Pezeshki et al. 1987b), salinities of 30 ppt decreased photosynthesis by 36 percent (Bertness et al. 1992), and Broome et al. (1995) found a decrease in stem length and number at salinities greater than 10 ppt. Cattail (*Typha latifolia*) had decreased biomass at salinities of 1.8 ppt, total biomass was significantly depressed at 18 ppt after 3 weeks, and total mortality was observed at salinities of 18 ppt after 4 months (Hootsmans and Wiegman 1998).

The HS model input was chosen by the modeling committee to provide conservative estimates of salinity changes associated with channel enlargement. Low flow changes were calculated using the three-month period exhibiting lowest flows of the simulation period, ranging from 400 to 800 cubic feet per second (cfs) on the Sabine River and 400 to 500 cfs on the Neches River. These are significantly lower than mean flows. Median flow salinities were calculated for a six-month period, not including late winter and early spring (usually higher rainfall) months.

Hydrodynamic/salinity model results are summarized by hydrologic unit in Tables 3 and 4 for Texas and Louisiana respectively. Salinity impacts are summarized in habitat acres by net with-project acreage loss and maximum projected salinity change by habitat type and hydrologic unit. Table 5 summarizes projected salinity-related habitat losses by habitat type within each state by acres and AAHUs. Following are summaries of the Service's analysis of potential project-related salinity impacts, by hydrologic units in Texas and Louisiana.

**Salinty related impacts to aquatic communities**

***Texas Habitat Areas***

A review of the impacts associated with the most recent modeling efforts suggest that Texas will have a conversion of 86 acres of fresh water marsh to upland at DA 24A. Indirect impacts suggest higher salinities over approximately 39,000 acres, resulting in lower productivity. In addition, the model indicates that there will be no salinity impacts in swamps/bottomland hardwoods/fresh water marsh north of I-10. Salinity increases range from 0.3 to 1.8 ppt, with the highest impacts in fresh water marsh at GIWW North and Adams Bayou, and brackish marsh in Old River Cove and GIWW North.

**Upper Neches River**

*North Neches River (Project HU TX 1)* --- This 4,143-acre unit has 2,760 acres of cypress-tupelo, 384 acres of fresh water marsh, 412 acres of bottomland hardwood forests, 127 acres of open water and the remainder is scrub/shrub and upland habitats. The large riverine flows and seasonal flooding that this area is exposed to would continue and only a negligible increase in water surface elevation would be expected in the FWP. The HS model indicates that no FWP salinity impacts and no loss of bottomland hardwood, marsh or swamp habitat acreage are expected to occur. As a result, there are no AAHU losses for hydrologic unit TX 1.

*Neches Lake Bayou (Project HU TX 2)* --- This 5,707-acre unit is located immediately downstream from TX 1 and contains 2,277 acres of cypress-tupelo swamp, 1,270 acres of fresh marsh, 1,040 acres of bottomland hardwood forests, with the remainder scrub/shrub and upland habitats. Habitats and fish and wildlife resources in this unit are very similar to TX 1. The large riverine trough flows and seasonal flooding that this area is exposed to would continue in the FWP and only a negligible increase in water surface elevation would be expected. The HS model indicates that no FWP salinity impacts and no loss of bottomland hardwood, marsh or swamp habitat acreage are expected to occur. As a result, there are no AAHU losses for hydrologic unit TX 2.

*Rose City (Project HU TX 3)* --- This 5,805-acre unit has 2,323 acres of fresh marsh, 1,775 acres of bottomland hardwood forests, 464 acres of cypress-tupelo, 1091 acres of open water, with the remainder other upland habitats. FWP impacts are associated with a 0.5 ppt salinity increase and would result in the loss of three acres of fresh marsh, with no losses in the bottomland hardwood or swamp areas. Also, the SNWW Dredged Material Management Plan proposes to expand an existing placement area in this unit. This expansion would result in the conversion of 85 acres of fresh marsh and 1 acre of open water to a confined upland placement area and the loss of 32 AAHUs.

*West of Rose City (Project HU TX 4)* --- This 493-acre unit contains 395 acres of fresh marsh and 97 acres of open water habitat. The marshes are remnants of larger marshes impacted by the industrial facilities and Corps placement area in the unit. Impacts associated with the project will be minimal. Salinity changes are expected to be minimal (0.5 ppt) with a loss of one acre of fresh marsh resulting in no change in AAHU's for this unit.

**Lower Neches River**

*Bessie Height (Project HU TX 5)* --- Bessie Heights is an 11,363-acre hydrologic unit and is the sight of the most contiguous loss of marsh in Texas. The unit contains 2,018 acres of fresh marsh, 1,932 acres of intermediate marsh, and 293 acres of bottomland hardwoods. FWP impacts would be associated with small increases in salinity (0.5ppt) and the loss of two acres of fresh marsh and one acre of intermediate marsh. These impacts would result in a total loss of 14 AAHUs for the unit.

*Old River (Project HU TX 6)* --- This unit is approximately 11,851 acres and contains 5,240 acres of brackish marsh and 230 acres of fresh and intermediate marsh on the periphery. There is a 199-acre tract of bottomland hardwood in one corner of the unit and 3,620 acres of the unit is open water. Increases of salinity to 13 ppt and the loss of 46 acres of brackish marsh result in a total loss of 116 AAHUs for the unit.

**Gulf of Mexico to North of GIWW**

*GIWW North (Project HU TX 7)* --- This 5,907-acre unit is comprised of three units located on the north side of the GIWW and all are within the largest remaining coastal freshwater marsh in Texas. There are 4,541 acres of fresh marsh, 588 acres of brackish marsh, 129 acres of intermediate marsh and 195 acres of open water. TPWD baseline salinities range from 0.7 to 0.9 ppt during the growing season in fresh and brackish marshes, respectively. Project impacts expect an increase in salinity to 4.0 ppt in fresh marsh and 1.6 ppt in brackish marshes. Sixty-three acres of fresh and two acres of brackish marsh will be lost. Project impacts will result in a total loss of 148 AAHUs in this unit.

*Texas Point (Project HU TX 8)* --- This unit is 11,422 acres and lies adjacent to the SNWW at Sabine Pass and extends for almost 13.5 miles along the Gulf of Mexico. The Texas Point NWR lies completely within this unit. This unit contains 4,898 acres of saline marsh, 2,398 acres of brackish marsh, 1,605 acres of intermediate marsh, 100 acres of fresh marsh, 1,413 acres of other upland areas, and 1,008 acres of open water. Baseline salinities for this area average 5.75 ppt for intermediate, 8.5 ppt for brackish and 12.5 ppt for the saline marshes. It should be noted that periodic hurricanes and tropical depressions do inundate these areas with high salinity waters, but usually are then punctuated by long periods of freshwater recovery (Gooch 1996). However, the potential for a 0.56 ppt increase to affect standing crop of fresh/intermediate marsh via inflow points at the (Service-estimated) six tidal creeks and bank failure points is certainly real. This pattern tends to serve the beneficial function of removal of surplus above-ground vegetation, much like periodic wildfires in prairie regions, thus allowing highly productive new-growth vegetation to recover, to the benefit of wildlife populations. This is different from encroachment of chronic, slightly higher salinity levels in these communities, which has been shown to alter vegetation patterns to a less diverse and less productive state for wildlife (Palmisano 1972).

Project impacts would include increases in salinity, interior land loss and shoreline retreat increases. Salinities are expected to move to 7.8 ppt, 10.6 ppt and 14.6 ppt for the intermediate, brackish and saline marshes, respectively. Expected land losses are 6 acres, 5 acres and 17 acres for intermediate, brackish and saline marshes, respectively. Shoreline retreat is expected to increase to 0.42 ft/yr between 0.5 and 3.5 miles west of the jetty. These impacts are expected to result in a loss of 31 AAHUs in this unit.

*Salt Bayou (Project HU TX 9)* --- This 55,044-acre unit is adjacent to the SNWW between TX 8 and the GIWW. The majority of this unit lies within the J.D. Murphree WMA and the McFaddin NWR. The Salt Bayou unit has been extensively impacted by human development, i.e. oil exploration, cattle grazing and the construction of levees and ditches to create waterfowl hunting opportunities. This development has lead to increases in the amount of open water and has decreased the amount of emergent marsh with causes most likely being the increases in salt water intrusion. Predicted losses of salinity increases from 6.9 ppt to 9.6 ppt for the brackish marsh and to 7.4 for the intermediate marsh include 49 acres of brackish marsh and 202 acres of intermediate marsh are expected. The 251 acres of brackish/intermediate marsh loss in Salt Bayou <u>is not included</u> in project compensation requirements because it was agreed that the Section 1135 Water Resources Development Act (WRDA) Keith Lake Fish Pass project, a TPWD/Corps cooperative project supported by the Service, would protect this entire HU from project-induced salinity increases. In fact, current project design alternatives would reduce

salinities within this HU by as much as 10 ppt. **The Service will monitor SNWW deepening progress along with the Section 1135 Keith Lake Fish Pass Project and will recommend additional habitat compensation should the Keith Lake project fail to materialize.** 10

*Cow Bayou (Project HU TX 10)* --- Cow Bayou flows into the Sabine River approximately three miles north of its confluence with Sabine Lake. This 4,990-acre unit comprises a narrow riparian corridor and its entire length is confined by development and Bridge City. There are two upland placement areas, 1,436 acres of fresh water marsh, 1,445 acres of intermediate marsh, and 110 acres of cypress-tupelo swamp located within the unit. A salinity increase of 1.0 ppt is expected in the swamps and fresh water marshes in the upper reaches. Salinity increases of 1.0 ppt (Table 3) are expected for both fresh water and intermediate marshes in the lower reaches. Fresh water and intermediate marsh loss are expected to be six acres and three acres, respectively, for a loss of 30 AAHUs.

*Adams Bayou (Project HU TX 11)* --- Adams Bayou flows into the Sabine River approximately 5 miles north of Sabine Lake. This 1,679-acre unit is comprised of a narrow riparian corridor. There are 516 acres of fresh marsh and 640 acres of bottomland hardwood forests. Cypress tupelo comprises only 115 acres in this unit. Swamp communities are expected to see salinity increases of 0.8 ppt and fresh marshes will see an increase of 1.5 ppt (Table 3). Though somewhat compromised and intruded-upon by urban areas and past oilfield development, these are important habitat areas heavily used by local residents for recreation. These increases translate into a loss of three acres for fresh water marshes. No loss of swamp or bottomland hardwood acres is expected, however, the increased salinity is expected to have an overall impact on the health of the system. Increased herbaceous coverage and slowing of tree growth is expected. These impacts reflect a loss of 19 AAHUs.

*South of Blue Elbow Swamp (Project HU TX 12)* --- This entire section (698 acres) of the lower Sabine River drainage system is composed of cypress-tupelo swamp. This habitat type is predicted to suffer no actual acreage loss from the 0.6 ppt salinity increase during low flow periods. Although no loss in swamp acreage is expected, the increase in salinity will cause a reduction in the overall health and productivity of the swamp. Expected impacts are a reduction of over story and a slowing in the rate of trunk diameter growth. This expected impacts result in a loss of 18 AAHUs.

*Groves, Neches River (Project HU TX 13)* ---This small (437-acres) intermediate marsh unit lying west of the Neches River shows a baseline salinity of 3.0 ppt and FWP impacts would increase salinities 1.0 ppt to 4.0 ppt. This translates to three acres of projected intermediate marsh loss and a loss of 3 AAHUs.

*Texas portion of shared HU's (Project HU LA/TX 1 and 2)* --- LA/TX 1 and 2 are predicted to have, at a maximum, 0.0 and 0.3 ppt salinity increases, causing insignificant habitat losses. The ICT Environmental Work Group biologists thought that such small predicted maximum salinity increases would not significantly percolate into adjacent, higher bottomland areas since bottomland flooding is almost always accompanied by increased freshwater events. Adjacent cypress-tupelo swamps would likewise be buffered from any slight channel salinity increases by large volumes of surface fresh water. Because impacts are expected to be negligible, there is no expected land loss and no loss of AAHUs.

**Salinity-related impacts to aquatic communities (Louisiana)**
**Louisiana Habitat Areas**

*Perry Ridge (Project HU LA 1)* --- This large (28,094-acres) unit lying immediately north of the GIWW and west of the Sabine River contains the largest freshwater marsh tract (18,859 acres) in the project area. Because of projected salinity increases in the upper and eastern Sabine Lake, it is considered potentially at risk from project-induced salinity intrusion. Significant (2,158 acres) bottomland forests also occur here. A small predicted salinity change (-0.3 ppt) at this unit's boundary extrapolates to predicted losses of 50 acres (-65 AAHU's) of fresh marsh and 12 acres (-53 AAHU's) of intermediate marsh (Table 4). The bottomland hardwood portion of the unit would not be affected by increased water levels enough to suffer damages from slightly increased salinities. Also, as is the case for upper Neches and lower Sabine Rivers (TX) units, higher water levels are normally associated with increased freshwater river flows and high rainfall events, conditions which would be reflected under the High Flow model scenario.

A shift toward more brackish marsh habitat occurred from 1949 to 1968. In 1968, there was a 10 percent decrease in fresh marsh and the unit was 55 percent intermediate and 20 percent brackish marsh, possibly caused by saltwater intrusion from the SNWW via Sabine Lake and the GIWW. The unit currently includes 27 percent intermediate marsh (7,370 acres), 29 percent fresh marsh (7,820 acres), 1 percent swamp (170 acres), and 30 percent open water (8,190 acres). The remaining 14 percent includes upland, ridge, swamp, forest, or developed land (3,751 acres) (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

*Willow Bayou (Project HU LA2)* --- This huge (36,291 acres) unit lies east of Sabine Lake and is bordered by Pine Ridge on the north, Sabine Lake on the west, the Burton-Sutton Canal on the east, and the Starks South Canal on the south. Most (35,100 acres) of its marsh acreage is classified as intermediate and is therefore potentially sensitive to minor salinity changes. The modeled FWP -0.9 ppt salinity increase is predicted to cause a loss of 102 acres (-328 AAHU's) of intermediate marsh during project life. The relatively small amount (1,182 acres) of brackish marsh within this unit is predicted to experience a 1.4 ppt salinity increase due to the project, causing a loss of 2 acres (- 1 AAHU) (Table 4).

The eastern two-thirds of this unit was historically a mixture of fresh and intermediate marsh with the west classified as brackish marsh. 1968 and 1978 vegetation type maps showed a trend toward more brackish conditions. In 1988, the majority of the unit was brackish marsh, with a small area of intermediate marsh located in the southeastern corner. In 1990, the unit consisted of approximately 7 percent intermediate marsh (2,500 acres) and 52 percent brackish marsh (18,960 acres), with the remaining 41 percent consisting of open water and upland habitats (15,010 acres).

*Black Bayou (Project HU LA3)* --- This 39,853-acre unit is the project area's largest and consists of primarily intermediate marsh. The Black Bayou unit is bordered on the west by the Sabine River and Sabine Lake, Pines Ridge to the south, the GIWW to the north, and the Gum Cove Ridge, Bancroft Canal, Black Bayou and Right Prong Canal to the east. The predicted 1.1 ppt salinity increase in the intermediate marsh extrapolates to a predicted net loss of 130 marsh acres (-509 AAHU's). The modeled brackish increase of 0.8 ppt will cause 4 acres of loss (-1 AAHU) (Table 4). The total predicted losses for the unit equal 134 acres and 510 AAHUs.

There has been a shift to more brackish marsh from 1949 to the present. In 1949, the distribution of marsh types was 50 percent fresh, 20 percent intermediate, and 25 percent brackish. By 1968, there was an increase of 15 percent in brackish marsh and 10 percent in intermediate marsh, and a 30 percent decrease in fresh marsh habitat. This increase in more saline marsh types may have been caused by saltwater intrusion via the Sabine-Neches and Calcasieu Ship channels. The unit currently consists of approximately 23 percent intermediate marsh (9,480 acres), 34 percent brackish marsh (13,750 acres), nominal fresh marsh (600 acres), and 33 percent open water (13,410 acres), with some swamp, upland, forest, and developed land (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

*West Johnson's Bayou (Project HU LA4)* --- This unit lies just south of Sabine NWR and is bordered by Sabine Lake to the west, Buck Ridge to the south, Deep Bayou to the east, and Gray's Ditch to the north. Johnson's Bayou flows from the southeast to the northwest through the unit. The unit consists primarily of intermediate marsh (10,031 acres), with 14 percent (1,837 acres) brackish marsh. The predicted 1.2 ppt salinity increase is expected to cause an additional loss of 142 acres (-269 AAHU's) of intermediate marsh and a 0.7 ppt salinity increase would lead to the loss of 64 acres (-1 AAHU) of brackish marsh (Table 4).

In 1949, the unit was composed of 85 percent brackish marsh, and 5 percent each of saline marsh, intermediate marsh, and beach habitats. Little change in marsh type has taken place from 1949 to the present. In 1968, the area contained 75 percent brackish marsh, and 25 percent intermediate marsh (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

*Sabine Lake Ridges (Project HU LA5)* --- This 33,472-acre unit is the most southerly of the Louisiana project hydrologic units and lies immediately north of the Gulf of Mexico and east of southern Sabine Lake and Sabine Pass. Subjected to higher salinities than the more northerly units, it is composed of 10 percent (3,198 acres) saline marsh, 44 percent (14,673 acres) brackish marsh, and 24 percent (8,232) intermediate marsh. Access for marine organisms is via Greens and Lighthouse Bayous. The 1.4 ppt maximum predicted salinity increase at the bayou's mouth would cause losses of 10 acres (-35 AAHU's) to saline marsh. A predicted salinity increase of 0.6 ppt would cause losses of 43 acres (-14 AAHU's) of brackish marsh and 93 acres (-218 AAHU's) of intermediate marsh (Table 4).

Sabine Lake Ridges Unit marsh types have recently shifted toward fresher marshes. In 1949, the area was 70 percent brackish marsh, 10 percent saline marsh, and 20 percent beach or Chenier. By 1968, 20 percent of the previous beach habitat had converted to intermediate marsh. Currently, the habitats in the unit consist of 11 percent saline marsh (3,800 acres), 35 percent brackish marsh (12,100 acres), 24 percent intermediate marsh (8,300 acres), 5 percent fresh marsh (1,810 acres), and 5 percent open water (1,713 acres), with the remaining 19 percent consisting of upland, swamp, forest, or developed land (6,545 acres) (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

*Johnson's Bayou Ridge (Project HU LA6)* --- This small (4,089-acre) unit is bounded on the south by the Gulf of Mexico and on the north by Hackberry Ridge. Johnson Bayou Ridge habitats consist of brackish (2,744 acres) and saline (370 acres) marsh with Chenier forested uplands along Hackberry Ridge (975 acres). The 0.7 ppt predicted salinity increase would lead to a loss of 22 acres (-6 AAHU) of brackish marsh. A predicted salinity increase of 1.8 ppt would cause a loss of 5 acres (-2 AAHUs) of saline marsh over the project life (Table 4).

Forty percent of this unit consisted of saline marsh, with 5 percent brackish and intermediate marsh and the rest being Chenier ridge habitat in 1968. Since 1968, approximately 25 percent of the saline marsh has shifted to brackish (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

*Southeast Sabine (Project HU LA7)* --- The 8,034-acre Southeast Sabine unit is bordered by a series of manmade canals bisecting the Sabine NWR. The western portion of this unit is bordered by the Starks Central Canal on the north, the Burton-Sutton Canal on the west, an unnamed canal to the east, and the Starks South Canal on the south. The work group determined that only the western portion of the unit would be affected by SNWW salinity increases. The unit contains 4,925 acres of intermediate marsh and 2,023 acres of fresh marsh. Predicted maximum salinity increases of 0.5 ppt would result in losses of 0 acres (-11 AAHUs) of fresh marsh. A predicted salinity increase of 0.2 ppt would cause a loss of 1 acre (- 0 AAHUs) of intermediate marsh (Table 4).

From 1949 through 1988, the unit was classified as intermediate marsh, with 10-20 percent brackish marsh. The unit contains 58 percent intermediate marsh (12,430 acres), 31 percent brackish marsh (6,590 acres), nominal fresh marsh (10 acres), and 11 percent open water and other habitats (2,249 acres) (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

*Southwest Gum Cove (Project HU LA8)* --- This is an interior marshland unit bounded by Gum Cove Ridge to the north, Starks North Canal on the south, and on the west by Right Prong and Black Bayous. Its 11,386 acres contain 3,615 acres of fresh marsh and 6,605 acres of intermediate marsh. Predicted salinity increases of 0.9 ppt would result in the loss of 8 acres (-14 AAHUs) of fresh marsh and a loss of 15 acres (-4 AAHU's) of intermediate marsh over the project life (Table 4).

The unit's habitats shifted to more brackish marshes from 1949-1968 when 15 percent of the fresh to intermediate marshes converted to brackish marsh. Habitats include approximately 38 percent fresh marsh, 23 percent intermediate marsh, 7 percent brackish marsh, and 17 percent open water. The remaining 14 percent incorporates upland, swamp, forest, or developed land (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

*East Johnson's Bayou (Project HU LA9)* --- This 26,719-acre unit is composed primarily of intermediate marsh (26,138 acres) plus a small amount of uplands along Buck Ridge, which forms its southern boundary. It is bordered on the north by Sabine NWR. Salinity increases of 1 ppt are predicted to cause additional losses of 46 acres (-190 AAHUs) of intermediate marsh over current marsh loss (Table 4).

The East Johnson's Bayou Unit was divided evenly between intermediate and brackish marsh in 1949. By 1968, the unit was comprised of 70 percent intermediate marsh and 30 percent brackish marshes, which is indicative of a salinity decrease (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999).

Louisiana portions of shared HU's (Project HU's LA/TX 1, 2) --- LA/TX 1 and 2 are predicted to have 0.1 ppt salinity increases, causing insignificant actual habitat losses and loss of 0 AAHU's to the cypress-tupelo community. The ICT Environmental Work Group biologists thought that such small predicted salinity increases would not significantly percolate into adjacent, higher elevation bottomland areas since bottomland flooding is almost always accompanied by increased freshwater events. Adjacent cypress-tupelo swamps would likewise be buffered from any slight channel salinity increases by large volumes of surface fresh water.

**Habitat Trade-offs, Mitigation, and Beneficial Use (BU) Plan**

On August 31, 2009, the Corps' Directorate of Civil Works – Planning Community issued implementation guidance for Section 2036(a) of the Water Resources Development Act of 2007. This guidance requires that the preferred alternative contain a mitigation plan for the fish and wildlife resources that are lost as a result of the unavoidable impacts caused by the project. These impacts must be compensated to the extent justified and the preferred alternative must have adequate mitigation that will ensure the channel improvement project will not have any measurable adverse impact to the significant resources in the area. The Corps also recognizes that the wetland resources outlined in this document are significant and could suffer long term impacts due to the preferred alternative.

The ICT met on several occasions and identified a preferred mitigation plan for Louisiana and Texas. All of the unavoidable impacts from the preferred alternative will occur in Louisiana. All of the project impacts in Texas will be offset by BU features.

The Work Group developed mitigation and BU goals, as follows:

1) No net loss of wetland acres,
2) Replace lost AAHU's 1:1,
3) Replace AAHU's in-kind,
4) Losses to be mitigated in the state in which they occur, and
6) Dredged material from Sabine Pass is to be shared equally between each state.

Following are explanations of proposed BU and mitigation features.

**Texas**

As previously discussed, land subsidence, salinity intrusion from original SNWW construction, small channel (largely oil field access) construction, levees, oil field brine runoff, and secondary salinity intrusion have all contributed to the conversion of over 9,500 acres of wetlands in the lower Neches River basin into tidally-influenced open water areas. Once converted, these areas are difficult to re-vegetate and return to their original productivity without raising lost elevations using massive amounts of dredged or otherwise imported material. Therefore, it was decided early in the interagency project planning process that new-work channel dredged material and subsequent maintenance material should be utilized to repair these distressed aquatic systems.

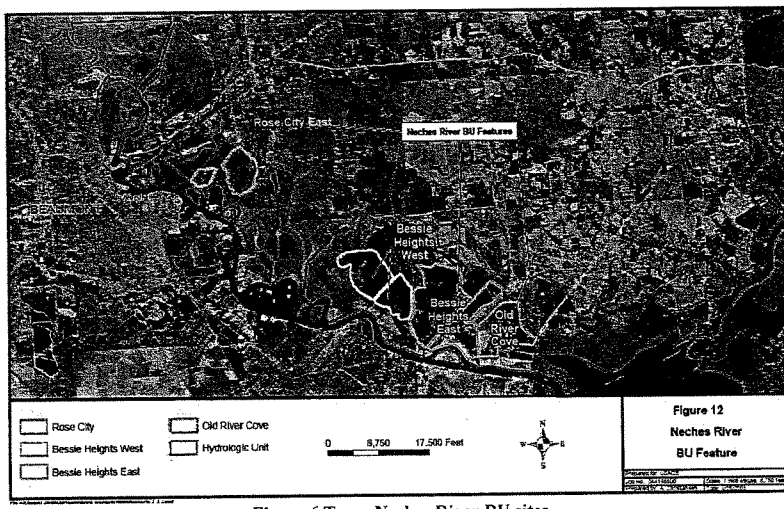


Figure 6 Texas Neches River BU sites

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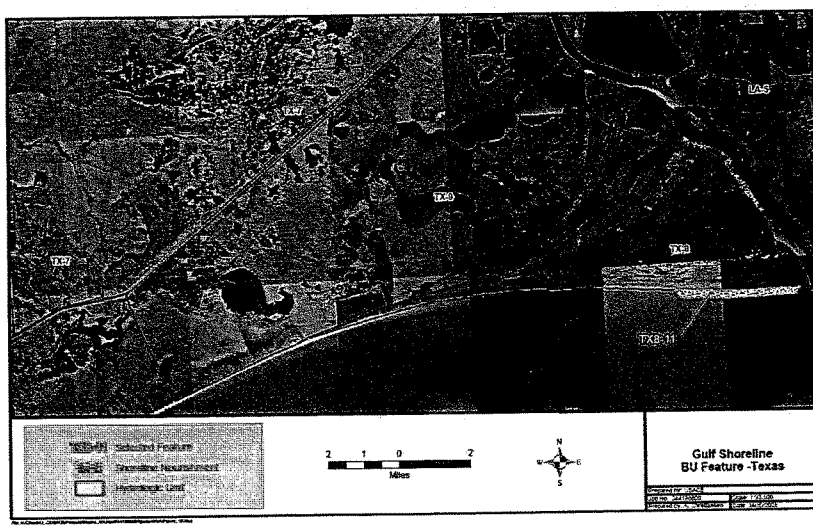


Figure 7 Texas shared BU beach nourishment

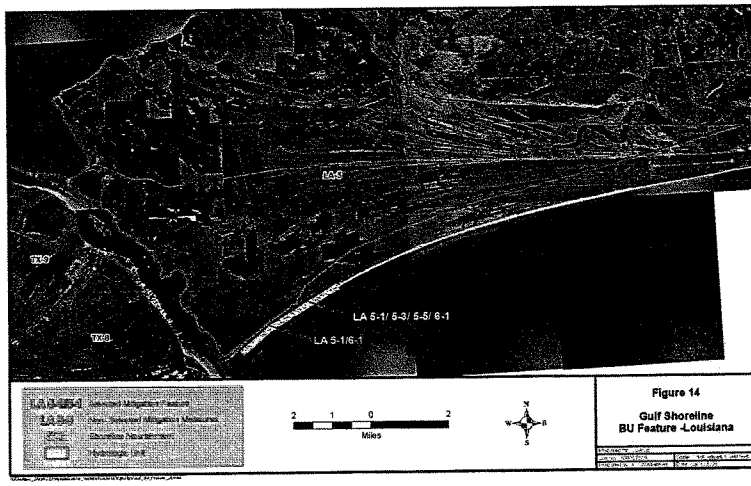


**Figure 8 Louisiana BU beach nourishment**

*Rose City Marsh BU*--- This formerly productive freshwater system includes most of hydrologic unit TX3, a 5,805-acre area composed primarily of cypress-tupelo swamp and freshwater marsh prior to the early 1900s. A total of 225 acres of emergent fresh marsh-elevation substrate would be constructed (and planted) using new work material by project year 15 and 120 more acres would be added using maintenance material from the first maintenance dredging cycle following construction. The placement of dredge material is expected to restore 18 inches of top soil over eroded mud flats and open water, thereby creating 345 acres of emergent fresh marsh, improving 72 acres of shallow water habitat and nourishing an additional 151 acres during the two events. This would result in construction of approximately 568 acres of restored marsh, marsh edge, channels, and potential swamp forest ridges (Tables 6 and 7). **The Service recommends that the post-authorization project work group pursue plans for the restoration of cypress-tupelo forest vegetation on suitable, higher-elevation ridges within the restored marsh area.** Formerly, this was the predominant vegetation type at this location, and cypress-tupelo swamp forest has been shown to support high native wildlife populations in this region and to be in decline on a nationwide basis. 12

The existing low salinities (0.25 ppt) show little improvement from the BU. In fact, the model shows a slight (0.3 ppt) (Table 3) salinity increase under low flow conditions with the project. However, since this projected increase is slight, the Service does not consider it biologically significant and to be compensated by the magnitude of habitat creation. Under actual field conditions, it is likely that many areas protected from direct connection by the newly constructed marshes and pumped terraces would frequently retain pockets of freshwater runoff from the surrounding watershed. We consider acreage losses and gains, through habitat creation, to be more realistic than small model-predicted salinity changes. Also, we consider it doubtful that

model output is sensitive enough to predict very small benefits to salinity levels at individual habitat features within shallow areas far removed from main channels.

*Bessie Heights Marsh BU*--- The most extensive losses of interior coastal wetlands in Texas have occurred in the lower Neches River delta. Of the estimated 13,800 acres of marshes formerly in this sector, 12,632 acres have been lost to open water (White et al. 1987, Sutherlin 1996). Primary causes were land subsidence and resultant salinity intrusion. Shallow water area (< 1 ft.) would be doubled within the sub-unit, and existing, currently stressed, marsh would be nourished by spillover from adjacent marsh creation. New work material to be used in this reach ranges in sand/clay ratios from 1:2 to 1:5. The marsh fans (splays) will be created by frequent movement of dredge pipes.

In the Bessie Heights East unit (Project HU 5), 1,190 acres of emergent intermediate marsh and 679 acres of emergent brackish marsh would be constructed using finer grained maintenance material. The DMMP features a total restoration of 1,869 acres in this unit, with improvement to 660 acres of shallow water habitat and the nourishing of an additional 615 acres of existing fringe marsh (Table 6). The inner marshes will have channels constructed to allow for drainage through reconstructed stream channels to the Neches River. This will provide flushing to the system and will maintain moderate soil salinities, while providing ingress and egress for marine dependent species.

*Old River Cove Marsh BU*---The Old River Cove (Project HU 6) will have a total of 639 acres of emergent brackish marsh restored, 139 acres of shallow water habitat improved and will re-nourish an additional 432 acres of existing fringe marsh at project inception (Table 6). Channels will be created to allow circulation throughout the created areas as well as to provide ingress and egress for marine dependent organisms. Conditions for submerged aquatic vegetation are expected to improve as still water areas are created and there is an increase in shallow water habitat. Table 6 summarizes the acreage to be improved from BU.

**Table 6 Neches River BU Summary**

| Components of Neches River BU Feature | Restored Emergent Marsh | Improved Shallow Water Habitat | Nourished Existing Marsh | Total Influence Area |
|---|---|---|---|---|
| Rose City East | 345 | 72 | 151 | 568 |
| Bessie Heights East | 1,869 | 660 | 615 | 3,180 |
| Old River Cove | 639 | 139 | 432 | 1,210 |
| Total | 2,853 | 871 | 1,198 | 4,958 |

13

The Service considers the marsh creation measures in the lower Neches delta, the salinity reductions within the created marsh areas and their basins, and the potential slight salinity reductions in the upper Neches River portion of the study area to be beneficial habitat measures and to compensate for the slight salinity-related habitat stress in lower project reaches. However, experience in other large-scale estuarine channel enlargement projects involving placement of large volumes of dredged material has taught us that methods and construction techniques often require significant adjustments, interagency coordination, planning, monitoring, and on-site inspections. Success of BU features depends on sound planning, timely inspections, and the

ability to modify construction techniques on-site. Salinity levels should be monitored in areas where the model predicts changes following channel enlargement.

Therefore, the **Service recommends that an interagency coordination team be formed to include all State and Federal environmental agencies to meet regularly and provide inspection oversight and recommendations during post-authorization planning and construction. The Service will request yearly Fish and Wildlife Coordination Act transfer funds during the construction phase to provide inspection and design recommendations for habitat creation features.** 14

***Colonial Waterbird Needs Analysis***

The Service reviewed colonial waterbird datasets from Texas (TCWC 2006), and Louisiana (Michot et al. 2004). Waterbird colony sites in Jefferson and Orange Counties, Texas, and Cameron Parish, Louisiana known to be active since 2000 were mapped and yearly averages tabulated. Numbers of active colonies and breeding populations were compared to available wetland habitat to estimate whether additional waterbird breeding colony(s) could increase populations of this desirable and beneficial bird group. Colonial waterbirds are considered an important species group and an indicator of the health of large aquatic ecosystems due to their high visibility and source of tourism revenue, their role as top-level predators, their sensitivity to environmental factors such as contamination, and the availability of reliable population estimates.

Orange and Jefferson Counties, Texas, from 1996 thru 2005, hosted at least 28 nesting colonies containing a 10-yr. average of 2,550 nesting pairs. Due to year-to-year inconsistencies in counting effort, the 10-yr. maximum count of 5,039 nesting pairs might be closer to the average yearly nesting population. These nesting waterbirds belonged to 13 species, including seven wading bird species. Wading birds (herons, egrets, and spoonbills) normally nest in mature brush and trees.

Calcasieu and Cameron Parishes, Louisiana, hosted 11 small colonies, detected during Michot et al.'s 2004 Louisiana aerial survey. These 11 colonies had five species and 220 nesting pairs, mostly black-crowned night herons. The black-crowned night heron is often overlooked in the TCWC counts. This species tends to aggregate in small daytime, often non-nesting, colonies in isolated mainland brush thickets and does not represent a true colonial waterbird in many aspects. An average of 1,214 wading bird nesting pairs were observed in three southwest Louisiana colonies; one colony in Pool 3 of the Sabine National Wildlife Refuge, and two colonies in the Gum Cove region north of Pool 3 in the 2004-2005 Louisiana statewide wading bird and seabird surveys (Green et al. 2006).

Orange and Jefferson Counties in Texas combined cover 1,490 sq. mile, over 50 percent of which is urbanized or industrial. Cameron and Calcasieu Parishes, Louisiana combined covers 3,026 sq. mile; approximately 10 percent is urbanized or industrial. Yet, the Texas side of the project area (Orange and Jefferson Counties) host, on average, about 20 times more colonial nesting waterbirds and eight times more species richness than the Louisiana side.

This indicates that there may be a shortage of predator-free nesting habitat in the southwest Louisiana region, and may indicate that additional predator-free nesting island(s) in the Sabine

Lake system could increase colonial waterbird populations over vast areas of appropriate feeding habitat in Louisiana.

*Sabine Lake Colonial Waterbird Nesting Island BU Opportunity* --- Because of the proximity to one-time sources of firm clay building material, the shortage of waterbird nesting habitat within large areas of feeding habitat in southwestern Louisiana, and the past success in creating waterbird nesting habitat in bay systems, the Service **recommends using new-work dredged material to construct a waterbird nesting island in the most efficient location for placement of material and at least one mile from shore in the upper Sabine Lake area.** The island should be 4 to 12-acres in size and should be built to an elevation of at least 8 ft. mean high tide. Suggested location(s) are shown in Figure 1. 15

The Service made similar recommendations for the Houston-Galveston Navigation Channels (HCNC) Project. In 1999, using stiff new-work clays from HGNC deepening, the 10-acre Evia island was constructed approximately 3 miles east of the ship channel and 1.5 miles north of Bolivar Peninsula, in southern Galveston Bay. Colonial-nesting waterbirds nested on Evia Island during the first year post-construction, and in increasing numbers and diversity each year following. Nesting populations have increased from 1,050 pairs in 2001 to 6,800 pairs in 2006. The percentage of all Galveston Bay nesting pairs which nest on Evia Island and the three other HGNC beneficial use islands has increased from 3 percent (1,824 nesting pairs) in 2001 to 23 percent (8,419 nesting pairs) in 2005.

Native tree plantings have begun to provide habitat for the (declining) wading bird species. Predator control, often an expensive requirement of nesting island management, was largely avoided by proper tree placement and the Service would assist in developing plans for tree placement and construction. The Service would also assist in post-construction monitoring and management. Texas Audubon Society and Golden Triangle Audubon Society have expressed interest in providing assistance in protection and management (Kasner 2007).

*Texas and Louisiana Point Gulf Beach Nourishment*--- Maintenance material from the Sabine Pass SNWW channel reach will be placed alternately, every three years, on either the Texas or Louisiana Gulf beach for a distance of approximately three miles. In addition to halting the projected slight accelerated shoreline loss from increased ship wake waves due to channel enlargement, a cumulative 674 acres of new saline marsh would be constructed by the end of the 50-year project life at Texas and Louisiana Points.

Sabine Pass maintenance material has averaged approximately 51 percent silt, 31 percent clay, and 18 percent sand for maintenance dredging cycles since 1975. The maintenance material would be hydraulically pumped onto the the beach and nearshore zone. Some material is expected to flow over existing beach, marsh, and near shore waters. Vegetation would be planted on the inland portion of the dredged material to assist in its stabilization. A similar Corps' WRDA Section 204 Continuing Authorities Program project constructed at Texas Point in 2004 showed that the dredged material dissipated quickly during the placement event, with 60 percent remaining following initial disposal. It is estimated that 50 percent of the remaining material after each placement episode will erode away by the end of each 6-year cycle. New material added every 6 years would eventually create 674 acres of new saline marsh by the end of the project life at Louisiana and Texas Points (USACE 2009)

**Existing Disposal Area Use and Management (DMMP) ---**

DAs 1-4 --- Nearshore sites should be maximized in order to maximize benefits to demersal and benthic communities from creating bottom surface topography. Within EPA Green Book guidelines, nearshore offshore disposal sites should be moved as close to the Gulf beach as practicable, for fisheries habitat as well as beach nourishment purposes. 16

DA 16A --- This 202-acre site is an existing high-quality intermediate marsh, containing several shallow, open water ponds, bayous and natural circulation channels (Figure 2). It is unleveed, except for the low natural river berm, and receives tidal circulation through these avenues leading into the manmade ditch running along its southwest border. The site is presently at natural elevations. Therefore, the Service objects to the use of this site for dredged material disposal, especially given the availability of other nearby disturbed sites. 17

DA 14A (82 acres) --- This site is a relatively undisturbed *Spartina patens* wet meadow, containing one large (approximately 6 acres) and several small open-water ponds. As a high-quality wetland at natural elevations which would freely flood during spring tide and heavy rainfall events, it provides habitat for a diverse array of native wildlife species. The Service objects to the use of this site for dredged material disposal, given the availability of other nearby disturbed sites. 18

DA 23A (269 acres) --- This area is a leveed, second-growth, scrub-shrub forest. Wetland areas are present, many formed by the backwater effect of the levees. Dominant species are black willow (*Salix nigra*), hackberry, and Chinese tallow, with the occasional red maple, water oak, and yaupon (*Ilex vomitoria*). The Service recommends that if this site is converted to an upland DA: 1) damages to wetlands ("scrub-shrub" bottomland forest) be calculated using WVA methodology for project mitigation, and 2) disposal area water regime protocol be developed, in conjunction with Service and TPWD biologists, to maximize wetland characteristics of the enclosed DA for wintering waterfowl habitat during between-disposal periods. 19

DA 24A (187 acres) --- This site is composed of a marginal upland (possibly remnant bottomland hardwood) ridge and isolated wetlands. Wetlands contain small open-water pockets but are primarily densely vegetated with California bulrush (*Schoenoplectus californicus*), common reed (*Phragmites australis*), and *Spartina patens*. Edges and ditches have a more diverse assemblage of wetland plants, including black willow, rattlebox (*Sesbania drumondii*), wax myrtle (*Myrica sebiferum*), smartweed (*Polygonum sp.*), and narrow-leaf cattail. Uplands and transitional areas are dominated by the invasive Chinese tallow, but contain occasional yaupon, deciduous holly (*Ilex verticillata*), common baldcypress, red maple, sweetgum, American holly, and greenbriar. Hydrology is restricted by levees and roads, but both wetland and upland areas have potential for restoration. Adjacent wetlands to the north and northeast are of higher quality and contain more natural hydrology and circulation patterns. 20

The Service recommends that, if the 187-acre portion of the site is converted to an upland disposal area: 1) disposal area levee alignments and discharge points be reviewed by Service and TPWD biologists before final site designation for input on minimizing impacts to adjacent high-quality habitats, 2) disposal area water regime protocol be developed, in conjunction with Service and TPWD biologists and Jefferson County Navigation District, to maximize wetland characteristics of the enclosed DAs during between-disposal periods for wintering waterfowl habitat.

DA 26 --- (192 acres) This leveed site, adjacent to the Neches River in an old oxbow bend, has previously been used for disposal of SNWW material. It is freshwater marsh dominated by Chinese tallow, with small pockets of *Phragmites* sp., leafy three-square, narrowleaf cattail, water hyssop, rice cutgrass, and wax myrtle, primarily along remnant borrow ditches. While the site does have some value as waterbird and native reptile and amphibian habitat associated with the few, small open-water areas, its value is limited. Therefore, the Service would not object to 21
its use as a new-work dredged material disposal site. However, a disposal area water regime protocol should be developed, in conjunction with Service and TPWD biologists, to maximize wetland characteristics of the enclosed DA during between-disposal periods for wintering waterfowl habitat.

DA 27A (84 acres) --- This leveed site contains a "backwater", isolated, early successional swamp forest created by previous levee construction. Species composition, limited species diversity, and high degree of disturbance make this habitat of fairly low value. 22

DA 27C (87 acres) --- The entire site has been leveed in the past and has received overland flow from past dredging activities. This site is a secondary upland forest. Common tree species (to 35 ft.) are water oak, sweet gum, arrowwood viburnum (*Viburnum dentatum*), Carolina buckthorn (*Frangula caroliniata*), wax myrtle, and loblolly pine (*Pinus taeda*). Most trees 23
greater than 10 inch diameter at breast height (dbh) have been wind-thrown by recent storm events. The site has some value as wintering songbird and small mammal habitat. The Service recommends that a disposal area water regime protocol be developed, in conjunction with Service and TPWD biologists and Jefferson County Navigation District, to maximize wetland characteristics of the enclosed DA during between-disposal periods for wintering waterfowl habitat.

DA 27D (35 acres) --- This leveed area receives regular inflow from an adjacent industrial cooling facility which may contain some contaminants. The water table is kept artificially high year-round, supporting a dense vegetative community dominated by California bulrush and fringed by second-growth common baldcypress, Chinese tallow, and sweetgum. Small open-water areas and outlying roadside borrow ditches contain dense stands of invasive water hyacinth and *Salvinia minima*, with some native yellow pond-lily. Dense, weed-choked plant cover and the artificial water regime limit this site's wetland wildlife value, but it supports a wetland wildlife community typified by red-winged blackbird (*Aegelaius phoniceus*), common coot (*Fulica atra*), moorhen (*Gallinula chloropus*), sedge wren (*Cistothorus platensis*), and wood duck (*Aix sponsa*).

**The Service recommends that if DA 27D is converted to an upland DA that a disposal area water regime protocol be developed to maximize wetland habitat potential during between-disposal intervals for wintering waterfowl use.** 24

**Table 7 SNWW Dredge Material Management Plan Restoration (BU) and Nourishment Features**

| Hydro unit | No. | Description | Size of Influence Area |
|---|---|---|---|
| Rose City | TX3-1 East | Restoring fresh marsh & shallow water habitat, & nourishing existing marsh in two construction events. New work material will be used to restore 225 ac marsh in 556 existing open water acres, construct hydraulic levees & construct three finger mounds & circular mound. Maintenance material from 1st cycle used to construct finger mounds & fill out northern margin, restoring an additional 120 acres of marsh. Material from Sec 18. | Influence area 568 ac; restoring 345 ac marsh in 556 open water acres |
| Bessie Heights | TX5-2 | Restoration of intermediate & brackish marsh & shallow water habitat, and nourishment of existing marsh with maintenance material for 28 years. Assume 7 maintenance cycles - 267 acres marsh created per cycle. New work material used to build hydraulic containment levee at S end. Maintenance material used to restore 70-75% of the existing 2,546 ac of open water. Material comes from Neches River Channel Sect 13, 14, & 15. | Influence area - 3180 ac; 679 ac brackish marsh restored in 847 ac open water, and 1190 ac intermediate marsh restored in 1683 ac of open water. |
| Old River Cove | TX6-1 | Restoration of brackish marsh & shallow water habitat, & nourishment of existing marsh with new work material. Area is semi-confined; new work material used to construct hydraulic containment levee along existing canals. New work material comes from Neches River Channel, Sections 13, 14, 15. | Influence area - 1,210 ac; restores 639 ac in 778 ac open water. |
| Keith Lake Marsh | TX9- 1 | Marsh restoration in areas of breaking marsh north of Keith Lake, within the TPWD J.D. Murphree Wildlife Management Area. Degraded marsh areas will be filled with thin layers (6 to 24 inches) of maintenance material from Section 7 of the Port Arthur Canal in one maintenance cycle. | Influence area – 580 ac |
| Texas Point | TX 8-11 | Nourish 0.5 to 3.5 miles from West Jetty using maintenance material from Section 5 over 50 yr project life. Unconfined placement of maintenance material along shoreline every 6 years for project life (8 placement episodes). Assume 50:50 split of material between Texas and Louisiana accomplished by alternating placement in TX and LA. | Affected shoreline 3.0 miles |
| Louisiana Point | LA5-6 | Nourish 0.5 to 3.5 miles from East Jetty using maintenance material from Section 5. Unconfined placement of maintenance material along shoreline every 6 years for project life (8 placement episodes). Assume 50:50 split of material between Texas and Louisiana by alternating placement in TX and LA. | Affected shoreline 3.0 miles |

(USACE 2009)

**Table 8 Summary of DMMP Beneficial Use Feature Benefits (Units in AAHUs)**

| | Swamp | Bottomland Hardwood | Fresh Marsh | Intermediate Marsh | Brackish Marsh | Saline Marsh | Totals |
|---|---|---|---|---|---|---|---|
| **Texas Impacts** | -22 | 0 | -206 | -48 | -131 | -5 | -412 |
| TX 3 Rose City East | | | +178 | | | | +178 |
| TX 5-2 Bessie Heights East | | | | +305 | +128 | | +433 |
| TX 6-1 Old River Cove | | | | | +235 | | +235 |
| TX 8-11 Texas Point Shoreline Nourishment | | | | | | +222 | +222 |
| **Texas BU Benefits** | | | | | | | +1,068 |
| **Louisiana Impacts** | 0 | 0 | -78 | -1,571 | -23 | -37 | -1,709 |
| LA 5-2/6-2 Louisiana Point Shore Nourishment | | | | | | +210 | +210 |
| Total Impacts | | | | | | | 2,121 |
| Total DMMP BU Benefits | | | | | | | 1,278 |
| Net Impacts over BU Benefits | | | | | | | -843 |

(USACE 2009)

The net Dredged Material Management Plan (DMMP) benefits (1,278 AAHUs) are not sufficient to totally offset project impacts of -2,121 AAHUs, thus a deficit of -843 AAHUs remain (Table 7). That deficit will be partially offset by the following proposed Louisiana mitigation. Louisiana impacts were minimized by Louisiana Point BU (+210 AAHUs), but 1,499 AAHUs of LA impacts remain to be mitigated. The benefits of the DMMP in Texas exceed Texas impacts by 656 AAHUs (+1,068 AAHUs from BU vs. -412 AAHUs impacts) (Table 8). Since the Coastal Zone Management Act does not apply to Federal lands, the Corps proposes to reduce the Louisiana mitigation needed by using excess Texas DMMP benefits to compensate for the project's impacts on the Sabine NWR. The total Sabine-Neches project impacts to the Sabine NWR (-340 AAHUs) will be offset by excess Texas DMMP benefits, leaving a surplus of +316 AAHUs and a compensatory mitigation target of 1,159 AAHUs in Louisiana (Table 9) (USACE 2009).

**Table 9 Compensatory Mitigation Target for Louisiana (in AAHUs)**

| | Texas | Louisiana | Total Project Area |
|---|---|---|---|
| Net FWP Benefits/Impacts | | | |
| Total Impacts | -412 | -1,709 | -2,121 |
| Total BU Benefits | 1,068 | 210 | 1,278 |
| Net FWP Benefits or Impacts | +656 | -1,499 | -843 |
| | | | |
| Excess Texas Benefits Applied to Federal Land | | | |
| Excess Texas Benefits | +656 | | |
| Sabine NWR Impacts | -340 | | |
| Net Excess Texas Benefits | +316 | | |
| | | | |
| Compensatory Mitigation Target | | | |
| Net Impacts LA and Project | | -1,499 | -843 |
| Federal Impacts Compensated By Texas Benefits | | +340 | |
| FWP Compensatory Mitigation Target | | -1,159 | -843 (-1,159 + 316) |

(USACE 2009)

*Louisiana SNWW Mitigation---*

Sabine-Neches project impacts to Louisiana marshes are primarily related to salinity increases associated with the proposed channel deepening. Since no feasible salinity reducing mitigation measures could be found, the Habitat Workgroup evaluated various mitigation measures consisting of marsh restoration, terracing, shoreline protection and Gulf shoreline nourishment. Marsh restoration included different sources of dredged material - BU from the Channel to Orange maintenance dredging, to dedicated dredging in the GIWW and Sabine Lake. The Corps applied the CE/ICA in the certified version of the IWR-PLAN to identify mitigation features that provided the most cost effective environmental benefits to offset project impacts (USACE 2009).

**Willow Bayou Unit Marsh Restoration - Sabine Lake Dedicated Dredging**

Marsh restoration using material from dedicated dredging in Sabine Lake (Alternative B) or SNWW new work material (Alternative C) was proposed for the Willow Bayou hydrologic unit. Marsh restoration areas LA 2-16 through LA 2-19, and a fifth area (LA 2 ADD) located north of Willow Bayou Canal in Unit 5 of the Sabine SNWR were considered. LA 2-16 includes a 1,831-acre project area and would restore 822 acres of shallow open water with 2.6 million (M) cubic yards of dredged material. LA 2-17 includes a 2,297-acre mitigation area and would restore 1,035 acres of open water with 3.4 M cubic yards of material. LA 2-18 includes a 681-acre mitigation area and would restore 251 acres with an estimated 809,893 cubic yards of material.

LA 2-19 includes a 1,809-acre mitigation area and would restore an estimated 719 acres of marsh with 2.9 M cubic yards of dredged material. LA 2 ADD would restore 436 acres of marsh in a 1,285-acre project area with an estimated 1.5 M cubic yards of material, for a total restoration of 3,263 acres of marsh if all alternatives were selected (Figure 9, Table 10).

**Figure 9 Willow Bayou Mitigation Proposed and Recommended**

Table 10 Summary of Benefits of Willow Bayou Marsh Restoration Measures Evaluated

| Mitigation Measure | AAHUs | Project Influence Area (ac) | Existing Marsh Nourished (ac) | Open Water (ac) | Restored Emergent Marsh (ac) | Cubic Yds. (Mil cyds) | Cubic Yds./ Acre |
|---|---|---|---|---|---|---|---|
| LA 2-16B & C | 445 | 1,831 | 803 | 1,028 | 822 | 2.6 | 3,163 |
| LA 2-17B & C | 492 | 2,297 | 1,003 | 1,294 | 1,035 | 3.4 | 3,285 |
| ***LA 2-18B** & C | 152 | 681 | 367 | 314 | 251 | 0.81 | 3,227 |
| LA 2-19B & C | 419 | 1,809 | 910 | 899 | 719 | 2.9 | 4,033 |
| ***LA 2-ADD B** | 214 | 1,285 | 745 | 540 | 436 | 1.5 | 3,440 |
| **Totals (considered)** | **1,722** | **7,903** | **3,828** | **4,075** | **3,263** | **11.21** | **3,435** |
| **Selected** | **366** | **3,775** | **1,112** | **854** | **687** | | |

Note: * Selected Willow Bayou Mitigation Measures. (USACE 2009)

The increments were combined in the ICA according to the most cost effective pumping distances and costs. Marsh would be restored by unconfined flow of dredged material from a hydraulic pipeline from either Sabine Lake (Alternative B) or SNWW Section 10 new work (Alternative C). Pipeline relocation and elevation control would be necessary to obtain the appropriate intermediate marsh elevation. Channels (tidal creeks, trenasses) would be constructed after the material has settled to return the areas to natural hydrologic conditions allowing tidal action to affect the newly restored marsh and to facilitate estuarine fisheries organism access (USACE 2009).

Dedicated dredging Alternative B would take material from a Sabine Lake borrow area located approximately 1,000 ft from the Sabine NWR shoreline. That borrow area would average 1,030 ft wide by 1.8 to 7.8 miles long by 7.5 ft deep. The borrow area would be continuous and parallel with the present Sabine Lake long shore circulation patterns to prevent the development of hypoxic conditions detrimental to aquatic organisms. The area is expected to fill with Sabine Lake and River sediments post construction. An access channel may be needed for the hydraulic dredge to access the proposed borrow area.

The borrow site is located within a Sabine Lake oyster seed harvesting ground designated by the Louisiana Department of Wildlife and Fisheries (LDWF), but oysters are not present in the proposed borrow area due to reduced salinities. Sabine Lake oyster reefs are limited to higher salinity areas in the southern part of Sabine Lake adjacent to and south of Blue Buck Point. An oyster survey by T. Baker Smith, Inc. (2006) found no live oyster reefs in the vicinity of the proposed eastern Sabine Lake borrow area. Use of this borrow area to implement this marsh restoration mitigation requires a waiver of lake dredging mitigation requirements from LDWF (USACE 2009). **The Service recommends that the Sabine Lake borrow area be relocated at least 1,000 feet from the eastern Sabine Lake shoreline to reduce possible adverse effects to shoreline erosion.** 25

Marsh restoration Alternative C, using SNWW new work dredged material, would pump dredged material from the deepening of the navigation channel across Sabine Lake and into the

Willow Bayou Unit marshes on SNWR. The 11-mile pumping distance would require the use of several booster pumps. An access canal may be required for booster pumps to access the lake shoreline (USACE 2009).

Marsh restoration benefits (Tables 10, 11, and 12) were calculated based on restoring additional marsh acreage, and the restored marshes' affect on reducing salinities and shoreline erosion due to reduction in wind fetch. Restoration of marsh in open water areas would reduce wind fetch and promote the still water conditions favorable for the growth of submerged aquatic vegetation. Land loss rates are expected to be lower due to the production of a more stable, higher marsh elevation (USACE 2009).

The last two columns of Table 10 depict total volume and volume per acre restored for each Willow Bayou Unit mitigation measure. The mean volume per acre is 3,435 cubic yards. This amount is close to the 3,478 cubic yards per acre calculated for the Coastal Wetlands Planning Protection and Restoration Act (CWPPRA) Sabine Refuge Marsh Creation Cycle 3 project (230 acres; 800,000 cubic yards). However the Sabine Refuge Marsh Creation Cycle 1 project restored about 125 acres of marsh using approximately 6,400 cubic yards of material per acre for an average of 4,900 cubic yards per acre for the two confined BU marsh restoration sites. The proposed Sabine-Neches mitigation will be unconfined dredged material placement. If this comparison with area constructed beneficial use projects is valid, the volumes needed to restore the mitigation areas listed in Table 10 could be underestimated by as much as about 30%.

**The Service questions whether the Corps would be able to achieve the degree of marsh restoration depicted in the mitigation with unconfined placement of dredged material (Tables 10, 11, and 12) and recommends that the Corps review their calculations for volume of dredged material needed to achieve the listed mitigation.** 26

The ICT approved Willow Bayou increments LA 2-18 B and LA 2-ADD B above. Alternative C for each of the above, consisting of marsh restoration using dredged material from the Sabine-Neches channel was considered too costly due to the need to transport the SNWW new work at least 11 miles across Sabine Lake. **The Service recommends Alternative "C" in the event that Alternative "B", Sabine Lake dedicated dredging, is not viable for SNWW Sabine NWR marsh restoration mitigation.** 27

**Black Bayou Marsh Restoration – Channel to Orange Maintenance Material**
Marsh restoration using dredged material from maintenance dredging of the Channel to Orange, Texas was proposed at LA 3-10 west of Rusty Vincent Lake (Figure 9). Material would be pumped from the Sabine River Channel between East Pass and the GIWW in one increment (LA 3-10R). Intermediate marsh at LA 3-10R would be restored in 6 cycles between TY5 and TY30, adding 132 acres each 5-yr cycle for a total of 792 acres restored in 1,148 acres of open water within a 2,465-acre project area (Figure 9, Tables 11 and 12) (USACE 2009).

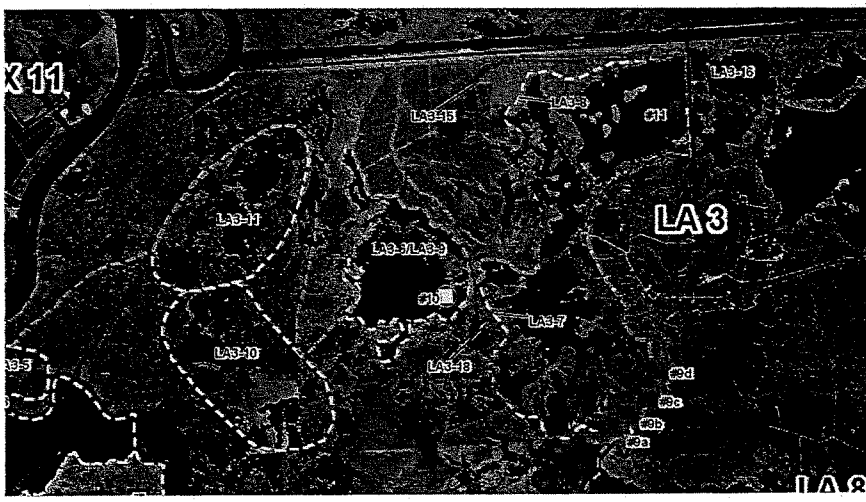


**Figure 10 Black Bayou Unit Mitigation Proposed and Recommended**

The restored marsh would be constructed by the unconfined flow of dredged material via hydraulic dredge similar to the Willow Bayou Unit restoration described above. Pipeline movement and elevation control would be necessary to achieve marsh elevation to restore intermediate marsh. Tidal creeks (trenasses) would be constructed after the dredged material has settled (6 months to a year) to return the area to natural hydrology and facilitate estuarine aquatic organism access to the restored marshes (USACE 2009).

Marsh restoration benefits (Table 11) are achieved by the restoration of marsh in shallow open water, and the restored marshes' effect in reducing salinities and shoreline erosion by reducing wind fetch. Approximately 70 percent of the open water would be restored to intermediate marsh, and existing fringe marsh would be "nourished" by winnowing fine-grained suspended solids during sediment placement. The restored marsh would reduce wave energies in remaining open water areas reducing turbidity and promoting conditions favorable for the growth of submerged aquatic vegetation. Land loss rates are expected to be lower due to the creation of a more stable, higher marsh elevation (USACE 2009).

**Table 11 Summary of Benefits of Selected Willow and Black Bayous Marsh Restoration Mitigation Measures; Channel to Orange Maintenance Material and GIWW Dedicated Dredging**

| Mitigation Measure | AAHU | Influence Area (ac) | Existing Marsh (ac) | Open Water (ac) | Restored Emergent Marsh (ac) |
|---|---|---|---|---|---|
| **Willow Bayou Mitigation** | | | | | |
| LA 2-18B & C | 152 | 681 | 367 | 314 | 251 |
| LA 2-ADD B | 214 | 1,285 | 745 | 540 | 436 |
| **Channel to Orange** | | | | | |
| **LA 3-10R** | 198 | 2,465 | 1,317 | 1,148 | 792 |
| **GIWW Dedicated Dredging** | | | | | |
| LA 3-15 B | 231 | 1,788 | 877 | 911 | 683 |
| LA 3-18 B | 239 | 1,877 | 1,049 | 828 | 621 |
| Total Selected | 1,034 | 8,096 | 4,355 | 3,741 | 2,783 |

(USACE 2009)

28

**Black Bayou Marsh Restoration - Dedicated Dredging of Lake Charles Deep Water Channel/GIWW**

Marsh restoration using dedicated dredging of accumulated material in the Lake Charles Deep Water Channel/GIWW was proposed for three areas in the vicinity of the Black Bayou Cutoff Canal (Figure 9). The 30-foot-deep 24.9 mile-long Lake Charles Deep Water Channel, constructed by local interests, joins the GIWW between the Sabine River and Lake Charles. It was authorized as a federal channel by the River and Harbor Act of 1935. It provided a deep water channel from the Port of Lake Charles to the Gulf of Mexico via the Sabine-Neches Waterway and was last maintained in 1940 when the Calcasieu Ship Channel was deepened to 30 feet. The channel contains sediment that could be mined to restore marshes in the Black Bayou area (USACE 2009).

Material would be pumped from a 13-mile stretch of the GIWW in two increments (LA 3-15 and LA 3-18) with LA 3-15 located immediately south of the GIWW in the Black Bayou watershed (Figure 9, Table 11). LA 3-15 would be restored first then LA 3-18. LA 3-15B and LA 13-19B would fill 75 percent of existing open water area. Intermediate marshes would be constructed via hydraulic dredge and unconfined pipeline discharge, with tidal creeks constructed after dredged material settlement similar to that described for LA 3-10R above (USACE 2009).

Marsh restoration benefits (Tables 11 and 12) are derived from the restoration of marsh acreage, as well as the restored marshes' effect in reducing salinities and wind fetch. Reduction in wind fetch would reduce shoreline erosion and turbidity and stimulate the production of submerged aquatic vegetation (SAV). An estimated 75 percent of the open water would be restored to intermediate marsh, and existing fringe marsh would be nourished by winnowing fine-grained suspended solids during material placement. Land loss rates are expected to remain the same because the area currently has a low land loss rate with the construction of the Black Bayou Hydrologic Restoration CWPPRA Project (CS-27). Dedicated dredging in the GIWW is not

predicted to establish a hydrologic connection to the deeper navigation channels in the Sabine and Calcasieu Rivers, and is not predicted to provide a channel for salinity wedges from those channels to enter the GIWW (USACE 2009).

The Service concurs with unconfined placement of material and recommends the construction of tidal creek channels (or trenasses) at least ten feet wide and two feet deep in the restored marsh, six months to a year, after disposal in order to return the area to natural hydrology for tidal movement and estuarine aquatic organism access to the restored marshes. The dredged material pipeline for marsh restoration (i.e., Willow Bayou and Black Bayou Units mitigation) should be placed in existing canals and waterways to the greatest extent practicable.

**Selected Mitigation Plan**

The selected mitigation plan compensates for the National Economic Development Plan (NED) salinity increase and associated losses in marsh acreage and biological productivity by restoring 2,783 acres of intermediate marsh in Louisiana to compensate for a projected 691 acres of marsh losses due to SNWW project salinity impacts. These mitigation measures produce 1,181 AAHUs that provide full compensation for the remaining (after DMMP BU) 1,159 AAHUs of impacts while meeting original mitigation goals for a balance of +22 AAHUs (Table 12).

The Service concurs that the Louisiana mitigation measures below (Table 12), along with the above BU measures compensate for SNWW project impacts in Texas and Louisiana. 29

The Corps should acquire a refuge Special Use Permit from the Sabine NWR (Terry Delaine, manager, Sabine NWR, 337-558-5574; or Don Voros of the Southwest Louisiana Refuges Complex, 1428 Hwy 27, Bell City, LA 70630; 337-598-2216) to coordinate the final planning for the dedicated dredging marsh restoration mitigation on Sabine NWR. 30

**Table 12 Recommended Louisiana mitigation measures, SNWW NED Plan**

| Selected Mitigation Measures | MFWP AAHU | Restored Emergent Marsh (acres) |
|---|---|---|
| **Willow Bayou** | | |
| LA2-18 B Marsh Restoration (Sabine Lake dredging ) | 152 | 251 |
| LA2 ADD B Marsh Restoration (Sabine Lake dredging) | 214 | 436 |
| **Black Bayou** | | |
| LA3-10R Marsh Restoration (Channel to Orange maintenance material) | 198 | 792 |
| LA3-15B Marsh Restoration (GIWW dredging) | 307 | 683 |
| LA3-18B Marsh Restoration (GIWW dredging) | 310 | 621 |
| Total Mitigation Compensation | 1,181 | 2,783 |
| Total Remaining Impacts (after BU) | -1,159 | -843 |
| **Net After Compensation** | **+22** | **+1,940** |

(USACE 2009)

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Table 13 summarizes SNWW total impacts (– 938 acres and – 2,121 AAHUs) and DMMP BU (3,527 acres, 1,278 AAHUs) and mitigation (2,783 acres, 1,181 AAHUs) benefits. The balance of impacts vs. benefits project-wide is + 5,372 acres and + 338 AAHUs (Table 13). Impacts and benefits by habitat type are depicted in Table 14. In Louisiana, 92 percent (-1,571 AAHUs) of the impacts were to intermediate marshes, followed by 5 percent (-78 AAHUs) in fresh, 2 percent (-37 AAHUs) in saline, and 1 percent (-23 AAHUs) in brackish marshes. In Texas, 50 percent (-206 AAHUs) of the impacts were in fresh marsh, followed by 32 percent (-131 AAHUs) and 12 percent (-48 AAHUs) in brackish and intermediate marshes, respectively, and 5 percent (-22 AAHUs) in swamp habitats (Table 14). DMMP BU benefits of +1,068 AAHUs totally compensate for Texas impacts (-412 AAHUs). The mitigation (+1,181 AAHUs), Gulf shoreline DMMP BU benefits, and excess Texas DMMP benefits fully compensate for SNWW impacts to Louisiana marshes by providing an excess of +2,429 acres and + 22 AAHUs (Table 13).

Table 13 SNWW mitigation totals, by acres and AAHUs

| Project Impacts (Acres/AAHUs) | FWP Impacts (Acres/AAHUs) | *Dredged Material Management Plan (DMMP) Benefits (Acres/AAHUs) | Net After DMMP (Acres/AAHUs) | Mitigation Benefits (MFWP) (Acres/AAHUs) | Difference (Acres/AAHUs) |
|---|---|---|---|---|---|
| **ACRES** | | | | | |
| LA FWP | - 691 | 337 | -354 | +2,783 | + 2,429 |
| TX FWP | - 247 | 3,190 | +2,943 | | +2,943 |
| **Total Acres** | **- 938** | 3,527 | +2,589 | **+2,783** | **+5,372** |
| | | | | | |
| **AAHUs** | | | | | |
| LA FWP AAHU | -1,709 | + 550 (+210 +340 from Texas) | -1,159 | +1,181 | +22 |
| TX FWP AAHU | -412 | + 728 (+1,068 - 340 to LA) | + 316 | 0 | + 316 |
| **Total AAHUs FWP** | **-2,121** | **+ 1,278** | **- 843** | **+1,181** | **+ 338** |

*Note: Excess Texas benefits (+340 AAHUs) were transferred to Louisiana to compensate for Sabine NWR impacts.

Table 14 SNWW impacts, BU, and mitigation totals by habitat type (AAHUs)

| Habitat | Impacts | DMMP BU Benefits | Mitigation Benefits | Net Difference Project vs. Mitigation AAHUs |
|---|---|---|---|---|
| **Louisiana** | | | | |
| Swamp | 0 | 0 | 0 | 0 |
| Fresh Marsh | -78 (5%) | 0 | 0 | -78 |
| Intermediate Marsh | -1,571 (92%) | 0 | +1,181 | -390 |
| Brackish | -23 (1%) | 0 | 0 | - 23 |
| Saline | -37 (2%) | +210 | 0 | + 173 |
| **Subtotal Louisiana** | **-1,709** | **+210** | **+1,181** | **-318** (mitigated by Texas BU) |
| | | | | |
| **Texas** | | | | |
| Swamp | -22 (5%) | 0 | 0 | -22 |
| Fresh Marsh | -206 (50%) | +178 | 0 | -28 |
| Intermediate Marsh | -48 (12%) | +305 | 0 | + 257 |
| Brackish Marsh | -131 (32%) | +363 | 0 | + 232 |
| Saline Marsh | -5 (1%) | +222 | 0 | + 217 |
| **Subtotal Texas** | **-412** | **+1,068** | **0** | **+656** |

(Units are in AAHUs)

**Monitoring**

*BU monitoring in the Neches River sites*

Success criteria at the Neches River sites will be the same as for the Louisiana sites. Texas has experienced colonization of some invasive species. The success criterion will include measures to limit the establishment of invasive plant species colonization at the BU sites. The Corps will assume management responsibilities for the first 10 years and then the Sabine Neches Navigation District (SNND) will assume responsibility for the remainder of the life of the project. Aerial photography will be used to monitor the progression of invasive species and will be flown in conjunction with the other data acquisition flights. Marsh elevation will be assessed one year after placement. The ICT will evaluate the data and determine if additional material is needed or if further action is necessary to allow for tidal exchange in the marsh. Marsh vegetation in this area has historically colonized on its own with little assistance. However, the ICT will evaluate the vegetation coverage in the mitigation sites and determine whether additional planting would be appropriate by using aerial photography beginning at year five after the material placement. If the vegetation coverage is not progressing, the ICT will make recommendations that will increase the likelihood of achieving the success criteria to include plantings. Invasive species will be monitored and the ICT will determine if further action is necessary to achieve the monitoring success criteria.

**Table 15 Ecological success criteria for Texas mitigation sites**

Monitoring the Neches River Beneficial Use Feature
for the Sabine-Neches Waterway Channel Improvement Project

| | Rose City East | Bessie Heights East | Old River Cove |
|---|---|---|---|
| **Ecological Success Criteria** | | | |
| Placed material will be 60-80% vegetated with native, typical, emergent marsh 5 yrs after placement of material. | 158 ac vegetated emergent marsh after one dredging cycle. | 1,308 ac vegetated emergent marsh after 28 yrs and seven maintenance dredging cycles. | 447 ac vegetated emergent marsh. |
| Marsh remains intact and 60-80% vegetated with native, typical, emergent marsh at end of project, 50 yrs. | 158 ac vegetated emergent marsh. | 1,308 ac vegetated emergent marsh. | 447 ac vegetated emergent marsh. |
| Invasive, noxious, and/or exotic plants comprise less than 4% of marsh cover. | Less than 6 ac with undesirable plants. | Less than 52 ac with undesirable plants. | Less than 18 ac with undesirable plants. |
| Placed material elevation. | Maximum optimal elevation (as determined by pre-construction surveys in consultation with ICT) 1 year after placement of material. | | |
| **Monitoring Organization** | USACE for 1st 10 yrs. SNND for monitoring after Yr 10 through 50-year period of analysis. | | |

(Corps 2009b)

*Louisiana*

Mitigation success criteria for all five sites in Louisiana will be the same due to proximity and similarity in ecological processes at each of the sites. The success criteria will consist of 60 to 80 percent emergent marsh, 20-40 percent open water and adequate elevation of the placed dredge material to support the colonization of the marsh vegetation. Service personnel believe that the marsh elevations at these mitigation sites range from 1.1 to 1.2 ft. Each of the mitigation sites will be constructed to the highest elevations (with instruction from the ICT and pre-construction surveys) that will support marsh vegetation. This target elevation is assumed to reach approximately 1.6 to 1.7 ft NAVD88 after settlement. This target elevation will allow for the projected sea level rise. Over the 50 year life of the project, an ecological success criterion of 60-80 percent emergent marsh is expected to be sustained. However, adaptive management will

be utilized to ensure that the success criteria are met on all levels. The USACE and the project sponsor, the SNND will manage the monitoring of the sites. Invasive species are believed to not be a problem in Louisiana. However, a success criterion is included to protect the marshes and prevent the spread of invasive plants to the mitigation sites. In addition, aerial photography will be collected and used to assess the success of the sites eight times over the life of the project. Table 16 depicts the acreage to be created.

**Table 16 Mitigation monitoring for Louisiana**

Mitigation Monitoring in Louisiana for the Sabine-Neches Waterway Channel Improvement Project

| | Willow Bayou | | Black Bayou West | Black Bayou East | |
|---|---|---|---|---|---|
| | LA 2-18B | LA 2-A00 B | LA 3-10R | LA 3-15B | LA 3-18B |
| **Ecological Success Criteria** | | | | | |
| Placed material will be 60-80% vegetated with native, typical, emergent marsh 5 yrs after placement of material. | 176 ac vegetated emergent marsh | 305 ac vegetated emergent marsh | 92 ac marsh after 1st maintenance dredging, 185 ac marsh after 2nd maintenance dredging, 277 ac marsh after 3rd maintenance dredging, 370 ac marsh after 4th dredging cycle, 462 ac marsh after 5th dredging cycle, and 554 ac marsh after 6th dredging cycle | 478 ac vegetated emergent marsh | 435 ac vegetated emergent marsh |
| Marsh remains intact and 60-80% vegetated with native, typical, emergent marsh at end of project, 50 yrs. | 176 ac vegetated emergent marsh | 305 ac vegetated emergent marsh | 554 ac vegetated emergent marsh | 478 ac vegetated emergent marsh | 435 ac vegetated emergent marsh |
| Invasive, noxious, and/or exotic plants comprise less than 4% of marsh cover | Less than 7 ac with undesirable plants | Less than 12 ac with undesirable plants | Less than 22 ac with undesirable plants | Less than 19 ac with undesirable plants | Less than 17 ac with undesirable plants |
| Placed material elevation | Maximum optimal elevation (as determined by preconstruction surveys in consultation with ICT) 1 year after placement of material | | | | |
| **Monitoring Organization** | U.S. Army Corps of Engineers and Sabine-Neches Navigation District | | | | |

(Corps 2009b)

*Monitoring of the BU placement on the Gulf Shore*

Dredge material from the project is to be placed alternately on the Texas and Louisiana shores near the top of Gulf beaches at Texas Point and Louisiana Point. Dredged material would nourish existing marshes and the near-shore shallow water. The expectation is that some of the material will remain and assist with the severe erosion that continues to plague these two shorelines. It is hoped that some of the material may wash up on the beaches due to high tides and storm events and may nourish the marshes behind the dunes. Monitoring efforts will be initiated every three years beginning with the first placement and will continue for two full 6-year cycles at each point to year 13. The focus of this objective is to monitor and evaluate the success of on-shore and near-shore disposal to achieve a reduced rate of shoreline erosion and possible accretion. Texas Point shoreline erosion rate average should be less than 44 ft/yr while the Louisiana shoreline should exhibit accretion rate averages of more than 1.2 ft/yr (USACE 2009b). The shoreline erosion or accretion will be calculated by using Year 1 baseline aerial photograph and photography from Years 4, 7, 10 and 13. An annual report completed by the District Engineer will summarize the results of the achieved successes, failures, disposal activities and recommendations for obtaining the goals set forth by the ICT. This report will be available to all ICT members and other cooperating agencies. Five years following the disposal, the ICT will meet to assess the results and status of the emergent marsh. At this time, the ICT will evaluate whether there is need for additional data collection and if not, the ICT can recommend other corrective actions such as plantings, discharge pipe placement, and contouring of the marsh. Monitoring activities are set to stop when it has been determined that placement of dredge material is achieving the goal of reduced shoreline erosion and marsh re-nourishment behind the Gulf beaches. By using adaptive management, the ICT can evaluate and make

modifications/recommendations on dredge material disposal at either of these sites during the monitoring period.

**Summary of Service Conclusions and Recommendations**

1.) Construct a 2 to 12-acre, + 8 ft. colonial waterbird nesting island at least one mile offshore in Sabine Lake using project-dredged material. The island should include a sloping sand beach, preferably protected by a rock breakwater similar to the design of Evia Island in Galveston Bay. The Service can assist in final design, location, and management. 32

2.) Create an interagency work group during post-authorization planning, and continue the work group through planning and construction phases. The work group would execute important design, inspection, and monitoring functions for habitat creation features. These include: a) the 345-acre freshwater marsh (potentially some swamp acreage) and 183-acre freshwater lake creation at Rose City, b) the 1,190-acre intermediate marsh and 679-acre brackish marsh and 1,090-acre shallow freshwater habitat creation at Bessie Heights, c) the 639-acre brackish marsh and 139-acre shallow water habitat at Old River Cove, d) the 687-acre intermediate marsh creation from Sabine Lake dredging at Willow Bayou on Sabine NWW and e) the 2,096-acre intermediate marsh creation from the GIWW and Channel to Orange-dedicated dredging of accumulated maintenance material in the LA Black Bayou Unit. Experience at ongoing Federal navigation projects in Galveston Bay, Corpus Christi Bay, Atchafalaya Bay, and elsewhere have shown us that large-scale habitat creation using dredged material requires ongoing feedback and modification during and following construction in order to successfully turn conceptual plans into successful habitat creation features. 33

3.) Include as part of the interagency work group tasks, the monitoring and guidance for aquatic habitat (wintering waterfowl) management within DMMP upland disposal sites 23A, 24A, 27A, 27C, and 27D. 34

4.) Replace on a 1:1 basis on suitable bottoms within Sabine Pass or in the southern portion of Sabine Lake, any estimated oyster reef losses caused by project features. Oyster habitat mitigation should be accomplished concurrently with channel construction, should consist of at least a 1-ft thick layer of shell or suitable cultch material such as graded limestone or fly-ash rock, and should be followed up at one year post-construction with bottom profiling survey and grab sampling to insure adequate relief (minimum average 0.5 ft above bay and pass bottom) and oyster spat coverage. This mitigation is not needed if no Sabine Lake or Pass oyster habitat is disturbed by project features. 35

5.) The Service concurs with Willow Bayou Unit Alternative "B", restoring marsh on the Sabine NWR through dedicated dredging of material from Sabine Lake and placing that material in open water areas on that refuge north of the Willow Bayou Canal. However, if Alternative "B" should not prove viable, the Service recommends that Alternative "C", beneficial use of new work material from the SNWW, be used to restore marsh on Sabine NWR, or the rock breakwater shoreline stabilization measures, or Sabine NWR terracing measures be implemented as long as the acres protected/restored and AAHUs gained fully compensate for projected impacts. 36

6.) The Service recommends that the Corps review their calculations for volume of dredged material needed to achieve the listed mitigation in Louisiana and questions whether the Corps 37

would be able to achieve the degree of marsh restoration depicted in the recommended mitigation with unconfined placement of dredged material (Tables 11 and 12).

7.) The Service recommends the construction of tidal creek channels (or trenasses) at least ten feet wide and two feet deep in the restored marsh, six months to a year, if necessary, after disposal in order to return the area to natural hydrology for tidal movement and estuarine aquatic organism access to the restored marshes. The tidal creeks could be constructed by tracking marsh buggy track-hoes, or similar equipment, over proposed creek channel routes. The dredged material pipeline for marsh restoration (i.e., Willow Bayou and Black Bayou Units mitigation) should be placed in existing canals and waterways to the greatest extent practicable to minimize marsh damage. 38

8.) The Service recommends that the Sabine Lake borrow area be relocated at least 1,000 ft from the eastern Sabine Lake shoreline to minimize borrow area shoreline impacts. 39

9.) The Corps should acquire a refuge Special Use Permit from the Sabine NWR (Terry Delaine, manager, Sabine NWR, 337-558-5574; or Don Voros of the Southwest Louisiana Refuges Complex, 1428 Hwy 27, Bell City, LA 70630; 337-598-2216) to coordinate the final planning for the dedicated dredging marsh restoration mitigation on Sabine NWR. 40

10.) The Service recommends that the Corps construct the Sabine-Neches project mitigation at the same time as waterway enlargement construction is performed. 41

11.) The Service recommends that the Corps require protective easements on privately owned lands where Sabine-Neches mitigation is to be performed to ensure that the mitigation is not compromised by future development activities. 42

12.) The Service recommends that the Corps implement a DMMP BU and mitigation monitoring program to consist of aerial photography interpretation, elevation, and vegetation surveys to be conducted periodically during the project life to ensure that the BU and mitigation is successful at offsetting project impacts during the project life. 43

13.) The Service recommends that if DA 27D is converted to an upland DA, a disposal area water regime protocol be developed to maximize wetland habitat potential during between-disposal intervals for wintering waterfowl use. 44

14.) Develop an exotic and invasive species plan that will be used to control exotic and invasive species at the mitigation sites based on the success criteria used in the monitoring plan. 45

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Mr. Steve Parris
U.S. Fish and Wildlife Service
Division of Ecological Services
17629 El Camino Real #211
Houston, TX 77058-3051

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The figure included in the Coordination Act Report (CAR) report is incorrect. It includes Neches River Beneficial Use (BU) components that have been dropped from the Preferred Alternative. Please see Final Environmental Impact Statement (FEIS) Figure 1.1-2 for the correct figure. |
| 2 | U.S. Army Corps of Engineers (USACE) notes that the CAR description of the Preferred Alternative (Recommended Plan in the Draft Feasibility Report [DFR]) is incorrect. The Recommended Plan is the Locally Preferred Plan (48-foot [ft] authorized depth), not the National Economic Development (NED) Plan (49 ft authorized depth). Also the description of the Recommended Plan in the CAR is incomplete. The Recommended Plan includes deepening and widening of the Taylor Bayou Channels and Basins and the addition of Neches River Turning/Anchorage Basins 1, 4 and 8 (see FEIS Section 2.3.2). |
| 3 | The figure included in the CAR report is incorrect. It includes Neches River BU components that have been dropped from the Preferred Alternative. Please see FEIS Figure 2.1-1 for the correct figure. |
| 4 | There are significant differences between U.S. Fish and Wildlife (USFWS) estimates of individual wetland types, as shown in CAR Table 1, and wetland type subtotals used in the Wetland Value Assessment (WVA) modeling of wetland impacts (FEIS Appendix C, Table 1). USACE notes that the Interagency Coordination Team (ICT) approved the wetland type acreages applied in the WVA modeling, and the impact results. Furthermore, USFWS in the CAR (pages 17-20) concurs with the USACE impact analysis. Therefore, the differences between these two estimates are assumed to be immaterial to the impact evaluation. |
| 5 | The total number of existing Placement Areas (PA) along the entire exiting Sabine-Neches Waterway (SNWW) is 20: 16 upland PAs and 4 Ocean Dredged Material Disposal Site (ODMDS) (see FEIS Section 2.4.2.1), not 13 as presented by the CAR. |
| 6 | PA 16A is discussed in FEIS Section 2.5.3.4.1: Areas Considered for PA Expansion. It is not an existing PA as implied by the CAR. As noted in the FEIS, this area was dropped from further consideration as a PA. |
| 7 | Table 4 reflects an error in FWP Net Change Average Annualized Habitat Units (AAHUs) presented in Draft EIS (DEIS) Table 4.1-3 for LA 8, Southwest Gum Cove, fresh marsh. The DEIS incorrectly shows a loss of 14 AAHUs for the net change to LA8 fresh marsh. The net change should be a loss 2 AAHUs (rather than a loss of 14 AAHUs as shown in the DEIS) and the total Louisiana change in AAHUs should therefore be a loss of 1,709 AAHUs. |
| 8 | USACE concurs with the restatement of losses by habitat type in this paragraph, with the exception of Louisiana losses in cypress-tupelo swamps. No loss (0 AAHUs) is predicted for Louisiana swamps (see FEIS Table 2.5-5). Also, USACE notes that the impacts listed in Table 4 would occur without the BU plan, which would fully offset impacts in Texas and partially offset impacts in Louisiana with BU benefits. |
| 9 | Error noted for comment 3 above is also reflected in this table. LA AAHUs for fresh marsh should be a loss of 78 rather than the loss of 90 shown in the table. |
| 10 | Comment noted. The Keith Lake Section 1135 CAP study was begun in 2003, well before impacts of the SNWW Channel Improvement Project (CIP) had been determined or potential mitigation measures defined. Since at that time it seemed likely that the CAP study and project construction would be completed before the SNWW CIP could be authorized and constructed, the Keith Lake Section 1135 study was considered separable from the SNWW CIP. It was assumed that a water control structure at the Fish Pass would be part of the future without-project condition for the SNWW CIP. |

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| | Incremental impacts of the SNWW CIP will be calculated for the Salt Bayou unit of the SNWW study area when WVA modeling is completed for the Keith Lake Section 1135 study. It is possible that the excess Dredged Material Management Plan (DMMP) benefits (316 AAHUs) of the SNWW CIP will cover all incremental project impacts. However, if it is determined that additional mitigation is needed, then USACE and the non-Federal sponsor of the SNWW CIP will initiate consultation with resource agencies, identify and incrementally justify additional compensatory mitigation for the Salt Bayou unit, and prepare a supplemental environmental impact statement. |
| 11 | The figure included in the CAR report is incorrect. It includes Neches River BU components that have been dropped from the Preferred Alternative. Please see FEIS Figure 2.5-1 for the correct figure. |
| 12 | The proposed Rose City Marsh BU was developed in consultation with the ICT (which includes the USFWS) and benefits of the BU feature reflect marsh restoration, only. The ICT-approved BU plan for this area does not include plans for cypress-tupelo forest revegetation. USACE will not add this as a formal BU feature at this time. Although historically, cypress-tupelo swamp vegetation was the predominant vegetation at this location, the salinity regime in this area is changing due to climate change and relative sea level rise, and in the long term it is unlikely that this area would be able to sustain substantial cypress-tupelo forest vegetation. |
| 13 | USACE notes a typographical error in the acres of Nourished Existing Marsh for Bessie Heights East. The acres should be 651 (rather than 615), and the total should be 1,234 rather than 1,198. Further, USACE notes that the textual descriptions, and in general, the acreage descriptions in this table, reflect the revised BU plan presented in the FEIS. It is only the figures (described in Comment responses 1, 3, and 11 that convey a previous version of the BU plan. |
| 14 | USACE has committed to continuing the ICT through the preconstruction, engineering and design (PED) and project construction phases to provide input during the development of plans and specifications for BU features and mitigation measures, and on best management practices as described in response 6 above. The ICT would continue into the operations phase to ensure that the BU and mitigation measures have been constructed as specified in the DEIS and that the goals of the compensatory mitigation plan have been fully achieved. See FEIS Appendix J for a description of the mitigation monitoring and contingency plan, which describes the role and responsibilities of the non-Federal sponsor, the Sabine Neches Navigation District (SNND). USACE notes the USFWS stated intent to request the annual transfer funds under the FWCA during the construction phase. USACE will consider such requests for years in which significant SNWW CIP construction activities are scheduled and funds are available. |
| 15 | The construction of a bird island in Sabine Lake using new work material from the SNWW was evaluated during screening of potential BU features as described in FEIS Section 2.5.3.1. The ICT (including USFWS) participated in this screening and approved the results. Construction of a bird island using new work material was found to be feasible, but the costs would exceed placement in available upland PAs. This feature was eliminated because incremental costs were higher than upland placement and no cost-share partner could be identified. |
| 16 | USACE notes that the 4 closest ODMDS sites were designated by the U.S. Environmental Protection Agency (EPA) for the continued placement of dredged material removed from the SNWW Entrance Channel (Federal Register Vol. 52, No. 175, September 10, 1987, page 34218; FEIS, 1983 [EPA, 1983a]). The siting and impacts of the existing ODMDS were evaluated by the FEIS for the maintenance dredging of the SNWW Entrance Channel (the authorized 40-ft Project (USACE, 1975). The selected sites were located as close to the shoreline as practicable. |
| 17 | PA 16A is discussed in FEIS Section 2.5.3.4.1: Areas Considered for PA Expansion. As noted in the FEIS, this area was dropped from further consideration as a PA because the existing vegetation community and hydrologic connectivity to adjacent wetlands makes this a high quality native marsh providing important habitat for native fish and wildlife. USACE concurs with the USFWS assessment of the value of this area, and therefore did not include it in the FEIS Preferred Alternative (DFR Recommended Plan). |
| 18 | PA 14A is discussed in FEIS Section 2.5.3.4.1: Areas Considered for PA Expansion. As noted in the FEIS, this area was dropped from further consideration as a PA because it provides habitat for native wildlife species, is covered by a valuable intermediate wetland, and is intermittently hydrologically connected to the riparian corridor. USACE concurs with the USFWS assessment of the value of this area, and therefore did not include it in the FEIS Preferred Alternative (DFR Recommended Plan). |

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| 19 | PA 23A is discussed in FEIS Section 2.5.3.4: Existing Inactive PAs. Recommendation 1: As noted in the FEIS, existing PA23A is a leveed upland area covered by secondary growth of tallow and black willow forest. It has been extensively modified by past placement activities and levee systems that have artificially altered the hydrology. Surrounding levees hold water and isolate the area from adjacent waterbodies, preventing contributions to the function of adjacent wetlands and the riparian corridor. It contains degraded habitat with low habitat value, primarily roosting habitat and some wildlife cover. USACE maintains that WVA modeling of this isolated, non-wetland habitat is not warranted and that renewed use of this area would not constitute a significant adverse impact. Recommendation 2: The DMMP (FEIS Appendix D) estimates that this PA would be used every 6 years for the placement of maintenance material. The PA must be drained between maintenance cycles to allow the sediment to settle, consolidate and dry out sufficiently for it to be used for levee maintenance and to provide PA capacity for the next cycle. USACE cannot accommodate this recommendation because it must manage the PA to provide future capacity for maintenance material from the proposed SNWW CIP. |
| 20 | PA 24A is discussed in FEIS Section 2.5.3.4.1: Areas Considered for PA Expansion. Recommendation 1: Impacts to low quality wetlands in the proposed PA have been assessed by the WVA model and included in the impacts evaluation for the proposed SNWW CIP. In order to minimize impacts, USACE redrew the proposed boundary to exclude 144 acres of higher value marsh, reducing the proposed PA from 331 to 187 acres. The boundaries of the proposed PA are set, and the locations of the levees are constrained by the proposed PA boundaries. USACE will design discharge points to minimize impacts to adjacent high quality habitat. Recommendation 2: The DMMP (FEIS Appendix D) estimates that this PA would be used once and filled with new work material from construction of the proposed SNWW CIP. There would be no ongoing opportunities to maximize wetland characteristics as recommended. |
| 21 | PA 26 is discussed in FEIS Section 2.5.3.4: Existing Inactive PAs. Recommendation: The DMMP (FEIS Appendix D) estimates that this PA would be used every 6 years for the placement of maintenance material. The PA must be drained between maintenance cycles to allow the sediment to settle, consolidate and dry out sufficiently for it to be used for levee maintenance and to provide PA capacity for the next cycle. USACE cannot accommodate this recommendation because it must manage the PA to provide future capacity for maintenance material from the proposed SNWW CIP. |
| 22 | PA 27A is one of the active PAs discussed in FEIS Section 2.5.3.3.1: Existing Active PAs. USACE notes that USFWS does not object to its use and does not make any recommendations. |
| 23 | PA 27C is discussed in FEIS Section 2.5.3.4: Existing Inactive PAs. Recommendation: The DMMP (FEIS Appendix D) estimates that this PA would be used every 6 years for the placement of maintenance material. The PA must be drained between maintenance cycles to allow the sediment to settle, consolidate and dry out sufficiently for it to be used for levee maintenance and to provide PA capacity for the next cycle. USACE cannot accommodate this recommendation because it must manage the PA to provide future capacity for maintenance material from the proposed SNWW CIP. |
| 24 | PA 27D is discussed in FEIS Section 2.5.3.4: Existing Inactive PAs. Recommendation: The DMMP (FEIS Appendix D) estimates that this PA would be used every 6 years for the placement of maintenance material. The PA must be drained between maintenance cycles to allow the sediment to settle, consolidate and dry out sufficiently for it to be used for levee maintenance and to provide PA capacity for the next cycle. USACE cannot accommodate this recommendation because it must manage the PA to provide future capacity for maintenance material from the proposed SNWW CIP. |
| 25 | FEIS Section 5.5.1 states that the borrow trench would be located at least 1000 feet from the Sabine National Wildlife Refuge (SNWR) shoreline, and that the exact location of the trench would be determined in consultation with the ICT (which includes USFWS) during PED. |
| 26 | As recommended, USACE has reviewed calculations for the volume of dredged material needed to construct the proposed mitigation areas. USACE believes that the estimate is sufficiently accurate for feasibility planning, and notes that the estimated cost of the mitigation area includes a 30 percent contingency. |
| 27 | If any part of the recommended mitigation plan is found to be not viable after project approval, USACE and the non-Federal sponsor of the SNWW CIP would initiate consultation with the ICT, identify and incrementally justify alternative compensatory mitigation, and prepare a supplemental environmental impact statement. |

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| 28 | USACE notes that the recommended Willow Bayou Mitigation Measure LA 2-18 B does not include the alternative "C" as indicated in the USFWS table. |
| 29 | USFWS concurrence with the USACE mitigation and BU plans for the proposed SNWW CIP is noted. |
| 30 | As noted in FEIS Section 7.9 USACE has requested a compatibility determination from the SNWR for the proposed Willow Bayou mitigation area. |
| 31 | USACE notes that the Louisiana mitigation measures apply to the SNWW LPP, not the NED plan. Also, the table incorrectly compares and adds restored emergent marsh acres for Total Mitigation Compensation (2,783 acres) to the net SNWW CIP project impacts as measured in AAHUs (a loss of 843 AAHUs). The estimated total loss of acres as a result of the SNWW CIP is 691 acres (FEIS Table 2.4-16). |
| 32 | See USACE response to Comment 15. |
| 33 | See USACE response to Comment 14. |
| 34 | See USACE responses to Comments 19, 20, 21, 23, and 24. |
| 35 | FEIS Section 4.11.2.1.2 evaluates the potential for impacts to oyster reef by the proposed SNWW CIP. No impacts to oyster reef are anticipated in Sabine Pass because the channel is not being widened and no slumping is expected at the top of cut. No impacts to oyster reef in Sabine Lake are anticipated because salinities are generally too low to support spat growth, as confirmed by recent survey. Furthermore, as stated in FEIS Section ES.5 and Section 5.5.1, USACE has proposed that a water bottom survey of the borrow and access channel areas in Sabine Lake be conducted during the PED phase of the project. In the unlikely event that oyster reef is encountered, plans will be revised to avoid impacts. |
| 36 | See USACE response to Comment 27. |
| 37 | See USACE response to Comment 26. |
| 38 | FEIS Sections 5.5.1 and 5.5.2 describes the proposed Willow Bayou and Black Bayou mitigation measures. The descriptions include the construction of tidal creek channels. USACE will develop construction methods and plans in consultation with the ICT (which includes USFWS) during PED. |
| 39 | See USACE response to Comment 25. |
| 40 | See USACE response to Comment 30. |
| 41 | USACE plans to construct the proposed Willow Bayou, Black Bayou East and first phase of Black Bayou West concurrently with proposed channel deepening. The remaining 5 phases of the Black Bayou West mitigation measure would be completed over approximately the next 30 years in conjunction with maintenance dredging of the Sabine River Channel. |
| 42 | The Black Bayou East and West mitigation measures are located on private property. USACE has determined that conservation easements are not required because all restored areas would remain jurisdictional wetlands and would continue to be subject to the navigational servitude (Final FR Section VIII.E). |
| 43 | FEIS Appendix J contains a mitigation and beneficial use monitoring plan that was developed in consultation with USFWS and reviewed by the ICT. USACE received one comment on the draft plan, asking that we ensure ICT involvement in the monitoring. The plan contains periodic aerial photography interpretation and vegetation surveys. Construction contracts for mitigation and BU sites would incorporate an adaptive management approach to ensure that the initial construction contracts attain the appropriate elevation over the acreage specified for emergent marsh within each mitigation site. |
| 44 | See USACE response to Comment 24. |
| 45 | FEIS Appendix J contains a mitigation and beneficial use monitoring plan that was developed in consultation with USFWS and reviewed by the ICT. If the percentage coverage of exotic and invasive species exceeds the success criteria, the ICT will develop plans to remove and manage those species. |

# Appendix A4

# Cultural Resources Coordination

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229
FEBRUARY 7, 2007

Environmental Section

Mr. Don Klima
Advisory Council on Historic Preservation
Office of Federal Agency Programs
Old Post Office Building
1100 Pennsylvania Avenue, NW, Suite 803
Washington, DC 20004

Dear Advisory Council on Historic Preservation (Council):

The US Army Corps of Engineers, Galveston District (USACE), proposes to initiate a Programmatic Agreement (PA) to avoid and mitigate, if necessary, impacts to historic properties that may occur during construction and operation of the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). The SNWW CIP includes improvements to the existing navigation channel, a Dredged Material Management Plan (DMMP) and an ecological impacts mitigation plan. A full description and maps of the proposed channel improvements can be found in the enclosed Background Report (Enclosure).

The USACE proposes negotiation of a four-party PA which outlines procedures to be followed for Section 106 compliance as per 36 CFR 800.6 (c) to address potential impacts to historic properties identified in the Background Report for the SNWW CIP project area (Enclosure). The four parties include the USACE, the Jefferson County Waterways and Navigation District (JCWND) and the Texas and Louisiana State Historic Preservation Officers (SHPOs) The draft PA will also be coordinated with interested Native American Indian tribes in accordance with 36 CFR 800.3 (f)(2). Included in the Enclosure is a draft PA prepared by the USACE that has been informally coordinated with the JCWND. The intent of the PA is to avoid or mitigate impacts to historic properties in areas directly affected by new dredging and channel construction, construction staging and access areas, extensions of existing placement areas, ecological mitigation features, areas affected by the beneficial uses of dredged material, and ongoing maintenance dredging and placement activities related to the SNWW CIP.

We are notifying the Council of our intent to negotiate the PA for the SNWW CIP and inviting your participation pursuant 36 CFR 800.6 (a)(1)(i)(C). If you have any questions, please do not hesitate to call Ms. Nicole Minnichbach at 409-766-3878.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Enclosure:
1 Background Report & Draft PA

CC w/o Enclosure

Paul Beard
Chairman
Board of Commissioners
Jefferson County Waterway and Navigation District
2348 Highway 69 N
Nederland, TX 77627

Thomas Hales Eubanks, Ph.D.
State Archaeologist and Director
Louisiana Division of Archaeology
P.O. Box 44247
Baton Rouge, Louisiana 70804

James E. Bruseth, Ph.D.
Deputy State Historic
Preservation Officer
Texas Historical Commission
P.O. Box 12276
Austin, Texas 78711

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229
FEBRUARY 7, 2007

Environmental Section

Thomas Hales Eubanks, Ph.D.
State Archaeologist and Director
Louisiana Division of Archaeology
P.O. Box 44247
Baton Rouge, Louisiana 70804

Dear Dr. Eubanks:

The US Army Corps of Engineers, Galveston District (USACE), proposes to initiate a Programmatic Agreement (PA) to avoid and mitigate, if necessary, impacts to historic properties that may occur during construction and operation of the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). A full description of the proposed channel improvements can be found in the enclosed Background Report (Enclosure). The SNWW CIP includes improvements to the existing navigation channel, a Dredged Material Management Plan (DMMP) and an ecological impacts mitigation plan.

The USACE proposes negotiation of a four-party PA which outlines procedures to be followed for Section 106 compliance as per 36 CFR 800.6 (c) to address potential impacts to historic properties identified in the Background Report for the SNWW CIP project area (Enclosure). Included in the Enclosure is a draft PA prepared by the USACE that has been informally coordinated with the Jefferson County Waterways and Navigation District (JCWND). The intent of the PA is to avoid or mitigate impacts to historic properties in areas directly affected by new dredging and channel construction, construction staging and access areas, new or extensions of existing placement areas, ecological mitigation features, areas affected by the beneficial uses of dredged material, and ongoing maintenance dredging activities relate to the SNWW CIP.

In summary, Galveston District requests your review of the enclosed PA. Upon receipt of your comments and finalization of the draft PA in consultation with JCWND, the USACE will coordinate a final draft PA with interested Native American Indian tribes in accordance with 36 CFR 800.3 (f)(2). Public coordination required by 800.3 (a) will be accomplished by inclusion of the final draft PA in the Draft Environmental Impact Statement, which will be made available for public review and comment. If you have any questions, please don't hesitate to call Ms. Nicole Minnichbach at 409-766-3878.

Sincerely,

for Carolyn Murphy
Chief, Environmental Section

Enclosure:
1 Background Report & Draft PA

CC w/o Enclosure

Thomas Hales Eubanks, Ph.D.
State Archaeologist and Director
Louisiana Division of Archaeology
P.O. Box 44247
Baton Rouge, Louisiana 70804

James E. Bruseth, Ph.D.
Deputy State Historic
Preservation Officer
Texas Historical Commission
P.O. Box 12276
Austin, Texas 78711

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229
FEBRUARY 7, 2007

Environmental Section

Mr. Paul Beard
Chairman
Board of Commissioners
Jefferson County Waterway and Navigation District
2348 Highway 69 N
Nederland, TX 77627

Dear Mr. Beard:

The US Army Corps of Engineers, Galveston District (USACE), proposes to initiate a Programmatic Agreement (PA) to avoid and mitigate, if necessary, impacts to historic properties that may occur during construction and operation of the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). A full description of the proposed channel improvements can be found in the enclosed Background Report (Enclosure). The SNWW CIP includes improvements to the existing navigation channel, a Dredged Material Management Plan (DMMP) and an ecological impacts mitigation plan.

The USACE proposes negotiation of a four-party PA which outlines procedures to be followed for Section 106 compliance as per 36 CFR 800.6 (c) to address potential impacts to historic properties identified in the Background Report for the SNWW CIP project area (Enclosure). Included in the Enclosure is a draft PA prepared by the USACE that has been revised as per your request during informal coordination. The intent of the PA is to avoid or mitigate impacts to historic properties in areas directly affected by new dredging and channel construction, construction staging and access areas, new or extensions of existing placement areas, ecological mitigation features, areas affected by the beneficial uses of dredged material, and ongoing maintenance dredging activities relate to the SNWW CIP.

In summary, Galveston District requests your review of the enclosed PA. Upon receipt of your comments and finalization of the draft PA in consultation with the Texas and Louisiana State Historic Preservation Officers (SHPOs), the USACE will coordinate a final draft PA with interested Native American Indian tribes in accordance with 36 CFR 800.3 (f)(2). Public coordination required by 800.3 (a) will be accomplished by inclusion of the final draft PA in the Draft Environmental Impact Statement, which will be made available for public review and comment. If you have any questions, please don't hesitate to call Ms. Nicole Minnichbach at 409-766-3878.

Sincerely,

for Carolyn Murphy
Chief, Environmental Section

Enclosure:
1 Background Report & Draft PA

CC w/o Enclosure

James E. Bruseth, Ph.D.
Deputy State Historic
Preservation Officer
Texas Historical Commission
P.O. Box 12276
Austin, Texas 78711

Paul Beard
Chairman
Board of Commissioners
Jefferson County Waterway and Navigation District
2348 Highway 69 N
Nederland, TX 77627

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229
FEBRUARY 7, 2007

Environmental Section

James E. Bruseth, Ph.D.
Deputy State Historic
Preservation Officer
Texas Historical Commission
P.O. Box 12276
Austin, Texas 78711

Dear Dr. Bruseth:

The US Army Corps of Engineers, Galveston District (USACE), proposes to initiate a Programmatic Agreement (PA) to avoid and mitigate, if necessary, impacts to historic properties that may occur during construction and operation of the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). A full description of the proposed channel improvements can be found in the enclosed Background Report (Enclosure). The SNWW CIP includes improvements to the existing navigation channel, a Dredged Material Management Plan (DMMP) and an ecological impacts mitigation plan.

The USACE proposes negotiation of a four-party PA which outlines procedures to be followed for Section 106 compliance as per 36 CFR 800.6 (c) to address potential impacts to historic properties identified in the Background Report for the SNWW CIP project area (Enclosure). Included in the Enclosure is a draft PA prepared by the USACE that has been informally coordinated with the Jefferson County Waterways and Navigation District (JCWND). The intent of the PA is to avoid or mitigate impacts to historic properties in areas directly affected by new dredging and channel construction, construction staging and access areas, new or extensions of existing placement areas, ecological mitigation features, areas affected by the beneficial uses of dredged material, and ongoing maintenance dredging activities relate to the SNWW CIP.

In summary, Galveston District requests your review of the enclosed PA. Upon receipt of your comments and finalization of the draft PA in consultation with JCWND, the USACE will coordinate a final draft PA with interested Native American Indian tribes in accordance with 36 CFR 800.3 (f)(2). Public coordination required by 800.3 (a) will be accomplished by inclusion of the final draft PA in the Draft Environmental Impact Statement, which will be made available for public review and comment. If you have any questions, please don't hesitate to call Ms. Nicole Minnichbach at 409-766-3878.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Enclosure:
1 Background Report & Draft PA

CC w/o Enclosure

Paul Beard
Chairman
Board of Commissioners
Jefferson County Waterway and Navigation District
2348 Highway 69 N
Nederland, TX 77627

Thomas Hales Eubanks, Ph.D.
State Archaeologist and Director
Louisiana Division of Archaeology
P.O. Box 44247
Baton Rouge, Louisiana 70804

Preserving America's Heritage

March 5, 2007

Ms. Carolyn Murphy
Chief, Environmental Section
Galveston District
Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

REF: Proposed Programmatic Agreement for Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Murphy:

On February 9, 2007, the ACHP received your notification and on February 19 the supporting documentation regarding potential adverse effects to historic properties associated with the construction and operation of the Sabine-Neches Waterway Channel. Based upon the information you have provided, we have concluded that Appendix A, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases* of our regulations "Protection of Historic Properties (36 CFR Part 800) does not apply to this undertaking. Accordingly, we do not believe that our participation in consultation to resolve adverse effects is needed. However, if we receive a request for participation from a State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer (THPO) or other consulting party, we may reconsider this decision. Additionally, should circumstances change and you determine that our participation is required, please notify us.

Pursuant to 36 CFR 800.6(b)(1)(iv), you will need to file the final Programmatic Agreement (PA) developed in consultation with the Texas and Louisiana SHPO and any other consulting parties, and related documentation with the ACHP at the conclusion of the consultation process. The filing of the PA and documentation with the ACHP is required in order to complete the requirements of Section 106 of the National Historic Preservation Act.

Thank you for providing us with the notification of adverse effect. If you have any questions, please call me at 202-606-8554.

Sincerely,

Tom McCulloch, Ph.D., R.P.A.
Program Analyst
Office of Federal Agency Programs

ADVISORY COUNCIL ON HISTORIC PRESERVATION
1100 Pennsylvania Avenue NW, Suite 809 • Washington, DC 20004
Phone: 202-606-8503 • Fax: 202-606-8647 • achp@achp.gov • www.achp.gov

**State of Louisiana**
OFFICE OF THE LIEUTENANT GOVERNOR
DEPARTMENT OF CULTURE, RECREATION & TOURISM
OFFICE OF CULTURAL DEVELOPMENT
DIVISION OF ARCHAEOLOGY

MITCHELL J. LANDRIEU
LIEUTENANT GOVERNOR

ANGÈLE DAVIS
SECRETARY

PAM BREAUX
ASSISTANT SECRETARY

April 19, 2007

Ms. Carolyn Murphy
Chief, Environmental Section
Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Draft Programmatic Agreement
Sabine-Neches Waterway Channel
Improvement Project (SNWW CIP)
Cameron Parish, Louisiana

Dear Ms. Murphy:

Receipt is acknowledged of your letter dated February 7, 2007, transmitting a copy of the draft Programmatic Agreement (PA) for the proposed Sabine-Neches Waterway Channel Improvement Project (SNWW CIP).

We have completed our review of the document and have enclosed a marked-up copy with our comments. Please address our comments as appropriate and transmit a fully executed copy of the PA for our files.

Should you have any questions concerning our comments, do not hesitate to contact Duke Rivet in the Division of Archaeology at (225) 342-8170.

Sincerely,

Pam Breaux

Pam Breaux
State Historic Preservation Officer

PB:PR:s

Enclosure: as stated

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# Appendix A5

# Public Comments

contact LTC Mark Malcolm—703–604–7047 or e-mail: Malcolm, Mark A LTC DUSA(OR).

**Wayne Joyner,**

*Program Support Specialist, Army Science Board.*

[FR Doc. 02–12700 Filed 5–20–02; 8:45 am]

BILLING CODE 3710–08–M

## DEPARTMENT OF DEFENSE

### Department of the Army; Corps of Engineers

### Intent To Prepare a Draft Environmental Impact Statement for Improvements to the Sabine-Neches Ship Channel Near Beaumont and Port Arthur, Texas as Published in a Resolution of the Senate Committee on Environment and Public Works, dated June 5, 1997, 105th Congress, 2nd Session

**AGENCY:** Department of the Army, U.S. Army Corps of Engineers, DoD.

**ACTION:** Notice of intent.

**SUMMARY:** The proposed action to be addressed in the Draft Environmental Impact Statement (DEIS) is to evaluate several widening and deepening alternatives to improve a deep-draft navigation channel that connects harbor facilities in the Beaumont and Port Arthur area with the Gulf of Mexico. The study will focus on circulation and salinity changes associated with an improved channel and develop dredged material disposal options that will include an evaluation of beneficial uses of dredged material. The project is being maintained at its authorized depth of 40 feet and includes about 56 nautical miles of deep-draft channel. The Beaumont/Port Arthur area is located about 90 miles northeast of Houston, Texas. The local sponsor for the project is the Jefferson County Waterway and Navigation District.

**FOR FURTHER INFORMATION CONTACT:** Questions about the proposed action and DEIS can be answered by: Ms. Lizette Richardson, (409) 766–3123, Project Manager, Project Management Branch, or Ms. Janelle Stokes, (409) 766–3039, Environmental Lead, Environmental Section, Planning Branch, Planning Environmental and Regulatory Division, P.O. Box 1229, Galveston, Texas 77553–1229.

**SUPPLEMENTARY INFORMATION:**

(1) *Background.* The study began in 1997 when Congress directed the Secretary of the Army to study the feasibility of modifying the channels serving the Ports of Beaumont, Port Arthur, and Orange, Texas in the interests of commercial navigation. A reconnaissance study evaluated a deepening and widening plan to establish a Federal Interest in the project. The study concluded that there was a Federal Interest in continuing studies in 1998. The feasibility study began in March 2000 and will determine the most cost-effective alternative for improving the channel while protecting the Nation's environment.

(2) a. *Alternatives.* The construction alternatives that will be evaluated in the feasibility phase are: (1) Deepening the channel to 45 ft from offshore to the Beaumont turning basin; (2) deepening the channel to 48 ft from offshore to the Beaumont turning basin ; (3) deepening the channel to 50 ft from offshore to the Beaumont turning basin ; (4) various combinations of selective widening and turning basins; 5) various combinations of selective widening and turning basins with each one of the above depths.

b. *No Action.* A "No Action" alternative will be evaluated and presented for comparison purposes in evaluating the various construction alternatives.

(3) *Scoping.* The scoping process will involve Federal, State and local agencies, and other interested persons and organizations. Scoping meetings are scheduled for May 28 and 29, 2002 in Lake Charles, Louisiana, and Beaumont, Texas. The time and place of these meetings will be announced in local newspapers and mailings. Issues to be discussed at these meetings include, but are not limited to, changes in salinity and circulation, changes in fresh and saltwater marshes, water and sediment quality, erosion along the channel, threatened and endangered species impacts, opportunities for ecosystem restoration, and the beneficial use of dredged material. Any person or organization wishing to provide information on issues or concerns should contact the Corps of Engineers at the above address.

4. *Coordination.* Further coordination with environmental agencies will be conducted under the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the Endangered Species Act, the Clean Water Act, the Clean Air Act, the National Historic Preservation Act, the Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat), and the Coastal Zone Management Act under the Texas Coastal Management Program and the Louisiana Coastal Resources Program. An Interagency Coordination Team (ICT) has been formed to provide guidance and counsel on matters relating to the evaluation of environmental impacts of this project. The ICT is composed of representatives from 4 Federal agencies, 7 regulatory agencies from the States of Texas and Louisiana, the local sponsor, and the U.S. Army Corps of Engineers.

5. *DEIS Preparation.* It is estimated that the DEIS will be available to the public for review and comment in January 2004.

**Carolyn E. Murphy,**

*Chief, Environmental Section.*

[FR Doc. 02–12647 Filed 5–20–02; 8:45 am]

BILLING CODE 3710–52–P

## DEPARTMENT OF ENERGY

### Federal Energy Regulatory Commission

**[Docket No. ER02–517–002, et al.]**

### UtiliGroup, Inc., et al.; Electric Rate and Corporate Regulation Filings

May 14, 2002.

The following filings have been made with the Commission. The filings are listed in ascending order within each docket classification.

**1. UtiliGroup, Inc.**

[Docket No. ER02–517–002]

Take notice that on May 3, 2002, UtiliGroup, Inc. (UtiliGroup) tendered for filing with the Federal Energy Regulatory Commission (Commission) additional information to its original Petition for Acceptance of Initial Rate Schedule, Waivers and Blanket Authority filed December 10, 2001 and Amendment filed February 4, 2002.

*Comment Date:* May 24, 2002.

**2. San Diego Gas & Electric Company**

[Docket No. ER02–613–001]

Take notice that on April 30, 2002, San Diego Gas and Electric Company (SDG&E) tendered for filing with the Federal Energy Regulatory Commission (Commission) revised tariff sheets in Docket No. ER02–613–000, dated December 24, 2001, reflecting its proposed recovery of revenue requirements. Since making its filing, SDG&E determined that the revenue requirement submitted did not include recovery of franchise fees paid to the cities and counties in its service territory.

SDG&E is requesting the Commission to approve the revised revenue requirements and rates effective July 1, 2002 through December 31, 2002.

*Comment Date:* May 24, 2002.

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

16 December 2009

**DEPARTMENT OF DEFENSE**

**Department of the Army; U.S. Army Corps of Engineers**

**Notice of Availability for the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Environmental Impact Statement Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Site Designation**

**AGENCY:** Department of the Army, U.S. Army Corps of Engineers (USACE), Department of Defense; U.S. Environmental Protection Agency (EPA).

**ACTION:** Notice of Availability.

**SUMMARY:** The U.S. Army Corps of Engineers, Galveston District, announces the release of the Draft Feasibility Report (DFR) and the Draft Environmental Impact Statement (DEIS), the EIS for the Ocean Dredged Material Disposal Site Designation, the Draft General Conformity Determination, and the public comment period, for the Sabine Neches Navigation District's (SNND) proposed Sabine-Neches Waterway Channel Improvement Project (SNWW CIP).

**DATES:** The USACE, Galveston District, will be accepting written public comments on the DEIS through February 10, 2010. All comments must be postmarked by February 10, 2010.

**ADDRESSES:** You may send written comments to the USACE, Galveston District, Attn: Ms. Janelle Stokes, P.O. Box 1229, Galveston, TX 77553-1229, or by email to janelle.s.stokes@usace.army.mil.

**FOR FURTHER INFORMATION CONTACT:** Questions about the proposed action and the DEIS should be directed to Ms. Janelle Stokes, (409) 766-3039, or at the email address above.

**SUPPLEMENTARY INFORMATION:**

*Authority*:-The lead agency for this proposed channel improvement action is the USACE with several cooperating agencies including EPA, the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), the Texas General Land Office,

and the Louisiana Department of Wildlife and Fisheries (LDWF). As authorized by the Senate Committee on Environment and Public Works Resolution, dated June 5, 1997, USACE has reviewed previous USACE reports on the SNWW and other pertinent reports to determine the feasibility of modifying the channels serving the ports of Beaumont, Port Arthur, and Orange, Texas, in the interest of commercial navigation.

The lead agency for the proposed action to designate four new Ocean Dredged Material Disposal Sites (ODMDS) to receive portions of new work and future maintenance material from the proposed CIP is EPA, under the authority of Section 102 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) (33 U.S.C. 1412).

*Background*: The USACE has joined in an agreement with the SNND to prepare a DFR and a DEIS for proposed improvements to the SNWW. The proposed SNWW CIP is intended to improve the efficiency of the deep draft navigation system while protecting the area's coastal and estuarine resources. The lead agency for the DEIS is USACE. This DEIS was prepared as required by the National Environmental Policy Act (NEPA) to present an evaluation of potential impacts associated with the proposed CIP. The DEIS is now available for public review and comment.

*Project Description*: The SNND proposes to increase the authorized depth of the channel from 40 to 48 feet along the entire 64-mile-long existing channel and add a 13.2-mile extension to the offshore channels into the Gulf of Mexico. The offshore navigation channels, known collectively as the Entrance Channel, are divided into the Extension Channel, the Sabine Bank Channel, the Sabine Pass Outer Bar Channel, and the Sabine Pass Jetty Channel. They would be deepened from 42 to 50 feet. The inshore channels (the Sabine Pass Jetty Channel, Sabine Pass Channel, Port Arthur and Sabine-Neches canals, and the Neches River Channel) would be deepened from 40 feet to 48 feet. No modifications to the existing Sabine Pass Jetties are contemplated in conjunction with this project. Potential rehabilitation of the jetties is currently being studied, with the goal of preparing a long range plan of modification needed to ensure that the jetties continue to function appropriately to support the Federal navigation channel. Except for the one channel reach just beyond the jetties, the bottom width of the offshore Entrance Channel would be 700 feet wide. Since the existing Sabine Bank Channel is 800 feet wide, the bottom width of the deepened channel would be reduced to 700 feet wide. However, high currents passing around the mouth of the jetties require that the bottom width of the Sabine Pass Outer Bar Channel remain 800 feet wide, and therefore the deepened channel would be tapered to connect to the 700 foot Entrance Channel. With the exception of the Taylor Bayou basins and channels, the inshore channels would retain their existing 500 to 400 foot widths. The Taylor Bayou basins and channels would be widened to improve maneuverability for vessels using that facility. Neither the Sabine Neches Canal nor the Neches River Channel would be systematically widened, but navigation efficiency would be improved with bend easings in both reaches, and the addition or enlargement of turning and anchorage basins on the Neches River Channel.

Approximately 98 million cubic yards (mcy) of new-work dredged material would be generated from the proposed project. Maintenance dredging over the 50-year period of analysis is expected to yield approximately 650 mcy of dredged material. Dredged material will be placed in 16 existing upland placement area (PA) features and two new expansion cells at existing upland PAs. For the Entrance Channel, material will be placed in four existing and four proposed ODMDS features.

The proposed sites for the four new ODMDS are bounded by the following coordinates:

ODMDS "A"
29° 24′ 47″ N, 93° 43′ 29″ W; 29° 24′ 47″ N, 93° 41′ 08″ W
29° 22′ 48″ N, 93° 41′ 09″ W; 29° 22′ 49″ N, 93° 43′ 29″ W

ODMDS "B"
29° 21′ 59″ N, 93° 43′ 29″ W; 29° 21′ 59″ N, 93° 41′ 08″ W
29° 20′ 00″ N, 93° 41′ 09″ W; 29° 20′ 00″ N, 93° 43′ 29″ W

ODMDS "C"
29° 19′ 11″ N, 93° 43′ 29″ W; 29° 19′ 11″ N, 93° 41′ 09″ W
29° 17′ 12″ N, 93° 41′ 09″ W; 29° 17′ 12″ N, 93° 43′ 29″ W

ODMDS "D"
29° 16′ 22″ N, 93° 43′ 29″ W; 29° 16′ 22″ N, 93° 41′ 10″ W
29° 14′ 24″ N, 93° 44′ 10″ W; 29° 14′ 24″ N, 93° 43′ 29″ W

The water depth at the proposed four new ODMDS ranges from 39 to 46 feet. The bottom topography is flat, and proposed ODMDS "A", the most inshore proposed ODMDS, is approximately 19 miles from the coast at its closest point. A separate DEIS evaluating the proposed designation by EPA of the four new proposed ODMDSs accompanies the SNWW CIP DEIS as Appendix B. Beneficial uses of dredged material in the DMMP consist of the Neches River Beneficial Use (BU) Feature (Rose City East, Bessie Heights East, and Old River Cove), and the Gulf Shore BU Feature at Texas and Louisiana Points. Compensatory mitigation in the form of marsh restoration is proposed for all unavoidable environmental impacts in Louisiana.

*Availability of Draft Environmental Impact Statement (DEIS)*: Pursuant to section 102(2)(c) of the NEPA of 1969, as amended and as implemented by the Council on Environmental Quality (40 CFR parts 1500-1508) a DEIS for the proposed SNWW CIP has been filed with the EPA and is being made available to Federal, State, and local agencies, and all interested parties. The DEIS can be viewed online at http://www.swg.usace.army.mil/. Copies of the DEIS can be requested from Ms. Janelle Stokes at the address above. In addition, copies of the DEIS are available for viewing at the following libraries:

- Beaumont Public Library, 801 Pearl, Beaumont, TX 77701.

- R.C. Miller Library, 1605 Dowlen, Beaumont, TX 77701.
- Elmo Willard Library, 3590 East Lucas, Beaumont, TX 77701.
- Theodore Johns Branch Library, 4255 Fannett, Beaumont, TX 77701.
- City of Orange Public Library, 220 N. 5th Street, Orange, TX 77630.
- Marion and Ed Hughes Public Library, 2712 Nederland Ave., Nederland, TX 77627.
- Port Arthur Public Library, 4615 9th Avenue (at Highway 73), Port Arthur, TX 77642.
- Bridge City Public Library, 101 Parkside Drive, Bridge City, TX 77611.
- Calcasieu Parish Public Library, 301 W. Claude Street, Lake Charles, LA 70605.

*Water Quality Certification*: The USACE is requesting §401 State Water Quality certification from Texas and Louisiana for this action. A Clean Water Act §404(b)(1) evaluation of the proposed action, provided in the DEIS (Appendix E), summarizes the results of water and sediment analyses and describes the effects of the proposed discharges. Short-term increases in turbidity may be caused by the unconfined flow of dredged material during construction of BU features and mitigation measures. Proposed channel improvements should decrease the number of vessel trips, thus decreasing the probability of a spill. All relevant sediment and water quality data for both new-work and maintenance dredging material were reviewed by a team of State and Federal resource agencies (the Contaminants Workgroup of the Interagency Coordination Team), including the Texas Commission on Environmental Quality (TCEQ) and Louisiana Department of Environmental Quality (LDEQ), and they found no cause for concern over water or sediment quality in any channel reach.

*Draft General Conformity:* As required by the Clean Air Act, the EPA has promulgated rules to ensure that Federal actions conform to the appropriate State Implementation Plan (SIP). The General Conformity Rule (40 CFR Part 51, Subpart W) applies to Federal actions, within maintenance or nonattainment areas. Pursuant to Section 176 of the Clean Air Act Amendments of 1990, the USACE has prepared a document entitled, "Draft General Conformity Determination, Sabine-Neches Channel Improvement Project" (Appendix F). This document will be noticed for public comment and will be submitted by the USACE to the TCEQ, EPA, and other air pollution control agencies, as appropriate, concurrently with this DEIS. As part of the General Conformity process, the USACE will make this document available to the public for review and comment for a period of 30 days. During this time, the USACE will consult with the TCEQ and the EPA seeking concurrence that emissions from the Preferred Alternative are conformant with the Texas SIP for the Beaumont-Port Arthur area. Once written confirmation is received from the TCEQ and the EPA, the USACE will prepare a Final General Conformity Determination for the proposed SNWW CIP.

Construction activities associated with the proposed CIP would result in emissions from combustion products from project dredging, support, and reuse/disposal equipment.

Pollutant emissions from construction and dredging activities may result in short-term impacts on air quality in the immediate vicinity of the project site. Emissions of volatile organic compounds for the activities subject to USACE responsibility are exempt from a General Conformity Determination because they are below the 100-ton-per-year (tpy) threshold. Estimated nitrogen oxide ($NO_x$) emissions for activities subject to USACE responsibility would exceed the conformity threshold of 100 tpy for all years of construction. Therefore, USACE has prepared a General Conformity Determination for $NO_x$ emissions, which would be submitted to TCEQ, EPA, and other air pollution control agencies, as appropriate, to ensure conformity of this project with the SIP. It is expected that the Preferred Alternative would be found to conform to the Texas SIP for the Beaumont-Port Arthur non-attainment area.

*Section 102 of the Marine Protection Research, and Sanctuaries Act (MPRSA)*: Section 102 of the MPRSA requires a determination that dredged material placement in the ocean would not reasonably degrade or endanger human health, welfare, or amenities or the marine environment, ecological systems, or economic potential (shellfish beds, fisheries, or recreational areas). Maintenance and construction dredged material proposed for placement at the existing and the proposed new ODMDSs, designated by the EPA under MPRSA, is subject to evaluation using the ocean dumping environmental criteria. The proposed new ODMDSs are outlined in Appendix B of the DEIS. The conclusion of the ODMDS Designation DEIS (Appendix B) was that the Preferred ODMDSs met all of the five general and 11 specific criteria listed in 40 CFR 228.5 and 228.6 and are, therefore, acceptable under the MPRSA. All material transported for ocean disposal would be evaluated pursuant to EPA Ocean Dumping Regulations and Criteria (MPRSA Section 102). Use of the ODMDSs would be in accordance with an approved Site Monitoring and Management Plan (SMMP, Appendix B).

*National Register of Historic Places*: The staff archaeologist has reviewed the latest published version of the National Register of Historic Places, lists of properties determined eligible, and other sources of information. The following is current knowledge of the presence or absence of historic resources and the effects of the proposed project upon these properties: remote sensing surveys have been completed for the Outer Bar Channel, the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel in Jefferson and Orange counties, Texas, and Cameron Parish, Louisiana. No remote-sensing survey has been conducted for the Sabine Bank Channel, the proposed Extension Channel or the existing or proposed ODMDSs. This project would not impact NRHP-listed properties or State Archeological Landmarks; however, it may potentially adversely impact terrestrial and marine historic properties eligible for listing in the NRHP. This DEIS has been coordinated with the Texas and Louisiana State Historic Preservation Officers. A Historic Properties Programmatic Agreement (Appendix H) has been executed among the Texas and Louisiana SHPOs, the SNND and USACE to address subsequent investigations, coordinate surveys of impact areas, test potentially eligible sites, and manage data recovery or avoidance measures as necessary. Tribal coordination, required by the NHPA, has been conducted. Tribes with

historical or cultural ties to the region were contacted early in the study to identify their interests and concerns. The draft Programmatic Agreement has also been coordinated with the Tribes. No Tribes have requested to become consulting parties, and no impacts to Tribal land or traditional cultural properties have been identified.

*Threatened and Endangered Species*: Indications are that the proposed project may affect a few Federally listed endangered or threatened species. The project is likely to adversely affect but is not likely to jeopardize the following species: loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles. The project, however, is not likely to adversely affect the piping plover or its Critical Habitat, or the brown pelican. Potential impacts to the wintering piping plover would be associated with implementation of the Gulf Shore BU Feature. The recurring placement of dredged material for shoreline nourishment would affect areas of designated Critical Habitat. A Biological Assessment (BA) was prepared and was presented to the USFWS and the NMFS in the DEIS. NMFS has reviewed the BA and has prepared a Biological Opinion outlining the measures to be taken to avoid and minimize potential sea turtle takes, particularly during hopper dredging activities. The USFWS provided concurrence with the determinations made in the BA for all species under their jurisdiction, including nesting sea turtles (Appendix G).

*Essential Fish Habitat (EFH)*: Consultation for EFH of the Magnuson-Stevens Fishery Conservation and Management Act was initiated in May 2002 with the public scoping meeting. Letters were also sent to the NMFS in April 2006. Our initial determination is the proposed action would have temporary and local impact on EFH and Federally managed fisheries in the Gulf of Mexico. In the long-term, restored marsh and improved shallow-water habitat in the proposed mitigation and Neches River BU Feature will create and benefit EFH. Open water in marshes would be improved as EFH habitat by creating smaller, shallow-water pools and channels in which fetch and turbidity are reduced. In addition, existing, sediment starved marsh within the influence areas targeted for mitigation and BU would be nourished by the winnowing of fine-grained sediments during unconfined placement of the dredged material. The requirements of the act have been met (Appendix A3).

*Other Agency Authorizations*: Texas and Louisiana Coastal Zone consistency certification is required. USACE has stated that the project is consistent with the Texas and Louisiana Coastal Zone Management Programs' goals and policies and will be conducted in a manner consistent with said Programs. Additional information can be found in Appendix I of the DEIS. The DEIS and Texas Coastal Consistency Determination has been submitted to the Coastal Coordination Council for review, and the Louisiana Coastal Consistency Determination has been submitted to the Louisiana Department of Natural Resources for review.

*Public Comment and Public Hearing:* A Public Hearing on the proposed project is scheduled for the last week of January. The specific day for the Public Hearing has not yet been determined. However, for more information on the hearing date, meeting location,

and general information, please visit http://www.swg.usace.army.mil/. Poster presentations will be available for viewing and project team members will be present to discuss the DEIS at a Workshop that will precede the hearing. The Workshop will be conducted from 5 p.m. to 6:45 p.m. on the day of the formal Hearing, and the formal Hearing will commence at 7 p.m.

*Public Interest Review Factors*: The DEIS will be reviewed in accordance with CEQ NEPA regulations (40 CFR Part 1500-1508), and USACE's regulation ER 200-2-2 (*Environmental Quality: Policy and Procedures for Implementing NEPA*, 33 CFR 230), and other pertinent laws, regulations and executive orders. The decision whether to recommend construction of this project to Congress will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity in the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits, which reasonably may be expected to accrue from the project, must be balanced against reasonably foreseeable detriments associated with the project. All factors which may be relevant to the project will be considered. These include, but are not limited to: dredged material management, air quality, shoreline erosion, economics, general environmental concerns, historic resources, protected species, navigation, recreation, water and sediment quality, energy needs, safety, hazardous materials, and in general, the welfare of the people.

*Solicitation of Comments*: The USACE is soliciting comments from the public, Federal, State, and local agencies and officials, Indian tribes, and other interested parties in order to consider and evaluate the impacts of this proposed activity. Comments will be considered in the evaluation of impacts on endangered species, historic properties, water quality, general environmental effects, and other public interest factors listed above. Comments will be used in preparation of the Final EIS pursuant to NEPA. Comments are also used to determine the overall public interest of the proposed activity.

16 December 2009
Date

DAVID C. WESTON
COL, EN
Commanding

*Comment Date:* 5 p.m. Eastern Time on Monday, December 28, 2009.

Any person desiring to intervene or to protest in any of the above proceedings must file in accordance with Rules 211 and 214 of the Commission's Rules of Practice and Procedure (18 CFR 385.211 and 385.214) on or before 5 p.m. Eastern time on the specified comment date. It is not necessary to separately intervene again in a subdocket related to a compliance filing if you have previously intervened in the same docket. Protests will be considered by the Commission in determining the appropriate action to be taken, but will not serve to make protestants parties to the proceeding. Anyone filing a motion to intervene or protest must serve a copy of that document on the Applicant. In reference to filings initiating a new proceeding, interventions or protests submitted on or before the comment deadline need not be served on persons other than the Applicant.

The Commission encourages electronic submission of protests and interventions in lieu of paper, using the FERC Online links at *http://www.ferc.gov.* To facilitate electronic service, persons with Internet access who will eFile a document and/or be listed as a contact for an intervenor must create and validate an eRegistration account using the eRegistration link. Select the eFiling link to log on and submit the intervention or protests.

Persons unable to file electronically should submit an original and 14 copies of the intervention or protest to the Federal Energy Regulatory Commission, 888 First St., NE., Washington, DC 20426.

The filings in the above proceedings are accessible in the Commission's eLibrary system by clicking on the appropriate link in the above list. They are also available for review in the Commission's Public Reference Room in Washington, DC. There is an eSubscription link on the Web site that enables subscribers to receive e-mail notification when a document is added to a subscribed docket(s). For assistance with any FERC Online service, please e-mail *FERCOnlineSupport@ferc.gov* or call (866) 208–3676 (toll free). For TTY, call (202) 502–8659.

**Nathaniel J. Davis, Sr.,**

*Deputy Secretary.*

[FR Doc. E9–30585 Filed 12–23–09; 8:45 am]

BILLING CODE 6717–01–P

## DEPARTMENT OF ENERGY

### Federal Energy Regulatory Commission

### Combined Notice of Filings No. 2

December 16, 2009.

Take notice that the Commission has received the following Natural Gas Pipeline Rate and Refund Report filings:

*Docket Numbers:* RP10–117–001.

*Applicants:* Algonquin Gas Transmission, LLC.

*Description:* Algonquin Gas Transmission, LLC submits First Revised Sheet 590 et al to FERC Gas Tariff, Fifth Revised Volume 1 effective 12/1/09.

*Filed Date:* 12/11/2009.

*Accession Number:* 20091214–0130.

*Comment Date:* 5 p.m. Eastern Time on Wednesday, December 23, 2009.

*Docket Numbers:* RP10–188–001.

*Applicants:* Arlington Storage Company, LLC.

*Description:* Arlington Storage Company submits First Revised Sheet No 4A to FERC Gas Tariff, First Revised Volume No. 1.

*Filed Date:* 12/09/2009.

*Accession Number: 20091210–0133.*

*Comment Date:* 5 p.m. Eastern Time on Monday, December 21, 2009.

Any person desiring to protest this filing must file in accordance with Rule 211 of the Commission's Rules of Practice and Procedure (18 CFR 385.211). Protests to this filing will be considered by the Commission in determining the appropriate action to be taken, but will not serve to make protestants parties to the proceeding. Such protests must be filed on or before 5 p.m. Eastern time on the specified comment date. Anyone filing a protest must serve a copy of that document on all the parties to the proceeding.

The Commission encourages electronic submission of protests in lieu of paper using the "eFiling" link at *http://www.ferc.gov.* Persons unable to file electronically should submit an original and 14 copies of the protest to the Federal Energy Regulatory Commission, 888 First Street, NE., Washington, DC 20426.

This filing is accessible on-line at *http://www.ferc.gov,* using the "eLibrary" link and is available for review in the Commission's Public Reference Room in Washington, DC. There is an "eSubscription" link on the Web site that enables subscribers to receive e-mail notification when a document is added to a subscribed docket(s). For assistance with any FERC Online service, please e-mail *FERCOnlineSupport@ferc.gov,* or call (866) 208–3676 (toll free). For TTY, call (202) 502–8659.

**Nathaniel J. Davis, Sr.,**

*Deputy Secretary.*

[FR Doc. E9–30584 Filed 12–23–09; 8:45 am]

BILLING CODE 6717–01–P

## DEPARTMENT OF ENERGY

### Federal Energy Regulatory Commission

### Notice of Commission Half-Day Closing

December 17, 2009.

Pursuant to Executive Order of President Barack Obama, all executive departments and other agencies of the Federal government shall be closed for the last half of the scheduled workday on Thursday, December 24, 2009, the day before Christmas Day.

In accordance with section 385.2007 of the Commission's Rules, 18 CFR 385.2007, filings and documents due to be filed on Thursday, December 24, 2009, will be accepted as timely on the next official business day.

**Kimberly D. Bose,**

*Secretary.*

[FR Doc. E9–30580 Filed 12–23–09; 8:45 am]

BILLING CODE 6717–01–P

## ENVIRONMENTAL PROTECTION AGENCY

**[ER–FRL–8986–8]**

### Environmental Impact Statements; Notice of Availability

*Responsible Agency:* Office of Federal Activities, General Information, (202) 564–1399 or *http://www.epa.gov/compliance/nepa/.*

Weekly Receipt of Environmental Impact Statements

Filed 12/14/2009 Through 12/18/2009

Pursuant to 40 CFR 1506.9

*Notice:* In accordance with Section 309(a) of the Clean Air Act, EPA is required to make its comments on EISs issued by other Federal agencies public. Historically, EPA has met this mandate by publishing weekly notices of availability of EPA comments, which includes a brief summary of EPA's comment letters, in the **Federal Register.** Since February 2008, EPA has been including its comment letters on EISs on its Web site at: *http://www.epa.gov/compliance/nepa/eisdata.html.* Including the entire EIS comment letters on the Web site satisfies the Section 309(a) requirement

to make EPA's comments on EISs available to the public. Accordingly, after March 31, 2010, EPA will discontinue the publication of this notice of availability of EPA comments in the **Federal Register.**

EIS No. 20090438, Draft EIS, NPS, NY, Roosevelt-Vanderbilt National Historic Sites, General Management Plan, Implementation, Hyde Park, NY, Comment Period Ends: 02/22/2010, Contact: Marjorie Smith, 339–223–0131.

EIS No. 20090439, Final EIS, FHWA, ME, Aroostook County Transport Study, Route I–161 Connector, To Identify Transportation Corridors that will Improve Mobility and Efficiency within Northeastern Aroostook County and other portions of the U.S. and Canada, U.S. Army COE Section 404 Permit, Endangered Species Act, NPDES and Section 10 River and Harbors Act, Caribou, Aroostook County, ME, Wait Period Ends: 01/25/2010, Contact: Mark Hasselmann, 207–622–8355.

EIS No. 20090440, Final EIS, USFS, CO, Vail Ski Area's 2007 Improvement Project, Proposed On-Mountain Restaurant from the top of Vail Mountain to Mid Vail, Special-Use-Permit, Eagle/Holy Cross Ranger District, White River National Forest, Eagle County, CO, Wait Period Ends: 01/25/2010, Contact: Don Dressler, 970–945–3212.

EIS No. 20090441, Final Supplement, FHWA, TN, Shelby Avenue/Demonbreun Street (Gateway Boulevard Corridor, from I–65 North [I–24 West] to I–40 West in Downtown Nashville, To Address Transportation needs in the Study Area. Davidson County, TN, Wait Period Ends: 01/25/2010, Contact: Charles J. O'Neill, 615–781–5770.

EIS No. 20090442, Draft EIS, USACE, 00, Sabine-Neches Waterway Channel Improvement Project, Proposed Ocean Dredged Material Disposal Site Designation, Southeast Texas and Southwest Louisiana, Comment Period Ends: 02/10/2010, Contact: Janelle Stokes, 409–766–3039.

EIS No. 20090443, Final EIS, FHWA, DC, ADOPTION—Department of Homeland Security Headquarters at the St. Elizabeths West Campus, To Consolidate Federal Office Space on a Secure Site, Washington, DC, Contact: Jack VanDop, 703–404–6282. The U.S. Department of Transportation's, Federal Highway Administration (DOT/FHWA) has ADOPTED the U.S. General Services Administration FEIS #20080452, filed on 10/31/2008. DOT/FHWA was a Cooperating Agency for the above project. Recirculation of the FEIS is not necessary under 40 CFR 1506.3(c).

EIS No. 20090444, Final EIS, USA, NM, White Sands Missile Range (WSMR), Development and Implementation of Range-Wide Mission and Major Capabilities, NM, Wait Period Ends: 01/25/2010, Contact: Jennifer Shore, 703–602–4238.

EIS No. 20090445, Draft EIS, USFS, ID, Boise National Forest Project, Proposed Amendments to the Land and Resource Management Plan, Wildlife Conservation Strategy (WCS) Phase 1: Forested Biological Community, Located within Portions of Ada, Boise, Elmore, Gem, and Valley Counties, ID, Comment Period Ends: 03/24/2010, Contact: Cyd Weiland, 208–373–4135.

EIS No. 20090446, Final EIS, USFS, VT, Jarbidge Ranger District Rangeland Management Project, Proposed Reauthorizing Grazing on 21 Existing Grazing Allotments, Humboldt Toiyabe National Forest, Elko County, NV, Wait Period Ends: 12/25/2009, Contact: Vernon Keller, 775–355–5356.

EIS No. 20090447, Final EIS, USACE, AL, Foley Land Cut Portion of the Gulf Intracoastal Waterway, Proposed Construction of Residential, Commercial and Marine Development, Gulf Shores and Orange Beach, Baldwin County, AL, Wait Period Ends: 01/25/2010, Contact: Linda Brown, 251–694–3786.

**Amended Notices**

EIS No. 20090424, Draft EIS, USN, AK, Gulf of Alaska Navy Training Activities, Proposal to Support and Conduct Current, Emerging, and Future Training Activities, Implementation, Gulf of Alaska, AK, Comment Period Ends: 01/25/2010, Contact: Amy Burt, 360–396–0924. Revision to FR Notice Published 12/11/2009: Correction to Contact Telephone Number.

EIS No. 20090433, Final EIS, USFS, CA, Lassen National Forest, Motorized Travel Management Plan, Implementation, Butte, Lassen, Modoc, Plumas, Shasta, Siskiyou, Tehama Counties, CA, Wait Period Ends: 01/19/2010, Contact: Christopher O'Brien, 530–252–6698. Revision to FR Notice Published 12/18/2009: Correction to Contact Telephone Number.

EIS No. 20090435, Draft EIS, APHIS, 00, Glyphsate-Tolerant Alfalfa Events J101 and J163: Request for No regulated Status, Implementation, United States, Comment Period Ends: 02/16/2010, Contact: Cindy Eck, 301–734–0667. Revision to FR Notice Published 12/18/2009: Correction to Contact Telephone Number.

Dated: December 21, 2009.

**Pearl E. Young,**

*NEPA Compliance Division, Office of Federal Activities.*

[FR Doc. E9–30588 Filed 12–23–09; 8:45 am]

BILLING CODE 6560–50–P

## FEDERAL MINE SAFETY AND HEALTH REVIEW COMMISSION

### Sunshine Notice

December 17, 2009.

**TIME AND DATE:** 10 a.m., Thursday, January 7, 2010.

**PLACE:** The Richard V. Backley Hearing Room, 9th Floor, 601 New Jersey Avenue, NW., Washington, DC.

**STATUS:** Open.

**MATTERS TO BE CONSIDERED:** The Commission will consider and act upon the following in open session: *Secretary of Labor* v. *Cumberland Coal Resources, LP*, Docket Nos. PENN 2008–51–R, *et seq.* (Issues include whether an order issued to the operator under 30 CFR 75.363(a) (requiring that hazardous conditions be corrected or posted) should be amended to allege a violation of 30 CFR 75.360(b) (requiring that the person conducting a preshift examination identify hazardous conditions).)

Any person attending this meeting who requires special accessibility features and/or auxiliary aids, such as sign language interpreters, must inform the Commission in advance of those needs. Subject to 29 CFR 2706.150(a)(3) and 2706.160(d).

**CONTACT PERSON FOR MORE INFO:** Jean Ellen, (202) 434–9950/(202) 708–9300 for TDD Relay/1–800–877–8339 for toll free.

**Jean H. Ellen,**

*Chief Docket Clerk.*

[FR Doc. E9–30591 Filed 12–22–09; 11:15 am]

BILLING CODE 6735–01–P

## FEDERAL TRADE COMMISSION

### Agency Information Collection Activities; Proposed Collection; Comment Request

**AGENCY:** Federal Trade Commission ("FTC" or "Commission").

**ACTION:** Notice.

**SUMMARY:** The information collection requirements described below will be

*www.regulations.gov,* your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD–ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters and any form of encryption and be free of any defects or viruses. For additional information about EPA's public docket visit the EPA Docket Center homepage at *http://www.epa.gov/epahome/dockets.htm.*

*Docket:* All documents in the docket are listed in the *http://www.regulations.gov* index. Although listed in the index, some information is not publicly available, e.g., CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in *http://www.regulations.gov* or in hard copy at the OEI Docket in the EPA Headquarters Docket Center.

Dated: February 12, 2010.

**Rebecca Clark,**

*Director, National Center for Environmental Assessment.*

[FR Doc. 2010–3240 Filed 2–18–10; 8:45 am]

BILLING CODE 6560–50–P

## ENVIRONMENTAL PROTECTION AGENCY

**[ER–FRL–8988–2]**

## Environmental Impact Statements; Notice of Availability

*Responsible Agency:* Office of Federal Activities, General Information (202) 564–1399 or *http://www.epa.gov/compliance/nepa/.*

### Weekly Receipt of Environmental Impact Statements

Filed 02/01/2010 through 02/12/2010. Pursuant to 40 CFR 1506.9.

### Notice

In accordance with Section 309(a) of the Clean Air Act, EPA is required to make its comments on EISs issued by other Federal agencies public. Historically, EPA has met this mandate by publishing weekly notices of availability of EPA comments, which includes a brief summary of EPA's comment letters, in the **Federal Register.** Since February 2008, EPA has been including its comment letters on EISs on its Web site at: *http://www.epa.gov/compliance/nepa/eisdata.html.* Including the entire EIS comment letters on the Web site satisfies the Section 309(a) requirement to make EPA's comments on EISs available to the public. Accordingly, after March 31, 2010, EPA will discontinue the publication of this notice of availability of EPA comments in the **Federal Register.**

Federal Offices in Washington, DC, were closed because of inclement weather from February 8–11, 2010. Accordingly the Notice of Availability for the Weekly Receipt of Environmental Impact Statements filed 02/01/2010 through 02/05/2010 was not published in the **Federal Register** on February 12, 2010.

EIS No. 20100033, Draft EIS, BLM, CA Chevron Energy Solutions Lucerne Valley Solar Project, Proposing To Develop a 45-megawatt (MW) Solar Photovoltaic (PV) Plant and Associated Facilities on 516 Acres of Federal Land Managed, California Desert Conservation Area Plan Amendment, San Bernardino County, CA, Comment Period Ends: 05/19/2010, Contact: Greg Thomsen 951–697–5237.

EIS No. 20100034, Final EIS, USFWS, CA, Hatchery and Stocking Program. Operation of 14 Trout Hatcheries and the Mad River Hatchery for the Anadromous Steelhead, Federal Funding, California Department of Fish and Game, CA, Wait Period Ends: 03/22/2010, Contact: Bart Prose 916–978–6152.

EIS No. 20100035, Draft EIS, USACE, TX, Lake Columbia Regional Water Supply Reservoir Project, Proposes to Construct, Operate and Maintain a Dam and Reservoir, Mud Creek, Angelina River, Cherokee and Smith Counties, TX, Comment Period Ends: 04/05/2010, Contact: Brent Jasper 817–886–1733.

EIS No. 20100036, Final EIS, BR, CA, New Melones Lakes Area Resource Management Plan, Implementation, Tuolumne and Calaveras Counties, CA, Wait Period Ends: 03/22/2010, Contact: Melissa Vignau 916–989–7182.

EIS No. 20100037, Second Draft Supplement, USFS, 00, Sierra Nevada Forest Plan Amendment, Proposes to Provide an Objective Comparison of all of the Alternatives for 2004 Final EIS, Amending Land and Resource Management Plans, Modoc, Lasser, Plumas, Tahoe, Eldorado, Stanislaus, Sequoia, Sierra, Inyo and Humboldt-Toiyabe National Forests, and the Lake Tahoe Basin Management Unit, Several Counties, CA and NV, Comment Period Ends: 04/05/2010, Contact: Randy Moore 707–562–8737.

EIS No. 20100038, Draft Supplement, FSA, 00, PROGRAMMATIC—Conservation Reserve Program (CRP), Implement Certain Changes to the CRP as Enacted by Congress in the 2008 Farm Bill, in the United States, Comment Period Ends: 04/05/2010, Contact: Mathhew T. Ponish 202–720–6853.

EIS No. 20100039, Final EIS, WAPA, 00, ADOPTION—Southwest Intertie Project, Construction and Operation, 500kV Transmission Line from the existing Midpoint substation near Shoshone, ID to a new substation site in the Dry Lake Valley of Las Vegas, NV area to a point near Delta, UT, Permits Approval and C, Wait Period Ends: 03/22/2010, Contact: Mathew Blevins 720–962–7621. U.S. DOE/WAPA has adopted the BLM's FEIS #19930233, filed 07/09/1993. WAPA was not a Cooperating Agency for the above FEIS. Accordingly, recirculation of the document is necessary under Section 1506.3(b) of the CEQ Regulations.

EIS No. 20100040, Draft EIS, NRC, IA, GENERIC—License Renewal of Nuclear Plants (GEIS) Regarding Duane Arnold Energy Center, Supplement 42 to NUREG–1437, near the Town of Palo, Linn County, IA, Comment Period Ends: 04/19/2010, Contact: Charles H. Eccleston 301–415–8537.

EIS No. 20100041, Final EIS, FHWA, MI, US–31 Holland to Grand Haven Project, Transportation Improvement to Reduce Traffic Congestation and Delay, Ottawa County, MI, Wait Period Ends: 03/22/2010, Contact: David T. Williams 517–702–1820.

EIS No. 20100042, Final EIS, USACE, CA, Natomas Levee Improvement Program Phase 4a Landside Improvement Project, Issuing of 408 Permission and 404 Permits, California Department of Water Resources (DWR) and the California Central Valley Flood Protection Board, Sutter and Sacramento Counties, CA, Wait Period Ends: 03/22/2010, Contact: Elizabeth Holland 916–557–6763.

EIS No. 20100043, Final EIS, FHWA, IA, Southeast (SE) Connector in Des Moines, Iowa, To Provide a Safe and Efficient Link between the MLK Jr. Parkway at SE 14th Street to the U.S. 65 Bypass, Funding, U.S. Army COE

Section 404 and NPDES Permits, Polk County, IA, Wait Period Ends: 03/22/2010, Contact: Lubin Quinones 515–233–7300.

EIS No. 20100044, Final EIS, USFS, CA, Lower Trinity and Mad River Motorized Travel Management, Proposed to Prohibit Cross-Country Motor Vehicle Travel Off Designated National Forest Transportation System (NFTS) Roads and Motorized Trails, Six River National Forest, CA, Wait Period Ends: 03/22/2010, Contact: Linda West 707–441–3561.

**Amended Notices**

EIS No. 20090442, Draft EIS, USACE, 00, Sabine-Neches Waterway Channel Improvement Project, Proposed Ocean Dredged Material Disposal Site Designation, Southeast Texas and Southwest Louisiana, Comment Period Ends: 03/12/2010, Contact: Janelle Stokes 409–766–3039.

Revision to FR Notice Published 12/24/2009: Extending Comment Period from 02/10/2010 to 03/12/2010.

Dated: February 16, 2010.

**Robert W. Hargrove,**

*Director, NEPA Compliance Division, Office of Federal Activities.*

[FR Doc. 2010–3241 Filed 2–18–10; 8:45 am]

BILLING CODE 6560–50–P

## FARM CREDIT ADMINISTRATION

### Farm Credit Administration Board; Sunshine Act; Regular Meeting

**AGENCY:** Farm Credit Administration.

**SUMMARY:** Notice is hereby given, pursuant to the Government in the Sunshine Act (5 U.S.C. 552b(e)(3)), that the February 11, 2010 regular meeting (75 FR 6393, February 9, 2010) of the Farm Credit Administration Board (Board) has been rescheduled due to the recent inclement weather in the Washington DC metropolitan area.

**DATE AND TIME:** The regular meeting of the Board will now be held at the offices of the Farm Credit Administration in McLean, Virginia, on February 24, 2010, from 9 a.m. until such time as the Board concludes its business.

**FOR FURTHER INFORMATION CONTACT:** Roland E. Smith, Secretary to the Farm Credit Administration Board, (703) 883–4009, TTY (703) 883–4056.

**ADDRESSES:** Farm Credit Administration, 1501 Farm Credit Drive, McLean, Virginia 22102–5090.

**SUPPLEMENTARY INFORMATION:** This meeting of the Board will be open to the public (limited space available). In order to increase the accessibility to Board meetings, persons requiring assistance should make arrangements in advance. Two of the three agenda items have been removed for this rescheduled meeting. The matter to be considered at the meeting is:

**Open Session**

- *Approval of Minutes*
- January 14, 2010

Dated: *February 16, 2010.*

**Roland E. Smith,**

*Secretary, Farm Credit Administration Board.*

[FR Doc. 2010–3356 Filed 2–17–10; 4:15 pm]

BILLING CODE 6705–01–P

## FEDERAL COMMUNICATIONS COMMISSION

**[IB Docket No. 04–286; DA 10–245]**

### Fourth Meeting of the Advisory Committee for the 2012 World Radiocommunication Conference Rescheduled to March 2, 2010

**AGENCY:** Federal Communications Commission.

**ACTION:** Notice.

**SUMMARY:** In accordance with the Federal Advisory Committee Act, as amended, this notice advises interested persons that the fourth meeting of the WRC–12 Advisory Committee will be held at the Federal Communications Commission. The purpose of the meeting is to continue preparations for the 2012 World Radiocommunication Conference. The WRC–12 Advisory Committee will consider any preliminary views and draft proposals introduced by the WRC–12 Advisory Committee's Informal Working Groups. The meeting, originally scheduled for February 10, 2010 as published in the **Federal Register**, Vol. 75, No. 9 on January 14, 2010, was postponed due to the closure of the Federal Government because of inclement weather. Less than 15 calendar days notice of the rescheduled meeting is being provided due to the need to receive the WRC–12 Advisory Committee's recommendations to provide timely input to the meeting of the Inter-American Telecommunication Commission (CITEL).

**DATES:** March 2, 2010, 11 a.m. to 12 noon.

**ADDRESSES:** Federal Communications Commission, 445 12th Street, SW., Room TW–C305, Washington, DC 20554.

**FOR FURTHER INFORMATION CONTACT:** Alexander Roytblat, Designated Federal Official, WRC–12 Advisory Committee, FCC International Bureau, Strategic Analysis and Negotiations Division, at (202) 418–7501.

**SUPPLEMENTARY INFORMATION:** The Federal Communications Commission established the WRC–12 Advisory Committee to provide advice, technical support and recommendations relating to the preparation of United States proposals and positions for the 2012 World Radiocommunication Conference (WRC–12).

In accordance with the Federal Advisory Committee Act, Public Law 92–463, as amended, this notice advises interested persons of the fourth meeting of the WRC–12 Advisory Committee. The WRC–12 Advisory Committee has an open membership. All interested parties are invited to participate in the WRC–12 Advisory Committee and to attend its meetings. The proposed agenda for the fourth meeting is as follows:

**Agenda**

Fourth Meeting of the WRC–12 Advisory Committee, Federal Communications Commission, 445 12th Street, SW., Room TW–C305, Washington, DC 20554.

*March 2, 2010, 11 a.m. to 12 noon*

1. Opening Remarks
2. Approval of Agenda
3. Approval of the Minutes of the Third Meeting
4. Informal Working Group Reports and Documents Relating to Preliminary Views
5. New Guidelines for Federal Advisory Committee Membership
6. Future Meetings
7. Other Business

Federal Communications Commission.

**Mindel De La Torre,**

*Chief, International Bureau.*

[FR Doc. 2010–3292 Filed 2–18–10; 8:45 am]

BILLING CODE 6712–01–P

## FEDERAL DEPOSIT INSURANCE CORPORATION

### Notice of Agency Meeting

Pursuant to the provisions of the "Government in the Sunshine Act" (5 U.S.C. 552b), notice is hereby given that at 10:10 a.m. on Wednesday, February 17, 2010, the Board of Directors of the Federal Deposit Insurance Corporation met in closed session to consider matters related to the Corporation's supervision, resolution, and corporate activities.

In calling the meeting, the Board determined, on motion of Vice Chairman Martin J. Gruenberg,

Barwil

Barwil Agencies (NA), Inc.
85 IH-10 North, Suite 105
Beaumont, TX 77707

Telephone: 409-832-6700
Fax: 409-832-2031
Telex: 6734231
Cable: BARWILBM

May 16, 2000

Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Mr. Frank Garcia,

I have just received the notice for the meeting concerning the Sabine-Neches Waterway, Texas Feasibility Study. I will not be able to attend the meeting, but would like to take this opportunity to give you my comments.

I am the Assistant Manager for Barwil Agencies (NA) Inc., a worldwide steamship agency with an office in Beaumont, Texas. In case you are not familiar with what we do, here is a brief description. We are the agents for foreign and U.S. Flag vessels that come into the ports of Port Arthur, Beaumont, and Orange, Texas. We attend the vessels on behalf of the owners and/or charters and assist in an efficient port stay and turn around.

With the current status of the Sabine-Neches Waterway, I feel that it is close to reaching its capacity for vessel traffic movement and without improvements our ports will not be competitive enough to attract new business or maintain the current level. If the information I have is correct, the combined ports of Port Arthur, Beaumont and Orange, Texas make the fourth busiest port in the Nation. With the multi-million dollar expansions at the Fina Refinery and the Clark Refinery and with the Exxon/Mobil merger this will only serve to increase the vessel traffic volume on our waterway. Approximately 75 to 80 percent and in some cases more, the crude oil used by the local refineries comes via the waterway by vessels.

Not only would waterway improvements help the refineries it would also be beneficial to the ports themselves and open up more opportunities for grain, bag products and forest products. Keeping in mind the environmental impact that deepening and widening the Sabine-Neches Waterway would have, I believe it is imperative that improvements to be made. If this issue is not addressed in a timely manner, economic growth and individual jobs could be lost.

Thank you for your time and the opportunity to make comments.

Sincerely,

Andy Collins

Andy Collins
Assistant Manager
Barwil Agencies (NA) Inc.

STREAM PROPERTY MANAGEMENT, INC.
P.O. Box 40
Lake Charles, Louisiana 70602

June 8, 2000

Richard D. Tomlinson, P.E.
Project Manager
Department of the Army
Galveston District
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

Re: Sabine-Neches Waterway
Texas Feasibility Study

Dear Mr. Tomlinson:

The Sabine-Neches Waterway Texas Feasibility Study should include the environmental concerns and potential impacts on the marshes east of Sabine Lake in Louisiana. The potential impacts of saltwater intrusion, increased tidal fluctuation, decreased freshwater retention and vegetative marsh loss are immense. The dredging of the channel from 1912 through 1962 and maintained through this year has been directly responsible for the loss of approximately 50,000 acres of vegetative marsh in Louisiana in the Sabine wetland basin. The environmental concerns for the vegetative wetland loss are of grave concern to myself as a landowner and other concerned citizens. Louisiana involvement as a stakeholder in this process needs to be emphasized in the feasibility study due to the fact that the majority of wetlands affected are located in Louisiana.

By this means we would suggest that the historical hydrology and the wetland diversity be re-established in the Sabine Lake system. The widening and deepening of the Sabine-Neches waterway will cause further marsh loss to an already stressed and fragile system. This feasibility study, through hydrologic modeling and other methods, will identify the problems in the Sabine ecosystem. We would suggest in the absence of a lock at the mouth of the Sabine Pass Channel, that there be at least a constriction at the causeway at its junction with Highway 82 and the separation of the Sabine Lake from the navigation channel along the northern boundary of Sabine Lake . Hydrologic protection should also include maintenance and construction of water control structures along inlets into

the wetlands east of Sabine Lake. There are many wildlife and wetland issues involved in these wetlands due to the historical diversity in this area. This project, as presently proposed with no environmental components, will have significant adverse impacts on my land in Cameron Parish. We emphasize the environmental, social, and economic concerns in our area and expect to be kept abreast of the study as it progresses.

Thank you for the opportunity to have input in the early stages of this feasibility study. We look forward to working with you very closely in the future.

Sincerely,

David Richard

DR:kd

CC: Congressman Chris John
1504 Longworth House Office Building
Washington, D.C. 20515

Congressman Nick Lampson
417 Cannon House Office Building
Washington, D.C. 20515-4309

OLD SOUTH WETLANDS, LLC
100 JYRO LANE
CARENCRO, LA 70520

June 21, 2000

Richard D. Tomlinson, P.E.
Project Manager
Department of the Army
Galveston District
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77552-1229

Re: Sabine-Neches Waterway
Texas Feasibility Study

Dear Mr. Tomlinson:

I am purchasing property in Cameron Parish Louisiana which has frontage on the lower Sabine River near its entrance into Sabine Lake and I am very concerned about the impact of the proposed Sabine-Neches Channel Improvement Project. I would be very much opposed to any project which would cause any environmental damage or ecological changes to this area such as saltwater intrusion, increased tidal fluctuation, decreased freshwater retention, or marsh loss. The State of Louisiana and the Federal Government are doing everything possible to stop coastal wetland loss and I would not want to see any project take place whose effect is antagonistic to these efforts. I would hope that every effort would be taken to take environmental concerns into consideration as related to this project.

Thank you for the opportunity to express my concerns. Please keep me informed as the project progresses.

Sincerely,

Randy Richard

Paula – pls add Mr. Richard to your list – thanks!
Richard

**JAMES C. ROBINSON**
230 WEST PRIEN LAKE ROAD
LAKE CHARLES, LA. 70601

July 5, 2000

Richard D. Tomlinson, P.E.
Project Manager
Department of the Army
Galveston District
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

Re: Sabine-Neches Waterway
Texas Feasibility Study

Dear Mr. Tomlinson:

The Sabine-Neches Waterway Texas Feasibility Study should include the environmental concerns and potential impacts on the marshes east of Sabine Lake in Louisiana. The potential impacts of saltwater intrusion, increased tidal fluctuation, decreased freshwater retention and vegetative marsh loss are immense. The dredging of the channel from 1912 through 1962 and maintained through this year has been directly responsible for the loss of approximately 50,000 acres of vegetative marsh in Louisiana in the Sabine wetland basin. The environmental concerns for the vegetative wetland loss are of grave concern to myself as a landowner and other concerned citizens. Louisiana involvement as a stakeholder in this process needs to be emphasized in the feasibility study due to the fact that the majority of wetlands affected are located in Louisiana.

By this means we would suggest that the historical hydrology and the wetland diversity be re-established in the Sabine Lake system. The widening and deepening of the Sabine-Neches waterway will cause further marsh loss to an already stressed and fragile system. This feasibility study, through hydrologic modeling and other methods, will identify the problems in the Sabine ecosystem. We would suggest in the absence of a lock at the mouth of the Sabine Pass Channel, that there be at least a constriction at the causeway at its junction with Highway 82 and the separation of the Sabine Lake from the navigation channel along the northern boundary of Sabine Lake . Hydrologic protection should also include maintenance and construction of water control structures along inlets into

the wetlands east of Sabine Lake. There are many wildlife and wetland issues involved in these wetlands due to the historical diversity in this area. This project, as presently proposed with no environmental components, will have significant adverse impacts on my land in Cameron Parish. We emphasize the environmental, social, and economic concerns in our area and expect to be kept abreast of the study as it progresses.

Thank you for the opportunity to have input in the early stages of this feasibility study. We look forward to working with you very closely in the future.

Sincerely,

James C. Robinson

DR:kd

CC: Congressman Chris John
1504 Longworth House Office Building
Washington, D.C. 20515

Congressman Nick Lampson
417 Cannon House Office Building
Washington, D.C. 20515-4309

A. R. DOOLEY, JR.
CHAIRMAN

2575 Ashley
Beaumont, TX 77702

July 7, 2000

Department of the Army
Galveston District Corps of Engineers
P. O. Box 1229
Galveston Texas 77553-1229

Gentlemen,

Please change my address to:

A. R. Dooley, Jr.
2575 Ashley
Beaumont, TX 77702

Here is a label from the recent mailing to me regarding the Sabine-Neches Waterway Feasibility Study.

SWG-PE-P 1332970/04/11/00/24/
- - - - - - - - - - - - - - -
A. R. DOOLEY
229 DOWLEN
BEAUMONT TX 77706

Thank you.

A. R. Dooley, Jr

***DOOLEY TACKABERRY***
Fire & Safety - Equipment/Services/Systems
4849 Cardinal Drive • Beaumont, Texas 77705 USA
Voice: 409.835.7696 • Fax: 409.835.7695 • email: rhew@dtihome.com

HYDRAULIC DREDGES – DRAGLINES – SPUD BARGES

MIKE HOOKS INC.

P.O. BOX 1525 • LAKE CHARLES, LA 70602

409 Mike Hooks Road
Westlake, LA 70669

*General Dredging & Marine Contractors*

PHONE (337) 436-6693
FAX (337) 433-8701

July 10, 2000

Richard D. Tomlinson, P.E.
Project Manager
Department of the Army
Galveston District
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

Re: Sabine-Neches Waterway
Texas Feasibility Study

Dear Mr. Tomlinson:

The Sabine-Neches Waterway Texas Feasibility Study should include the environmental concerns and potential impacts on the marshes east of Sabine Lake in Louisiana. The potential impacts of saltwater intrusion, increased tidal fluctuation, decreased freshwater retention and vegetative marsh loss are immense. The dredging of the channel from 1912 through 1962 and maintained through this year has been directly responsible for the loss of approximately 50,000 acres of vegetative marsh in Louisiana in the Sabine wetland basin. The environmental concerns for the vegetative wetland loss are of grave concern to myself as a landowner and other concerned citizens. Louisiana involvement as a stakeholder in this process needs to be emphasized in the feasibility study due to the fact that the majority of wetlands affected are located in Louisiana.

By this means we would suggest that the historical hydrology and the wetland diversity be re-established in the Sabine Lake system. The widening and deepening of the Sabine-Neches waterway will cause further marsh loss to an already stressed and fragile system. This feasibility study, through hydrologic modeling and other methods, will identify the problems in the Sabine ecosystem. We would suggest in the absence of a lock at the mouth of the Sabine Pass Channel, that there be at least a constriction at the causeway at its junction with Highway 82 and the separation of the Sabine Lake from the navigation channel along the northern boundary of Sabine Lake. Hydrologic protection should also include maintenance and construction of water control structures along inlets into the

wetlands east of Sabine Lake. There are many wildlife and wetland issues involved in these wetlands due to the historical diversity in this area. This project, as presently proposed with no environmental components, will have significant adverse impacts on my land in Cameron Parish. We emphasize the environmental, social, and economic concerns in our area and expect to be kept abreast of the study as it progresses.

Thank you for the opportunity to have input in the early stages of this feasibility study. We look forward to working with you closely in the future.

Sincerely,

T. A. Hooks.

TH:gs

CC: Congressman Chris John
1504 Longworth House Office Building
Washington, D.C. 20515

Congressman Nick Lampson
417 Cannon House Office Building
Washington, D.C. 20515-4309

CENTURY GROUP

Century Group Inc.
P.O. Box 228
Sulphur, Louisiana 70664-0228
Tel: 1-800-527-5232, Ext. 147
Fax: 1-800-887-2153
E-Mail: sales@centurygrp.com
Website: www.centurygrp.com

July 13, 2000

Richard D. Tomlinson, P. E.
Project Manager
Department of the Army
Galveston District
U. S. Army Corps of Engineers
P. O. Box 1229
Galveston, TX 77553-1229

Re: Sabine – Neches Waterway
Channel Improvements Project

Dear Mr. Tomlinson:

As a landowner of approximately 1,200 acres of marshland adjacent within 2 miles of the Sabine River and Sabine Lake, I would like to express my concern over the deepening and widening of the channels serving the ports of Beaumont and Orange. Because of channelization in the past, marshlands east of Sabine Lake in Louisiana have realized increased salt water intrusion and tidal fluctuations which have had a negative impact in regards to erosion and loss of vegetation essential for a healthy marine estuary.

It is our hopes that your agency will strongly consider implementing measures that will not only stop further destruction of these fragile wetlands, but will help return the Sabine River basin to its historical state.

As a landowner on the lower Calcasieu River Estuary I can forewarn you that the widening and deepening of this channel will only accelerate the destruction and loss of these wetlands. We are witnessing firsthand rapid erosion and loss of marshland because of the tidal fluctuations caused by the Calcasieu River Ship Channel.

C:\Data\JRV\PRECAST\US Army Corp of Engineers Tomlinson 07132000.doc

I appreciate the opportunity to be able to express my concerns and ask that I be included on the mailing list of this project so that I can be kept informed of the progress of this study. Your consideration is greatly appreciated.

Should you have any questions please feel free to contact me at 1-800-527-5232, Ext. 109.

Sincerely,
CENTURY GROUP INC.

Rusty Vincent
President/CEO
Railroad Products Division
P. O. Box 228
Sulphur, LA 70664-0228

Cc: Congressman Chris Johns
1504 Longworth House Office Building
Washington, DC 20515

Congressman Nick Lampson
417 Cannon House Office Building
Washington, DC 20515-4309

RV/cmt

T. BARRY WILKINSON
ATTORNEY AT LAW
769 SEVENTH STREET
P. O. BOX 588
PORT ALLEN, LA 70767

TELEPHONE
(225) 383-3020

FACSIMILE
(225) 336-9919

July 25, 2000

Mr. Richard D. Tomlinson, P.E.
Project Manager
Department of the Army
Galveston District
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

RE: Sabine-Neches Waterway
Texas Feasibility Study

Dear Mr. Tomlinson:

I was recently made aware of the Sabine-Neches Waterway channel improvement project planned with the U.S. Army Corps of Engineers. I understand that a feasibility study is going to be undertaken regarding this project. I represent the owners of wetlands and marshes lying east of the Sabine Lake in Louisiana. We have occupied this property in excess of thirty-three years. In that regard, we have already seen drastic changes in our marsh vegetation and salt water intrusion. The changes have been most pronounced in the last three to five years. However, the changes are for the worse and seem to be accelerating in the last year or two. It appears from the planned project that without due consideration and counter balancing measures that this project will further accelerate the negative impacts of salt water intrusion, increase tidal fluctuation, decreased fresh water retention and vegetative marsh loss. I realize that the project is probably a needed project from an economic standpoint. However, with the proper study and input I am certain that proper measures can be taken to lessen the negative impact of salt water intrusion, increased tidal fluctuation, decreased fresh water retention and vegetative marsh loss. It has been suggested that a lock at the mouth of the Sabine Pass Channel would help immensely in this regard. If this is too costly or not feasible then there should be at least some sort of constriction near the causeway at its junction with Highway 82 and the separation of the Sabine Lake from the navigation channel along the northern boundary of Sabine Lake. Other recommended measures are the maintenance and construction of water controlled structures along the numerous inlets into the wetlands east of Sabine Lake. Without these measures being taken I fear that there will eventually be a total destruction and loss of the wetlands and

marshes as we have historically known them. Again, I must emphasize that without the implementation of the currently proposed project we are already having immense problems in this regard. Thank you for allowing me to provide some input in the early stages of this feasibility study. I would appreciate being kept notified of developments and the opportunity to further participate in this process.

If you have any questions, please contact me.

Very truly yours,

T. Barry Wilkinson

cc: Congressman Chris John
1504 Longworth House Office Building
Washington, D.C. 20515

Congressman Nick Lampson
417 Cannon House Office Building
Washington, D.C. 20515-4309

# WEST CAMERON PORT COMMISSION

P. O. Box 1160
Cameron, Louisiana

Clifton Cabell, President
Jimmy Brown, Vice-President
Greg Wicke, Secretary
Terry Hebert, Treasurer

Board Members
Rodney Guilbeaux
Robert Manuel
Wendell Wilkerson
Sammy Faulk
J.P. Constance


July 26, 2000

Major Randy L. Turner, Deputy District Engineer
Department of the Army
Galveston District Corps of Engineers
P. O. Box 1229
Galveston, TX 77553-1229

Re: Sabine-Neches Waterway, Texas Feasibility Study

Dear Major Turner:

The West Cameron Port Commission is concerned about the impact this navigation project would have on saltwater intrusion into the swamps and marshes of the Calcasieu-Sabine Basin east of Sabine River and Sabine Lake. These marshes have already suffered catastrophic losses due to hydrologic alterations. It is imperative that this feasibility study evaluate the potential impacts to the Louisiana and Texas coastal marsh ecosystem from these hydrologic alterations.

In essence, we the West Cameron Port Harbor & Terminal Commission stand in opposition to the widening and deepening of the channel.

Sincerely,

Clifton Cabell, President
WEST CAMERON PORT COMMISSION

.ether
pieces so I copied
it for you.

(5)

Carolyn Thibodeaux
337-775-5046 (H)
337-775-7877 (F)
beachesCT@netscape.com

CAMERON PRESERVATION ALLIANCE

Ms. Carolyn Thib.
Mr. Ernest Granger, V.
Mrs. Hilda Crain, . Grand
Mrs. Cindy McGee, S Johnson
Mrs. Marianna Primeaux, At . Camer

SABINE PASS LIGHTHOUSE, INC.
P.O. BOX 773
CAMERON, LA 70631
www.sabinelighthouse.org

October 10, 2001

Senator Mary Landrieu
United States Senate
Washington, DC 70510-1804

Dear Senator Landrieu:

The Cameron Preservation Alliance - Sabine Pass Lighthouse, Inc. request to be put on your mailing list to be notified of any correspondence, meetings or activities concerning the dredging, widening, and any other projects in which the Sabine Ship Channel is included.

We are very concerned about activities on-going in this area. The on- going Corp of Engineers project to dredge the Sabine River and dump the spoils on the banks of the river is very disturbing. There is a grove of 40 year old trees that will be destroyed It is my understanding that the "Back to Nature" idea means that our government would take the lead in protecting and saving important areas such as this for fu' generations. This is a beautiful natural area with an abundance of migrating This project is also interfering with the access to the Sabine Pass Lighthou levees are butting up to the only access by vehicle to this National Treas the levee is several feet higher than the road, when it rains, the mud w the road.

Should you need more information, please do not hesitate to contact me 7226.

Sincerely,

Carolyn

Carolyn Thibodeaux, President
Cameron Preservation Alliance -
Sabine Pass Lighthouse, Inc.

**Coalition to Restore Coastal Louisiana**

746 Main Street, Suite B101 • Baton Rouge, LA 70802
225-344-6555 • Fax 225-344-0590 • coalition@crcl.org • www.crcl.org

May 28, 2002

Ms. Lizette Richardson
Galveston District
US Army Corps of Engineers
P O Box 1229
Galveston TX 77553-1229

Dear Ms. Richardson:

On behalf of the Coalition to Restore Coastal Louisiana, we would like to express our grave concern about the potential negative impacts on Louisiana's coastal wetlands should the proposed widening and/or deepening of the Sabine-Neches Waterway channel take place.

The proposed changes to the Sabine-Neches Waterway channel will increase shoreline erosion and saltwater intrusion in the Calcasieu-Sabine basin. Saltwater intrusion has contributed greatly to the loss of wetlands in the Calcausieu-Sabine basin over the past 50 years. This project would exacerbate the loss of additional wetlands and vital estuarine habitat.

Due to the potential for increased salinity and shoreline erosion, this proposed project appears to conflict with the restoration strategies outlined in *Coast 2050*. *Coast 2050* is a comprehensive strategic plan for restoring Louisiana's coastal wetlands and stabilizing the coastal zone to prevent further wetland loss. The plan has been approved by all 20 coastal parishes, as well as the state, and federal government agencies, including the US Army Corps of Engineers. This project as proposed could potentially thwart the implementation of *Coast 2050* and threaten Louisiana's ability to gain greater national support for coastal restoration.

Also, the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) requires that all US Army Corps of Engineers' navigation and flood control projects be consistent with coastal restoration plans developed under the CWPPRA statute. We have seen no evidence to date that this has been done with respect to this project.

Irrespective of this legal requirement for consistency, any proposed project that will contribute to the destruction of wetlands while state and federal government programs spend millions of dollars to restore those same wetlands is inconceivably wasteful and ill-planned

We will submit a letter outlining our concerns in greater detail by June 28.

Sincerely,

Mark S. Davis
Executive Director

*Our Coast ... Our Future*

tree free

# COMMENT FORM

**PUBLIC SCOPING MEETING**
**SABINE-NECHES WATERWAY FEASIBILITY STUDY & EIS**
**LAKE CHARLES, LA. – MAY 28TH, 2002**
**BEAUMONT, TX. – MAY 29TH, 2002**

This form is provided for your comments on the Sabine-Neches Waterway Feasibility Study and Environmental Impact Study. We appreciate your interest and comments on this project.

Comments:

It has recently been brought to the attention of Jefferson County Drainage District No. 7 that a Feasibility Study is under way relative to the modification of the Sabine-Neches Waterway. As you are probably aware, the District operates and maintains a Hurricane Flood Protection System consisting of a combination of Pump Stations, Canals and the Levee. This system was designed and built by the U.S.C.O.E. with the District serving as the local sponsor. The District is concerned about the impact that deepening and widening the channel may have relative to the integrity of the hurricane levee. In the past few years, settlement of the blanket stone along the waterway has been observed and is presently being monitored by the District. This problem has also been expressed to the Corp. At this time, the District is requesting to be brought into the discussion group so as to address any issues that may adversely effect the levee system.

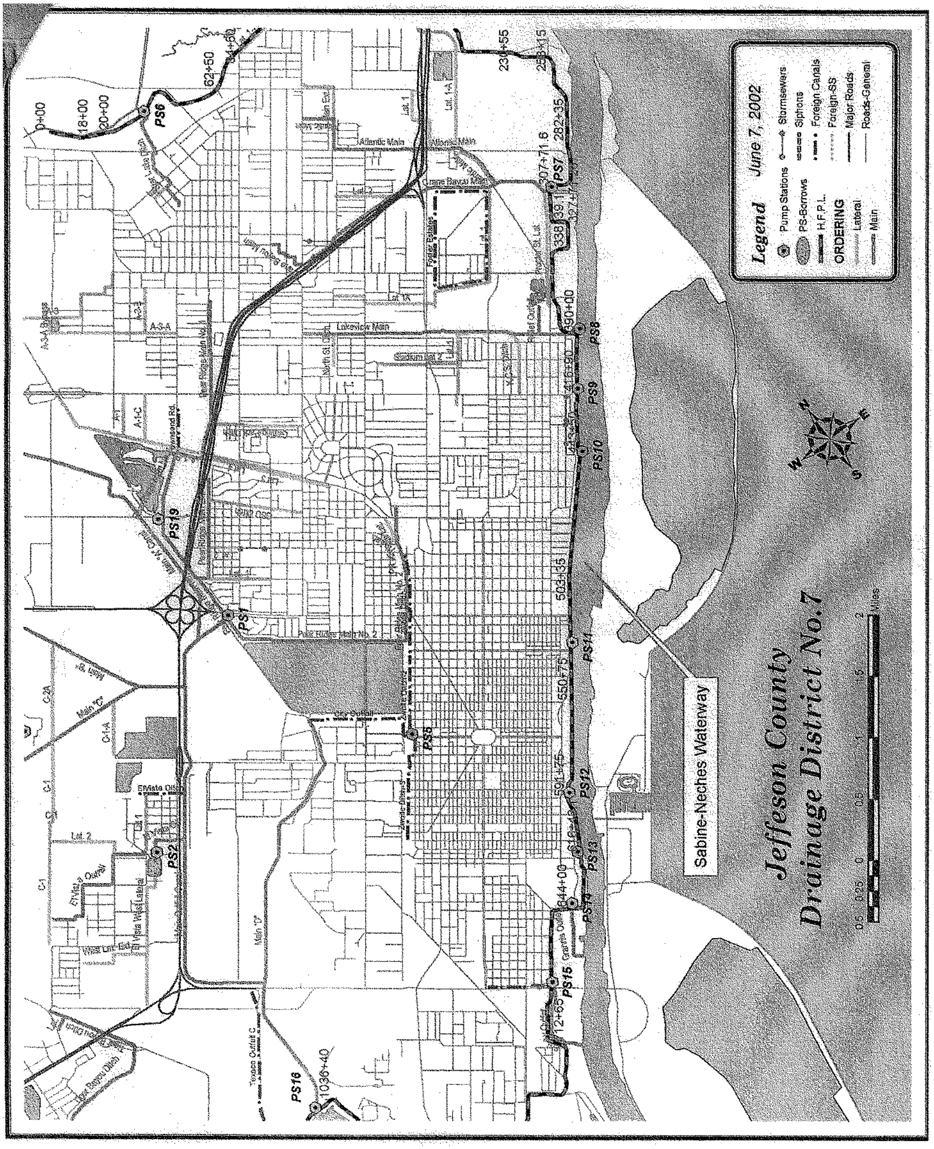
Mail your comments by June 28, 2002 to:

Colonel Leonard D. Waterworth
District Engineer
U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, TX 77553

Please print:

Your name: Phil Kelley

Address: Jefferson County Drainage District No. 7
P. O. Box 3244
Port Arthur, TX 77643


Jeffeson County
Drainage District No.7
Sabine-Neches Waterway
Legend
June 7, 2002
Pump Stations
PS-Borrows
H.F.P.L.
ORDERING
Lateral
Main
Stormsewers
Siphons
Foreign Canals
Foreign-SS
Major Roads
Roads-General
Miles

# COMMENT FORM

**PUBLIC SCOPING MEETING**
**SABINE-NECHES WATERWAY FEASIBILITY STUDY & EIS**
**LAKE CHARLES, LA. – MAY 28TH, 2002**
**BEAUMONT, TX. – MAY 29TH, 2002**

This form is provided for your comments on the Sabine-Neches Waterway Feasibility Study and Environmental Impact Study. We appreciate your interest and comments on this project.

Comments:

After attending the meeting in Beaumont on 5/29/02, I discussed the issues presented with one of my clients, Jefferson County Drainage District No. 7 (DD7). The staff at DD7 has expressed some concerns and have raised some valid issues which need to be considered. DD7 along with the U.S.C.O.E. constructed the Hurricane Flood Protection Levee (HFPL) around Pt. Arthur in the 70's and 80's. DD7 would like to know what impacts to the HFPL and the associated gate and pumping structures will be caused by the proposed upgrade to the Sabine-Neches Waterway. DD7 is additionally disturbed by the fact that they have not been contacted by any member of the project team to discuss any issues they might have in addition to those stated above.

Mail your comments by June 28, 2002 to:

Colonel Leonard D. Waterworth
District Engineer
U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, TX 77553

Please print:

Your name: Allen D. Sims, P.E.

Address: Carroll & Blackman, Inc.
1360 N. Seventh Street
Beaumont, TX 77702

SIERRA CLUB

Houston Regional Group
P.O. Box 3021
Houston, Texas 77253-3021
713/895-9309

5/29/2002

Ms. Janelle Stokes
Environmental Lead
Planning Branch
and
Ms. Lizette Richardson
Project Manager
Project Management Branch

Galveston District
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Dear Ms. Stokes & Ms. Richardson,

I am sorry I cannot be at the public scoping meetings for the Draft Environmental Impact Statement (DEIS) for the Sabine-Neches Waterway Feasibility Study. Please forgive this hand written letter. My computer has malfunctioned and is not working.

Please send me a copy of any materials available or handed out at the scoping meetings about this proposal.

"When we try to pick out anything by itself, we find it hitched to everything else in the universe." *John Muir*

Recycled paper

We have a number of concerns we want to bring to your attention.

First, the cumulative impacts of this project and all past, present, and future forseeable actions must be addressed fully in a comprehensive DEIS. For instance, some of the actions that should be analyzed, assessed, & evaluated include the environmental impacts of the present, past, or future Neches River Channel, the Port Arthur East and West Turning Basins, the Beaumont Turning Basin, the East and West Sabine Pass Jetties, all dredge disposal areas, Taylors Bayou Turning Basin, the Gulf Intercoastal Waterway, the Sabine-Neches Canal, Highway 87, the Orange Turning Basin, the Cow Bayou Channel, the Adams Bayou Channel, the Sabine River Channel, the Channel Around Harbor Island, the Orange Municipal Slip, the Channel to Echo, the Sabine Pass Anchorage Basin, the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar, the Sabine Bank, the Port Arthur Canal,

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The Neches River Saltwater Barrier, the Steinhagen Dam & expansion, the Sam Rayburn Dam and expansion, Toledo Bend Reservoir, Rockland Reservoir, Fastrill Dam (wecher), Lake Palestine, Lake Striker, Lake Easter, Lake Jacksonville, Lake Athens, Lake Cherokee, Martin Lake, Lake Murvaul, Lake Tyler, Lake Tyler East, Big Cow Creek Dam, Bon Weir Dam, Ponta Dam, Socogee Dam, Stateline Dam, State Highway 322 stages I & II, Rabbit Creek Dam, Carthage Dam, Kilgore Dam, various wastewater treatment plants, water pipelines or canals, and other water projects in the Sabine & Neches Rivers. Also any major ports/other developments and highways.

All of these past, present, and forseeable future actions have or will have impacts on the Sabine & Neches Rivers. In toto all must be comprehensively assessed in a DEIS that analyzes all cumulative impacts.

For instance, we are very concerned that the existing channels in the Sabine and Neches and <u>any</u> proposals to deepen those channels will increase saltwater intrusion and impact the Big Thicket National Preserve (BTNP), including the Beaumont and Pine Island/Little Pine Island Bayous Corridor. This will result in diminished biodiversity and vegetation killing.

We are very concerned about so-called beneficial (4) uses of dredged materials. At present we do not favor the creation of spoil islands in any marine or brackish environments. These islands will simply serve as another way to redeposit the dredge material while giving the appearance of being environmentally green. Storms will overtop & redeposit sediments into prime nursery areas for finfish, crabs, shrimp, and other marine or aquatic life.

We are concerned that deepening channels to 45-50 feet will increase salinity in brackish water areas & destroy their nursery area function.

The full cost of the proposal must have full mitigation provided. This means full land acquisition to mitigate for destroyed or degraded habitats. Only then will a true benefit/cost be determined & project feasibility can then be assessed.

The full impacts of this proposal on the development of the floodplains of the Neches & Sabine Rivers must be determined.

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The full impacts on Blue Elbow Swamp must be determined.

The full impacts on this proposal driving development in a hurricane and storm prone area must be determined.

The full impacts on the Texas Point and McFaddin National Wildlife Refuges must be determined.

The full impacts on the J. D. Murphree Wildlife Management Area and Sabine Rim State Park must be determined.

The full impacts of dredge disposal on the beach paralelling State Hwy 87 must be determined & the linkages fully assessed including impacts.

We urge the Corps not to rush into this project. Already Corps personnel are stating the project looks like it has a positive benefit when public review & input and full assessment, analysis, & evaluation have not been done (See enclosed articles). This appears to make the Corp biased in favor of the proposal before it has even

(6)

been assessed. This biasing is illegal under the National Environmental Policy Act (NEPA) and the Council on Environmental Quality's (CEQ) NEPA implementing regulations.

We appreciate the opportunity to comment and request we be placed on the mailing list and be sent all information about this proposal including a hard copy of the DEIS.

Thank you.

Sincerely,

Brandt Mannchen

Brandt Mannchen
Chair, Big Thicket Committee
Lone Star Chapter of the Sierra Club
5431 Carew
Houston, Texas 77096
H 713-664-5962, W 713-640-4313

BUSINESS

D

THURSDAY
JANUARY 31, 2002

◆ Markets/3D ◆

# Engineers weigh ship channel deepening

## Sabine-Neches passage could be dredged to 50 feet

By DAN WALLACH
THE ENTERPRISE

BEAUMONT — A preliminary decision to deepen the Sabine-Neches Ship Channel to 50 feet from its existing 40 feet could be ready by July.

An engineer conducting a study for the U.S. Army Corps of Engineers said the depth range under consideration is anywhere from 45 to 55 feet.

"The draft work we've been doing so far looks like it's in the 50-foot range," said Richard Tomlinson, the project manager. "We don't officially know ourselves, so we can't say for sure."

To recommend the project, the corps must show an economic benefit in the national interest.

A local waterway official said that benefit already is proved with the corps recently increasing the waterway's ranking for foreign-trade tonnage from fifth to third.

The trend in U.S. ports is to cut deeper channels to accommodate larger ships, particularly those that serve oil and petrochemical refining plants.

Tomlinson said the estimated cost of digging the Sabine-Neches channel 10 feet deeper is about $400 million.

The local sponsors would have to pay 25 percent of the cost, he said.

The local sponsors also would have to provide some additional assets, such as real estate for placement of dredged material.

However, current law requires local sponsors to pay 50 percent of the total cost if the channel depth goes past 45 feet, said Tom Jackson, general manager of the Jefferson County Waterway and Navigation District.

Also, if the depth goes past 45 feet, the local sponsor assumes maintenance costs, Jackson said.

"There is a proposal to nullify that penalty, but as it stands today, there is a penalty for

STUDY, next page

1666

FROM THE BUSINESS COVER

# STUDY: Benefits would exceed upgrade costs

Continued from page 1D

depths past 45 feet," Jackson said.

"If it changes, we could go to 50 feet," he said.

Another wild card is the cost of relocating pipelines that cross the channel, he said.

A federal judge in Houston this week wrote an opinion involving the Port of Houston that places the cost of pipeline relocation on the port.

The corps already approved cutting the Houston Ship Channel to 45 feet from 40 feet, and construction there is under way.

The port is appealing the judge's decision.

In July 1991, U.S. District Judge Howell Cobb in Beaumont dealt with a similar problem in which a pipeline company wanted Drainage District 6 to pay for line relocations in the Taylor Bayou flood control project.

Cobb ruled against the pipeline company, saying its position "not only was not good law, but not good sense."

The Fifth Circuit Court of Appeals in 1993 upheld Cobb's ruling that the pipeline company was responsible for the relocation.

Jackson said at least 65 pipelines cross the Sabine-Neches ship channel.

The corps' recommendation for deepening is based on a cost-benefit ratio averaged during a 50-year span for the project, Tomlinson said.

In the case of the Sabine-Neches channel, the cost-to-benefit ratio is 1-to-2, he said.

If the cost is measured at about $400 million, the benefit is expected to yield about $800 million, he said.

"All depths are in that (cost-benefit) ballpark," he said.

The greatest net benefit results from a depth of 50 feet for the channel, he said.

The corps also is studying whether to deepen the channel serving Corpus Christi to as deep as 52 feet from its current 45 feet.

Tomlinson said the corps will determine its recommendation in July and prepare its environmental impact study for public review by December 2003.

A final version of the plan should be ready by April 2004, he said.

**Business reporter Dan Wallach may be reached at dwallach@beaumontenterprise.com or call (409) 833-3311, ext. 450.**

# Dredge project would produce huge amounts of silt, sludge

By JEORGE ZARAZUA
THE ENTERPRISE

BEAUMONT — Sorry kids, this is bigger than mud pies.

We're talking about millions of tons of silt, or dredged sediment, that is expected to be pumped from the bottom of the Sabine-Neches Ship Channel if the federal government approves the deepening and widening of the waterway.

It's such a colossal amount of dirt that the U.S. Army Corps of Engineers has begun to consider what to do with it, even before the project is approved.

Deepening the ship channel to 45 feet will produce enough silt, commonly called spoil, to create a mountain 14,000 feet above sea level if dumped in one place, or fill the Astrodome three times.

Traditionally, the Corps has set the dredged sediment aside, dumping it either on land surrounding the river or out in the Gulf of Mexico, where ships don't travel.

But in an effort to be more environmentally friendly, not to mention there's little room in the county for a mountain-sized mud pile, the Corps has enlisted the aid of a Baton Rouge consulting firm to help come up with solutions.

Representatives with Gulf Engineers and Consultants Inc. have had public meetings across Southeast Texas and Southwest Louisiana, asking residents how more than 40 million cubic yards of dredged sediment can be used to help the environment.

The representatives recently posed the question to Jefferson County commissioners.

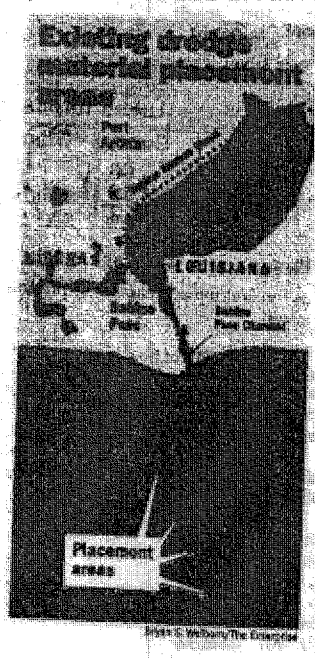
SILT, page 6A

## WEATHER

Today: Scattered showers
High: 60s. Low: 40s.

Update, page 2A

http://www.SoutheastTexasLive.com




Brian S. McBride/The Enterprise

THE BEAUMONT ENTERPRISE ◆ Thursday, January 24, 2002

# SILT: Project not yet approved

Continued from page 1A

"We're not interested at this point whether the ideas are technically or economically feasible, the Corps is going to take all the suggestions that are made and sort them out," said Jacques Bagur, one of the consultants.

County Commissioners said they want the dredged sediment pumped out along the county's coast, forming barriers that would protect not only its beaches, but also Texas 87.

Richard Tomlinson, the Corps' project manager, said other suggestions include pumping the silt via pipelines to areas such as the Bessie Heights Marsh and the J.D. Murphee Wildlife Management Area to replenish their marshes.

"This is going to be some good stuff," Tomlinson said. "In fact, we anticipate there is going to be a demand for the material."

If all else fails, then the Corps could build its own island.

It's been done before with the dredged sediment from the deepening project at the Houston Ship Channel, said Marilyn Uhrich, a spokeswoman for the Corps in Galveston.

It took the Corps about a month to create Evia Island, which has become a protected habitat for gulls, pelicans, sandpipers and a myriad of other birds.

Gulf Engineers and Consultants Inc. may be reached at 225-336-4606.

Reporter Jeorge Zarazua may be reached at jzarazua@beaumontenterprise.com or at (409) 833-3311, ext. 419.

(5)

**DEPARTMENT OF THE ARMY**
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

CEMVN-PM

12 Jun 02

MEMORANDUM FOR Commander, Galveston District, Post Office Box 1229, Galveston, Texas 77553

SUBJECT: Senator Mary Landrieu's Letter Forwarding a Letter From Ms. Carolyn Thibodeaux, Cameron Preservation Alliance Regarding the Sabine Ship Channel

1. As the subject letter concerns a matter within your jurisdiction, I am forwarding it directly to you for a reply (see encl 1).

2. We have advised Senator Landrieu's office that the letter is being forwarded to you (see encl 2).

2 Encls
as

THOMAS F. JULICH
Colonel, EN
Commanding

Estate of J. G. GRAY
P.O. Box 40
Lake Charles, Louisiana 70602

02 JUL 12 AM 3:57

June 24, 2002

Colonel Leonard Waterworth
District Engineer
U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, TX 77553

Re:Public Scoping Meeting – Sabine Neches Waterway Feasibility Study and EIS

Dear Colonel Waterworth:

Stream Property Management, Inc. is a wholly owned subsidiary of the Estate of J.G. Gray located in Lake Charles, Louisiana. We own, manage and represent tens of thousands of acres that will be adversely impacted by the widening and/or deepening of the Sabine Neches Waterway. Huge areas of valuable coastal wetlands in the Sabine Basin in Louisiana have been adversely affected for the past century by the changes in hydrology through salt water intrusion and increased tidal fluctuation caused by the Sabine-Neches Waterway.

In this day and time of environmental awareness, our country and state have recognized the importance of coastal wetlands. Louisiana passed Act 6 (R.S. 49:213 et seq.) in 1989 creating the Coastal Wetlands Conservation and Restoration Authority as the initial step to restore Louisiana Coastal Wetlands.. The Coastal Wetlands Planning, Protection, and Restoration Act (P.L. 646) was passed by the 101st U.S. Congress in 1990. These Acts have shown widespread public support and awareness in Louisiana and the United States for the preservation and restoration of our coastal wetlands. There have been huge mistakes made in the past allowing large quantities of salt water to intrude into traditional freshwater wetlands. The coastal marshes located in Calcasieu and Cameron Parishes were traditionally fresh and intermediate wetlands with a small border of brackish marsh along the shoreline. Since the channel construction and enlargements, beginning in the late 1800's, huge areas of these wetlands have been washed out to sea. Because of the fragile nature and organic composition of the soils, these soils have not been rebuilt, thus leaving vast open water expanses.

The deepening and widening of channels has been shown to not only increase salinities but to increase tidal fluctuations and storm surges. In low lying areas such as these wetlands surrounding Sabine Lake, an increased tidal amplitudes are devastating to these fragile marshes. The added danger in deepening and widening this channel is a further threat to the deterioration of our coastal wetlands, allowing increased hurricane and tropical storm surges to inundate these marshes.

As your staff can aptly demonstrate, the losses on both sides of Sabine Lake parallel the channel improvements on the Sabine Neches Channel. It is also evident at this point in time that freshwater is becoming a more valuable resource as witnessed by your latest project regarding the saltwater barrier in the Neches River. There is no such barrier in the Sabine River. There is no such barrier between the Sabine Basin and the Calcasieu Basin which was connected by a deep water channel by act of congress in 1912. The hydrology of this basin can not tolerate more changes and, in fact, needs to have the past century of adverse impacts addressed as soon as possible.

Coast 2050 is a comprehensive plan endorsed by five departments of the U.S. Government and the State of Louisiana. This plan outlines many restoration efforts, along with the white paper published in 1994, the Calcasieu-Sabine Basin plan submitted by NRCS in 1989 and many other plans that have addressed these problems and outlined solutions. The solutions identify a salinity control measure at Sabine Pass, along with perimeter control projects, one of which has been recently approved by the Coastal Wetlands Planning, Protection and Restoration Act, the East Sabine Lake Project. This project outlines a perimeter control system to control salinity inside the interior marshes of the east side of Sabine Lake. This project has been developed by five federal agencies including the U.S. Army Corps of Engineers (New Orleans District) to protect this area. As pointed out in the scoping meeting in Lake Charles, we have seen no evidence of coordination between the Interagency Coordination Team (ICT) group for the Sabine Neches Waterway and the plans and construction projects being implemented in Louisiana. A representative from Coastal Management, Department of Natural Resources, has been attending these ICT meetings but coordination in regard to these larger projects has not been witnessed according to the minutes of the ICT.

Many meetings with user groups were held to ask for public input into eco-system planning and beneficial use of dredged spoil ideas. The 244 suggestions by user groups and landowners are added to the official record for the scoping meeting by this letter with Attachment "A". One of the issues that was brought up during these user group meetings was lack of public input, and lack of the ability to question the merits of the project, along with the lack of public and private participation. Private landowners that are being affected by this project have had an almost inconsequential voice in this process. This was evidenced in the scoping meeting that was held in Lake Charles on May 28th by allowing the public only three minutes per person to comment. The Corps of Engineers and Jefferson County Navigation District have had years to plan this project and have spent millions of dollars prior to these scoping meetings. The individuals from the public whose land was being affected were given a total time of three minutes to speak at the scoping meeting. This is hardly enough time for an individual to explain his

interest in the project or how the project may affect him. Now, is it equitable that the government has spent millions in preparing for this project and allows the public, whose private land is being affected, a three minute time frame with the option to submit written comments as per this correspondence? I feel this was totally inadequate and totally unfair to the private landowners being affected by this channel.

By this means, we request that before any channel improvements are approved that the past wetland damages of this channel be restored to the satisfaction of the landowners affected by this channel improvement prior to the proposed channel improvement project moving forward.

Some spoil disposal sites are located on the east bank of the Sabine River in Louisiana from Sabine Pass to Sabine Lake. These areas of spoil deposition should no longer be used with the technology we have available today. This spoil should be placed for beneficial use in many areas around the lake that are not being utilized at this time. Spoil is also being placed in public water bottoms of Sabine Lake. This public resource does not deserve to be taken away for channel improvements and/or maintenance. The Keith Lake area on the west side of the Sabine Neches channel has also been severely deteriorated by the saltwater intrusion and excessive tidal fluctuation caused by this channel. Many opportunities for water control and beneficial use of dredged spoil are available in that area as evidenced by suggestions in Attachment "A".

I want to thank you for the ability to make these comments and would hope that further coordination with private landowners and individuals who will be adversely affected by the proposed channel improvements be consulted and kept abreast of every activity in the future. I regret that this type of government action is intended for the public good but seems to exclude the public from comment except for limited and controlled through "scoping" meetings.

Sincerely,

David Richard
P.O. Box 40
Lake Charles, LA 70602
337-433-1057, extension 19
drichard@streamcompany.com

Enclosure
CC: Senator John Breaux
Senator Mary Landrieu
Congressman Nick Lampson
State Senator G. Theunissen
State Representative Dan Flavin
State Representative Ronnie Johns

# RECOMMENDATIONS MASTER LIST

1. Deposit dredged materials in open water areas within the marshes (affected by subsidence, erosion, and saltwater intrusion) at Texas Point NWR.

2. Deposit dredged materials at Lafitte's Landing 1 and 2 (south end of Pleasure Island, lake side, along shoreline and by marina) to provide shoreline erosion control and wetland creation.

3. Deposit dredged materials at Pleasure Island Marina for shoreline erosion control and marsh creation.

4. Construct a salinity control structure at the Keith Lake Fish Pass/SNCC intersection to reduce saltwater intrusion while allowing for unhindered navigation and marine organism ingress/egress.

5. Construct a system (depending on hydrologic model) of berms or levees (terraces) north of Pleasure Island in the gap and restore the island along the Sabine-Neches Canal to protect the lake from higher salinities in the channels.

6. Restore the hydrologic connection (freshwater sheetflow) at Salt Bayou between the marshes north and south of the GIWW.

7. Construct a structure on the east part of Salt Bayou to restore freshwater flow to marshes south of the GIWW.

8. Deposit dredged materials, particularly those with higher sand content, lineraly along the shoreline from Texas Point NWR westward through McFaddin NWR.

9. Deposit dredged materials, particularly those with higher sand contant, lineraly along the shoreline east of the entrance channel.

10. Create gaps in both entrance channel jetties to increase sediment transport to Gulf shorelines.

11. Stabilize the shoreline on the east edge of Texas Point NWR at gaps in the jetty north of pilot station and repair the jetty.

12. Construct a two to six acre bird island or islands, at least five feet high with a sheltered lagoon, in the north part of Sabine Lake near Sidney Island at least one mile offshore.

13. Establish salinity controls, including the restoration of historic flow volumes, in Texas Bayou and associated channels connecting to the SNWW on Texas Point NWR through such things as low-level rock weirs, plugging man-made channels, water control structures, and/or other channel modifications.

14. Deposit dredged materials in open water areas and degraded marshes in the east part of the Salt Bayou watershed north and south of Keith Lake.

15. Stabilize the shoreline in any reaches of the GIWW projected to have increased salinities as a result of the project.

16. Establish erosion control on the Taylor Bayou outfall canal shoreline, primarily on the south bank.

17. Stabilize the banks of the GIWW in Louisiana, particularly the south bank, because the north bank has been largely stabilized through two coastal restoration projects.

18. Protect the cypress swamp area south of the Neches River Saltwater Barrier from possible excessive salinities by installing structures, terraces, or other hydrologic components.

19. Use high sand content dredged materials from offshore, including existing disposal areas, for beach enhancement purposes.

20. Implement the East Sabine Lake Hydrologic Restoration Project to protect approximately 35,000 acres of brackish to intermediate marsh in the west part of the Sabine NWR and adjacent lands from elevated salinities by such things as water control structures at major bayous and canals and earthern terraces in existing shallow-water areas.

21. Construct a gate on the Sabine Pass Channel or a sill offshore to establish hydrologic control.

22. Restore the interior hydrology of Salt Bayou marshes south of the GIWW on TPWD land.

23. Construct a low-level rock weir or similar structure at the causeway to prevent excessive salinities from entering the lake.

24. Construct salinity controls in the brackish marsh regions east of the intersection of Lighthouse Bayou and the Sabine Pass Channel.

25. Deposit dredged materials from the SNWW in large, shallow, open-water areas in the west part of the Sabine NWR north and south of the Willow Bayou Canal and in the Greens Lake area.

26. Deposit dredged materials from the SNWW on the east shoreline of Sabine Lake at the Sabine NWR and adjacent lands.

27. Deposit dredged materials from the SNWW in the open-water areas of the Greens Lake area to create marshes.

28. Establish salinity control between the GIWW and the Sabine River to protect the Louisiana side.

29. Establish salinity control west of the Hwy. 87 bridge and the GIWW to protect the Texas side.

30. Use new work materials one-time offshore that would degrade to feeder berms.

31. Establish topographic relief offshore.

32. Establish nearshore feeder berms for shoreline protection.

33. Protect and stabilize the Middle Marsh Drain Ditch.

34. Restore the saltwater guard lock at the north end of Pleasure Island.

35. Establish salinity control at the mouth of Cow Bayou.

36. Establish salinity control at the mouth of Adams Bayou.

37. Establish salinity control on the Old Ferry Road Borrow Ditch.

38. Establish salinity control at Old River Bayou.

39. Create terraces in the Entergy Power Plant Marsh.

40. Isolate the Entergy outfall canal by recreating the historic canal berms.

41. Use dredged materials to create terraces and mounds and backfill canals in the Bessie Heights Marsh.

42. Restore the natural hydrology of the Bessie Heights Marsh by restoring the natural bayou and closing the two canals.

43. Divert some of the stormflow in Anderson Gully into the Bessie Heights Marsh.

44. Restore the cypress swamps in the Rose City Oilfield through hydrologic restoration, salinity control, and beneficial use of dredged materials.

45. Plug the Hwy. 87 borrow ditch to restore flows to Nig Bayou.

46. Protect the shoreline on the north side of Old River Cove.

47. Use dredged materials to create mounds and terraces in Old River Cove.

48. Use dredged materials in the Old River Unit of the Lower Neches River WMA.

49. Use dredged materials in the open-water areas of the Burton Canal Marsh east of the Sabine River and the Burton Canal.

50. Use dredged materials in the open-water areas of the marsh east of Phoenix Lake.

51. Protect and restore the north shore of Keith Lake.

52. Construct a structure in the Sabine River at Orange to protect the cypress-tupelo swamps upstream if Sabine Compact withdrawals are implemented.

53. Use dredged materials to create a bird island north of the causeway.

54. Use dredged materials to restore marsh elevations in the interior of the Salt Bayou Marsh south of the GIWW.

55. Divert the Neches River through the Bessie Heights Marsh into Sabine Lake by leveeing the channel.

56. Create a substrate for oysters in south Sabine Lake to restrict salinity and flow.

57. Construct a navigation lock at Sabine Pass, which would resolve many of the problems, particularly saltwater intrusion, in the Sabine Lake area.

58. Construct a low-level rock weir constriction at the mouth of Sabine Lake at the causeway to reduce saltwater intrusion.

59. Implement the East Sabine Lake Hydrologic Restoration Project (a CWPPRA project) to provide salinity control on the east shore of Sabine Lake.

60. Implement the NRCS Public Law 566 rock weirs along the length of Black Bayou.

61. Construct a salinity control structure at the mouth of Black Bayou.

62. Use dredged materials between Pleasure Island and Sabine Island to create an earthen barrier that would protect Sabine Lake from saltwater intrusion from the channels.

63. Use dredged materials to restore the marsh in the Old River Unit south of Bridge City.

64. Remove Placement Area 11 at the north end of Pleasure Island to restore the estuarine bottom and reestablish public access to state waterbodies.

65. Remove Placement Area 8 at the south end of Pleasure Island to restore the estuarine bottom and reestablish public access to state waterbodies.

66. Use dredged materials to restore the marshes north and south of Keith Lake.

67. Use dredged materials to restore the marshes in the Greens Bayou area.

68. Use dredged materials to restore the marshes in the Willow Bayou area.

69. Establish an earthen barrier with water control structures along the entire east edge of Sabine Lake to protect the marshes from salinity intrusion and wave action.

70. Use dredged materials to restore the marshes north of Lighthouse Bayou.

71. Construct a structure at the mouth of Lighthouse Bayou to reduce salinity intrusion.

72. Use dredged materials to restore the marshes south of Perry Ridge.

73. Provide greater opportunities for fishing (for example, piers) to compensate for the decline of boater access to Sabine Lake from Louisiana that has been brought about by hydrologic restoration projects.

74. Stabilize the shoreline on the east side of Sabine Lake using boudin bags (geotextile tubes filled with dredged materials).

75. Use dredged materials to restore the marshes northwest of the Black Bayou Oil and Gas Field.

76. Maintain Sabine River freshwater flows into Sabine Lake in keeping with the Coast 2050 strategy.

77. Establish a navigation lock on the GIWW at Gum Cove Ridge to reduce saltwater intrusion to the east.

78. Use dredged materials to enhance the existing marsh strip and refurbish the deteriorated rock barriers on the south side of the GIWW in the Gum Cove Unit 13 area.

79. Use dredged materials to restore the marshes and establish a bird island south of the GIWW in the Gum Cove Unit 13 area.

80. Provide shoreline protection and hydrologic restoration for the fresh marsh east of the Sabine River and between the GIWW on the south and the Sabine Island WMA on the north.

81. Create terraces and use dredged materials to restore marshes between Perry Ridge and the Sabine River.

82. Protect the marshes between the Sabine NWR and Sabine Pass by protecting the shoreline of Sabine Lake and establishing salinity controls on Madame Johnsons Bayou,

Forge Bayou, Greens Bayou, and Johnsons Bayou in keeping with the East Sabine Lake Hydrologic Restoration Project.

83. Use dredged materials to restore marsh in all open-water areas east of Sabine Lake where it is feasible to pump them, and construct terraces to restore marsh in all open-water areas east of Sabine Lake where it is not feasible to pump dredged materials (note: not location specific).

84. Use dredged materials and construct terraces in the open-water areas of the Black Bayou Cutoff Canal area.

85. Restore the hydrology and prevent saltwater intrusion at the oil field ditch and lateral ditches running west from the Black Bayou Cutoff Canal.

86. Establish a state park in the area east of Lighthouse Bayou and south of Hwy. 82 (contingent on private property donation and not necessarily including the lighthouse).

87. Use dredged materials to restore eroded beaches in the vicinity of the 15-mile marker from the Louisiana line (that is, in the Dunn Beach and Martin Beach areas).

88. Construct an earthen barrier on the east bank of the Sabine River from the GIWW to Sabine Island to eliminate saltwater intrusion.

89. Use dredged materials to restore the marshes in the area north of the GIWW and west of the Gray and Vinton drainage canals.

90. Use one-time placement of dredged materials in various areas to create coastal forest and chenier habitat (note: not location specific).

91. Use dredged materials to create cheniers on the high marsh from Louisiana Point to Holly Beach.

92. Use dredged materials to restore marshes in the Bessie Heights Marsh area.

93. Provide erosion control along the channel on the north portion of Pleasure Island.

94. Provide erosion control along the channel on the extreme south portion of Pleasure Island.

95. Use dredged materials to restore the north end of Pleasure Island where Sabine Lake is breaking through.

96. Use dredged materials to restore the southern tip of the peninsula north of the northern tip of Pleasure Island.

97. Provide erosion control using concrete revetment on the west side of the Port Arthur Canal across from Placement Area 11 in the vicinity of the vessel repair facility.

98. Use dredged materials to close the gap between the channel and Sabine Lake north of Pleasure Island.

99. Use dredged materials to close the gaps between the islands at the north end of Sabine Lake.

100. Elevate Hwy. 87 with dredged materials near Sabine Pass.

101. Provide erosion control along the channel on the south portion of Pleasure Island in the vicinity of Placement Area 8.

102. Use dredged materials to restore the marsh on the south end of Humble Island.

103. Use dredged materials to restore the marsh on the south side of the GIWW below Taylor Bayou.

104. Use dredged materials to restore the marshes north of the GIWW in Louisiana.

105. Restore access to the Sabine Lighthouse and stop erosion in the immediate area.

106. Use dredged materials to build developable land on the north side of the Neches River from Beaumont downstream.

107. Use dredged materials to build up the area near Hwy. 82 and the causeway so that a bridge can be built over the channel directly linking Hwy. 82 and Hwy. 87.

108. Use dredged materials to restore the eroding beach in the vicinity of Peveto Beach.

109. Breach the levees and use dredged materials to restore the manmade lakes within Sabine NWR to their original marsh condition.

110. Use dredged materials to fill in oilfield service canals wherever they are contributing to salinity intrusion into Louisiana's marshes (note: not location specific).

111. Use dredged materials to build islands offshore on both sides of the channel for migratory birds that would simulate the function of a natural delta.

112. Use dredged materials to build islands for migratory birds in Sabine Lake far enough from shore to protect from predators.

113. Use dredged materials to construct cheniers in Louisiana and Texas, planting them with oaks and other vegetation that occur on natural cheniers.

114. Use dredged materials to restore cheniers in Louisiana and Texas (perhaps by removing the existing top layer of sand and shell, depositing dredged materials, and they relaying the sand and shell on top), with easements to protect them for bird use.

115. Use dredged materials to buffer cheniers in Louisiana and Texas that are in danger of disappearing.

116. After placing dredged materials in new placement areas, shape and contour the areas so that they appear natural, and plant native vegetation to support wildlife (note: not location specific).

117. Shape and contour existing dredged material placement areas so that they appear natural, and plant native vegetation to support wildlife (note: not location specific).

118. Construct recreational amenities, particularly primitive campgrounds, on cheniers and on placement areas that have been filled (note: not location specific).

119. Construct a lock at Sabine Pass to prevent saltwater intrusion into Sabine Lake.

120. Construct a bulkhead on the channel side of Pleasure Island from the intersection of the SNWW and the GIWW to the north end of the island.

121. Mine dredged materials from Placement Area 8 to build up the 43 acres at the south end of Pleasure Island owned by the port and then replace with new dredged materials.

122. Preserve the productive shallow-water areas of the two placement areas on Pleasure Island by depositing dredged materials on top of the existing levees, particularly near the channel, and develop the land for recreational use.

123. Use dredged materials to build up the land on the southern portion of Pleasure Island from Placement Area 8 to the south end of the island on the lake side and bulkhead the channel side.

124. Provide erosion control for all of Pleasure Island on the channel side.

125. Use dredged materials to rebuild the approximately one-quarter mile of land at the north end of Pleasure Island that has completely eroded away and protect it with erosion control structures.

126. Use dredged materials to build up the land on Pleasure Island directly across from the Taft Avenue Extension to preserve its potential as a location for a second bridge to the island.

127. Construct a new salinity control structure on the north side of the GIWW at the point where Salt Bayou intersects the GIWW.

128. Use dredged materials to restore the beach and create dunes south of McFaddin NWR between Sea Rim State Park and High Island.

129. Use dredged materials to rebuild the island at the McFadden Bend Cutoff (Reserve Fleet area across from Sun Terminal) that was lost to erosion.

130. Use dredged materials to restore Bessie Heights Marsh and construct salinity control structures to protect the marsh.

131. Construct a salinity control structure on the Keith Lake Fish Pass.

132. Limit salinity intrusion into Keith Lake by using dredged materials to fill in the cuts that have been made into the lake on its north side.

133. Build vegetated dunes and institute ongoing erosion control and beach nourishment for the eroded beach in the vicinity of McFaddin NWR.

134. Construct a structure at the channel end of the Pilot Station Cut to limit saltwater intrusion.

135. Construct a structure at the channel end of the Texas Bayou Cut to limit saltwater intrusion.

136. Construct a structure at Keith Lake Fish Pass to limit saltwater intrusion.

137. Investigate the potential for mining existing placement areas for high-quality dredged materials that can be used in various restoration projects (note: not location specific).

138. Use maintenance dredging materials from the GIWW to restore the eroded beach in the vicinity of McFaddin NWR.

139. Use dredged materials from the lower portion of Taylor Bayou for marsh restoration and beach nourishment.

140. Mine the high-quality sediments from behind the dam at Steinhagen Lake (outside of the study area) for use in marsh restoration and beach nourishment projects in the study area.

141. Modify the jetty system to restore the longshore current and deposition of materials along the beach west of the channel.

142. Use the high-quality materials from offshore channel dredging to restore the eroded beach in the vicinity of McFaddin NWR.

143. The beach in the vicinity of McFaddin NWR is being eroded because the longshore current is deflected outward by the jetties and then turns back sharply toward the beach.

Build a longshore parallel jetty system to minimize the assault on the beach by the inwardly turning longshore current.

144. Because it is of higher quality, use dredged materials from the GIWW for beach restoration west of the channel rather than for other purposes.

145. Reinforce the shoreline all along the channel to reduce erosion and the need for maintenance dredging.

146. Implement the Drainage District 6 proposed Taylors Bayou Diversion Channel project west of the present diversion channel and from Taylors Bayou to the GIWW to alleviate flooding.

147. Use dredged materials to restore the eroding beach south of McFaddin NWR to protect Hwy. 87.

148. Pump sand from offshore to restore the eroding beach south of McFaddin NWR to protect Hwy. 87.

149. Restore the Rose City Marsh in keeping with the plan of action submitted by TNRCC, which involves breaking the open-water areas into cells with levees and restoring one cell at a time with dredged materials.

150. Preserve the oxbow above the Rose City Marsh, with possible donation or easement and recreation link with mainland.

151. Close the breaks into the marsh on the southeast bank of Keith Lake that are contributing to saltwater intrusion.

152. Resolve the problem of too much fresh water in the Blind Lake area where the TPWD levee and the GIWW are interrupting sheetflow, perhaps by constructing a drainage canal to the GIWW.

153. Reduce saltwater intrusion into Bessie Heights Marsh by separating the marsh from the Neches River by building a levee along the river bank and rebuilding the levee on the GSU canal.

154. Reduce saltwater intrusion by building a levee across the old dredged material placement area to Bird Island Bayou.

155. Restore the Mires Bayou area by building levees to close the oxbow at both ends, which would limit saltwater intrusion.

156. Protect the Texas Point marshes by constructing a longshore rock jetty and placing dredged materials along the beach behind the jetty.

157. Use dredged materials to restore marshes throughout the study area that have been converted to open-water areas, as seen by comparing historic to contemporary maps (note: not location specific).

158. Constrict the channel to about 250 feet at Sabine Pass to reduce saltwater intrusion into Sabine Lake.

159. Construct a lock at Sabine Pass to eliminate saltwater intrusion into Sabine Lake.

160. Deposit dredged materials southeast of the lighthouse to create a raised area or dunes that would protect the lighthouse from storm surges and assist in erosion control.

161. Place dredged materials southeast of the lighthouse along the mudflats and slightly inshore at an elevation of about three feet to protect the lighthouse.

162. Control coastal erosion west of Johnsons Bayou by the placement of materials from offshore channel dredging.

163. Use every opportunity presented by the present and proposed projects to preserve the lighthouse for future generations (note: not site or recommendation specific).

164. Construct a saltwater barrier at the mouth of Lighthouse Bayou to limit saltwater intrusion into the marsh.

165. Construct an emergent or submerged rock barrier north of the causeway to limit saltwater intrusion into Sabine Lake.

166. Build a levee or separate salinity control structures from Blue Buck Point east to limit saltwater intrusion into the marshes through the numerous small ditches and oilfield canals.

167. Construct an erosion control structure and rebuild the land with dredged materials in the eroding cove on the east side of the lake and north of the causeway.

168. Construct an erosion control structure and rebuild the land with dredged materials in the eroding cove on the east side of the lake and south of the causeway.

169. Construct a lock at the mouth of the channel to eliminate saltwater intrusion into Sabine Lake.

170. Build placement areas to a reasonable level, then move on to other areas, allowing the old placement areas to vegetate or be used for development (note: not location specific).

171. Use dredged materials to restore the eroding beaches from Texas Point to High Island.

172. Use dredged materials for dune restoration south of Hwy. 87 if it is ever rebuilt.

173. Use dredged materials for marsh restoration in the Bessie Heights Marsh.

174. Use dredged materials for marsh restoration in Keith Lake wherever open-water areas are emerging.

175. Use dredged materials for marsh restoration in the Salt Bayou watershed north and south of the GIWW.

176. Use dredged materials to build up low-lying land suitable for development that is not marsh land (note: not location specific).

177. Because most dredged materials contain pollutants, continue to put them in placement areas rather than using them for ostensibly beneficial purposes (note: not location specific).

178. Any beach-quality sand that is available should be used to restore the eroding beaches from Texas Point to High Island.

179. Use dredged materials to construct a road to the Sabine Lighthouse.

180. Use dredged materials to restore the beaches east of the channel.

181. Construct a lock at the mouth of the channel to eliminate saltwater intrusion into Sabine Lake.

182. Construct a revetment or levee and fill in back with dredged materials to restore the eroding cove at the mouth of Lighthouse Bayou.

183. Remove Point Hunt Island in the channel to allow a straight passage for vessels so that the land to the east is not subjected to collisions.

184. Use dredged materials to fill in the open-water areas in Sabine NWR.

185. Use dredged materials to further build up the potentially developable land on the east side of the channel, and investigate ways to modify present restrictions on development.

186. Constrict the channel at Sabine Pass to reduce saltwater intrusion into Sabine Lake.

187. Construct a weir in the vicinity of the causeway to reduce saltwater intrusion into Sabine Lake.

188. Construct a series of small islands between the north end of Pleasure Island and Sabine Island to reduce saltwater intrusion into Sabine Lake from the channel.

189. Use the higher-quality dredged materials obtained through offshore dredging for marsh and beach restoration.

190. Use dredged materials to restore the shoreline and Hwy. 87 between Texas Point and High Island.

191. Continue to insure freshwater inflow into Sabine Lake from the Neches and Sabine rivers (note: not location specific).

192. Construct a public boat launch on the Louisiana side of the causeway at the site of the present deteriorated boat ramp to provide access to Sabine Lake from Louisiana.

193. Rehabilitate the old boat launch at the burned out bridge on old Hwy. 90.

194. Rebuild the deteriorating islands between the north end of Pleasure Island and Sabine Island to reduce saltwater intrusion into Sabine Lake from the channel.

195. Construct substrates for oysters in Sabine Lake to renew oyster production.

196. Ensure that future restoration and beneficial use projects comply with Louisiana mandates and Louisiana's Coast 2050 plan (note: not location specific).

197. Stabilize the levees of the GIWW throughout its entire extent in the Louisiana portion of the study area.

198. Restore the levees on the Vinton Drainage Canal.

199. Use dredged materials to restore road access to the Sabine Lighthouse.

200. Construct a lock in Sabine Pass to eliminate saltwater intrusion into Sabine Lake.

201. Use dredged materials for erosion control on both sides of the channel from Sabine Pass to the north end of Pleasure Island.

202. Stabilize the shoreline of the entire Neches River channel.

203. Stabilize the lake shoreline and replenish adjacent marshes in the area from Blue Buck Point to Johnsons Bayou, leaving the bayous open.

204. Construct a structure within the causeway to slow tidal flows in and out of the south end of Sabine Lake.

205. Construct a lock at the mouth of the Sabine River to regulate freshwater flows into Sabine Lake from Toledo Bend Reservoir.

206. If the SNWW project is approved, develop a joint Louisiana-Texas plan to deal with any unforeseen problems that might occur (note: not location specific).

207. Use dredged materials for beach restoration from Texas Point to High Island.

208. Construct a fishing pier in connection with the improved boat launch on the Louisiana side of the causeway.

209. Construct a large parking area in connection with the improved boat launch on the Louisiana side of the causeway.

210. Construct a structure at the mouth of Lighthouse Bayou to limit saltwater intrusion.

211. Use dredged materials to restore the beach from Louisiana Point to Constance Beach.

212. Use dredged materials to reinforce the roadbed of Hwy. 82 along the Louisiana coast.

213. Use dredged materials to enhance the beach at Louisiana Point.

214. Use dredged materials to restore Fina Anchorage Island created by the cutoff in the Neches River.

215. Use dredged materials for chenier restoration in Louisiana, including planting of native vegetation to provide habitat for neotropical migratory songbirds.

216. Use dredged materials to restore deteriorating marshes in the chenier plain.

217. Use dredged materials to construct new cheniers in Louisiana.

218. Establish salinity control on the bayous and canals entering Sabine Lake from Louisiana.

219. Use dredged materials to restore cheniers on the Texas side of the channel.

220. Use dredged materials to restore beaches and dunes along the Louisiana coast to provide bird habitat.

221. Move Hwy. 87 one thousand feet inland from the beach from Texas Point to High Island, build a dune structure, and fill in the area with dredged materials to slow erosion.

222. Stockpile dredged materials and mine them for beneficial use when needed (note: not location specific).

223. Use dredged materials (sand and mud) to restore the coastline west of Texas Point.

224. Use dredged materials to restore the marshes north of Keith Lake.

225. Restore the marshes from Bessie Heights Marsh to Rose City Marsh as one marsh system.

226. Fill manmade ditches within the Texas marshes (Sea Rim Pintail Flats Marsh, Lower Neches Marsh, Bessie Heights Marsh, Texas Point Marsh, McFaddin Marsh, Meyers Bayou Marsh, etc.) to restore the historic hydrology and salinity (note: not location specific).

227. Construct a saltwater barrier at Sabine Pass.

228. Construct water control structures at the mouth of every canal and bayou in Texas that connects with the channel (Pilot Station, Texas Bayou, Keith Lake Fish Pass, Bessie Heights, Lower Neches, etc.) to restore the historic hydrology, and use dredged materials to fill the canals after water control is accomplished (note: not location specific).

229. Use dredged materials to raise Hwy. 87 from the GIWW bridge south to Sabine Pass.

230. Reconstruct Hwy. 87 from the GIWW bridge south to Sabine Pass to allow sheetflow under the road.

231. Use dredged materials to build up eroding areas on Pleasure Island while avoiding any damages to the lake.

232. Develop a comprehensive study of the best possible restoration of the marsh system from Bessie Heights Marsh to Rose City Marsh.

233. Transport dredged materials outside of the study area so that they can be more widely used, for example at Rollover Pass (note: not location specific).

234. Use dredged materials to create vegetated dunes and restore the beaches from Texas Point to High Island.

235. Mine existing placement areas for materials to build dunes and restore beaches along the Texas coast (note: not location specific).

236. Use dredged materials to build a barrier island from Texas Point to Rollover Pass.

237. After historic hydrology and salinity have been reestablished (as per 226 and 228) in Texas' degraded marshes (Sea Rim Pintail Flats Marsh, Lower Neches Marsh, Bessie Heights Marsh, Texas Point Marsh, McFadin Marsh, Meyers Bayou Marsh, etc.), build land masses and islands, with coarse dredged sand used to establish bird grit sites (note: not location specific).

238. Use dredged materials to construct a bird island in Sabine Lake.

239. Use the higher-quality materials from offshore dredging for beach restoration.

240. Construct water control structures at the mouth of every canal and bayou in Texas that connects with the channel (Pilot Station, Texas Bayou, Keith Lake Fish Pass, Bessie Heights, Lower Neches, etc.) to restore the historic hydrology, and use dredged materials to fill the canals after water control is accomplished (note: not location specific).

241. Use dredged materials to create vegetated dunes and restore the beaches from Texas Point to High Island.

242. Use dredged materials from the SNWW and from Entergy's canal dredging to restore the declining marshes on Entergy property.

243. Use dredged materials to levee Entergy's outflow canal to keep sediment out of the canal and to keep the flow of water from eroding the marsh.

244. Use dredged materials in any fashion that would keep saltwater from intruding into the marshes on Entergy property.

Date: June 27, 2002

To: Lizette Richardson
Galveston District Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

From: Harold J. Schoeffler
Conservation Chair Delta Chapter, Sierra Club
P.O. Box 2218
Lafayette, LA 70502

Re: Scoping Comments Sabine-Neches Waterway

The following concerns are listed in the hopes that these issues will be thoroughly investigated and addressed in the environmental impact study.

1. Any dredging project threatens aquifers, and a geologic study of the entire site is necessary to make sure that vitally needed groundwater sources are not contaminated.
2. Mitigate the loss of productive water bottoms, wetlands and farmlands related to spoil disposal and channel enlargement.
3. Limit through the building of a lock system the loss of fresh water during flood, salt water intrusion during low water droughts and minimize hurricane storm surges.
4. Maintain the estuarine nature of the Sabine lake and marsh system.
5. Allow for the escapement of species such as eels and channel bass that depend on free movement from fresh water to salt water.
6. Protect entire area from long term loss of wetlands and marshes.
7. Consider as an alternative the piping of products to an offshore terminal such as an offshore super port.
8. Determine impact on neo-tropicals, wading birds, water fowl, terns, skimmers, brown pelicans and sandpipers.
9. Determine the impacts of a worse case collision such as two tankers , and determine the need for a port traffic control system over the entire project area.
10. Determine impacts on water quality during initial and maintenance dredging.
11. Determine shoreline impacts on riparian zones related to vessel wave impacts and initial and maintenance dredging.
12. Determine impacts on 404B1 guideline areas such as wildlife reserves and management areas, rookeries, wetlands, oyster reefs, mud flats, sandbars and beaches.
13. Determine socio-economic impacts on sport commercial fisheries, hunting, crabbing, shrimping, tourism, oystering and other recreational losses associated with the project.
14. Endangered sea turtles are attracted to tidal passes such as the Sabine and could be taken by dredges. Determine the risk and take all precautions to protect endangered sea turtles.

15. Determine the impacts on flora and fauna in the project area. Look at placing top soil, grading, leveling and planting of spoil areas above sea level with a goal of creating wildlife habitat.
16. Make spoil areas subject to the public servitude.
17. Test sediments for toxic materials before dredging over entire length of project.
18. Determine impacts of increased shipping and marine traffic.
19. Determine gulf shoreline impacts due to possible changes in near shore currents and wave patterns.

Sincerely,

Harold J. Schoeffler

Harold J. Schoeffler

**Coalition to Restore Coastal Louisiana**
746 Main Street, Suite B-101 • Baton Rouge, LA 70802
225-344-6555 • 225-344-0590 fax • 1-888-522-6278 • www.crcl.org

June 28, 2002

Ms. Lizette Richardson
Galveston District
US Army Corps of Engineers
P O Box 1229
Galveston TX 77553-1229

Dear Ms. Richardson:

On behalf of the Coalition to Restore Coastal Louisiana, we would like to express our grave concern about the potential negative impacts on Louisiana's coastal wetlands should the proposed widening and/or deepening of the Sabine-Neches Waterway channel take place.

The proposed changes to the Sabine-Neches Waterway channel will increase shoreline erosion and saltwater intrusion in the Calcasieu-Sabine basin. Saltwater intrusion has contributed greatly to the loss of wetlands in the Calcausieu-Sabine basin over the past 50 years. This project would exacerbate the loss of additional wetlands and vital estuarine habitat.

Due to the potential for increased salinity and shoreline erosion, this proposed project appears to conflict with the restoration strategies outlined in *Coast 2050*. *Coast 2050* is a comprehensive strategic plan for restoring Louisiana's coastal wetlands and stabilizing the coastal zone to prevent further wetland loss. The plan has been approved by all 20 coastal parishes, the state, and federal government agencies, including the US Army Corps of Engineers. This project, as proposed, could potentially thwart the implementation of *Coast 2050* and threaten Louisiana's ability to gain greater national support for coastal restoration.

Also, the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) requires that all US Army Corps of Engineers' navigation and flood control projects be consistent with coastal restoration plans developed under the CWPPRA statute. We have seen no evidence to date that this has been done with respect to this project.

Specific ecological impacts include, but are not limited to increased salt-water intrusion, plant community changes, loss of wetlands as a result of plant community changes due to salt-water intrusion, increased introduction of exotic species due to ballast water discharge, loss of oyster reefs in Sabine Lake due to increased salinity levels, contaminants in dredged sediments entering the food web, increased scour of some channel areas, and potential impacts to sensitive fin fish species such as paddle fish. Overwhelmingly, the increase in salinity levels to the estuary, including surrounding wetlands, will have the broadest and longest lasting effects. Three dimensional models by Dr. Ehab Meselhe of the University of Louisiana-Lafayette indicate that a large volume (wedge) of salt-water can potentially move well into the channel, with its propose dimensions, as well as into Sabine Lake. Experience has taught us that

increasing channel depth and width directly allows more salt laden water to enter the ecosystem. Both the existing Sabine-Neches Water Way (SNWW) and the nearby Calcasieu Ship Channel are examples of these impacts. Wetland deterioration connected with salt-water intrusion is well documented. Marshes near the Calcasieu Ship Channel underwent almost immediate changes after dredging to deepen the channel was conducted in the mid 1950's, resulting in the loss of nearly all fresh and oligohaline marshes within 20 years (USFWS data). Some of these exist as salt marshes today, but thousands of acres of land were converted to open water. Currently, intense efforts funded by CWPPRA and in accordance with *Coast 2050* are being conducted to restore these ecosystems to healthy and productive habitat.

Along the Sabine Lake eastern shoreline, healthy coastal marsh in Sabine National Wildlife Refuge will undoubtedly be impacted. This area is one of the healthiest areas of marsh in southwestern Louisiana. Loss or deterioration of this habitat will allow greater intrusion into the interior of the refuge. To the north of the refuge, Gray Stream Property Management Company owns much of the wetland between the north refuge boundary and the Gulf Intercoastal Water Way (GIWW). These wetlands are already in a state of advanced deterioration. Additional stresses due to increased salt-water effects could potentially result in the loss of these lands.

Potential impacts to fauna in the estuary include detrimental effects upon paddle fish, Kemp's Ridley Sea Turtle and oyster reefs. Within the Sabine River Drainage Basin, the Western Sand Darter and the Western Hill Splitter Mussel reside, both on the endangered species list of the state of Texas, and therefore species of concern in the state of Louisiana (LA DWF). The paddle fish is a long-lived, migratory, and environmentally sensitive species, typically not reaching breeding maturity until after 3 years of age or longer. If environmental conditions are not right, breeding will not occur. Impacts due to salt-water intrusion and due to increased suspended sediments in the water column as a result of dredging could adversely affect reproduction of this species. Populations of paddle fish have decreased steadily over the past few decades, resulting in this species being placed on the protected species list of the state of Louisiana. In addition, larval paddle fish drift to the south end of Sabine Lake which is the nursery area for the species. Most people agree that salt-water concentrations will increase at the south end of the lake, thus further endangering this estuarine species.

Kemp's Ridley Sea Turtle populations occupy nearshore waters near Sabine Pass. Dredging operations could have direct impacts upon the turtles. Oyster reefs are common in the lower half of Sabine Lake. Altering the isohaline will result in the loss of some of these reefs. Payouts by the state of Louisiana to owners of oyster reefs must be considered in cost-benefit ratio analyses. Also, increased sediment loads in the water column will adversely affect these oyster beds, covering them at least in part and lowering productivity or possibly killing them outright.

Little has been said about the beneficial use of dredged materials. These materials should be used to restore and/or enhance degraded marshes. However, since these materials come from a heavily traveled ship channel which is connected to a city with heavy industry, the potential for contaminants in the sediments is large. Virtually no work has been done on the concentrations of contaminants in dredged materials used beneficially for wetland restoration. There is no record as to whether or not contaminants, such as heavy metals, are entering the food web and possibly bioaccumulating as they move up the line. The only research project addressing this question is being conducted at McNeese State University, in Lake Charles Louisiana and no data has been produced yet for public use. In another project, on the Anacostia River, large concentrations of contaminants have been found in sediments which were dredged from the river and then used to restore degraded marsh. Therefore, this issue should be of major concern.

The potential for the introduction of exotic species will increase with increased ship traffic from foreign ports. Since ballast water exchange at sea in not mandated in the United States, organisms from foreign waters will be released when the ballast is dumped from these ships. Either requiring ballast exchange at sea, or requiring the quarantining of ships until port authorities can ascertained that no non-native species exist within the ballast, must be enforced to reduce this threat. Introduced species is already a major problem in US waters.

The question of hurricane and storm surge impacts has arisen. Some feel that these impacts will be minimal since hurricanes are infrequent. This is inadequate reasoning. Given the low elevation of the Louisiana coast, even many miles inland, coastal flooding due to storm surge and other weather related events is a fairly common occurrence. A tropical system, such as a hurricane can be low enough in intensity as to not cause widespread structural damage to buildings but can still produce significant tidal surges. Along the Gulf of Mexico coast in Louisiana, as sustained southern wind can produce tidal surges several feet above normal. Tropical storms and low lever hurricanes can produce surges sufficient enough to flood much of the landscape. These don't even need to directly hit the area of the proposed project to cause flooding. As long as the winds are from the southwest to the southeast, tidal surges of unusual height will occur. Therefore, the premises, as well as the logic used to present the argument that hurricanes will have a negligible effect are flawed. These wetlands are our best defense against tidal surges. To compromise their integrity and structure will certainly lead to increased flooding problems and associated costs.

In general, this project seems to be designed to benefit just a few people, namely those of Beaumont, Texas, while the negative impacts and costs will be the burden of many, mostly the people of Louisiana. Ecological impacts of increased salt concentrations will affect both flora and fauna and result in wetland loss. We have seen this cause-and-effect many times. Therefore, the cost of restoration of Louisiana wetlands must be considered. Also, since this project will most likely have negative impacts on Louisiana wetlands, then it violates the CWPPRA requirement that all US Army Corps of Engineers' navigation and flood control

projects be consistent with coastal restoration plans developed under the CWPPRA statute. Additional costs will be felt in the loss of commercial oyster fishing and potential lawsuits, loss of tourism in declining sport fishing, loss of tourism due to loss of wetlands (unless these are restored), an increase in the decline of protected, threatened and endangered aquatic species, and increased National Security costs as shipping traffic increases to the Port of Beaumont.

Finally, we were dismayed at the effort put forth at the EIS Scoping meeting in Lake Charles on May 28, 2002. In opening remarks, the US Army Corps of Engineers stated it wished to assemble all concerns relative to this project. However, only three minutes per person was allowed which, given the complexity of the issues and the range of concerned parties, was grossly inadequate. This constraint seemed to fulfill the legal obligation of the Corps to solicit comments, but did not provide enough time for the presentation of all issues and concerns of the public in attendance. The purpose of public meetings and public comment is to learn from the public's experience and to better understand the concerns they have. It is not to learn what can be learned in three minutes. The perfunctory nature of this meeting defeated the very purpose of the meeting to a large extent and we would hope that future efforts to build the record as required by the National Environmental Policy Act and common courtesy will be better handled.

In closing, we feel that any proposed project that will contribute to the destruction of wetlands while state and federal government programs spend millions of dollars to restore those same wetlands is inconceivably wasteful and ill-planned.

Sincerely,

Mark S. Davis
Executive Director

Cc: CRCL board
Gov. M.J.Foster
Senator John Breaux
Senator Mary Landrieu
Congressman Chris John
Sec. Jack Caldwell (LDNR)
Sec. Jimmy Jenkins (LDWF)
Sec. J. Dale Givens (LDEQ)
Senator Gerald Theunissen
Senator Willie Mount
Rep. Ronnie Johns
Rep. Don Flavin

LOUISIANA

MAJORITY
CHIEF DEPUTY WHIP

COMMITTEES:

COMMERCE, SCIENCE, AND TRANSPORTATION

FINANCE

RULES AND ADMINISTRATION

SPECIAL COMMITTEE ON AGING
CHAIRMAN

WASHINGTON OFFICE:
(202) 224-4623
TDD (202) 224-1986

senator@breaux.senate.gov
http://www.senate.gov/~breaux

United States Senate
WASHINGTON, DC 20510-1803

STATE OFFICES:

2237 SOUTH ACADIAN THRUWAY, SUITE 802
BATON ROUGE, LA 70808
(225) 248-0104

U.S. FEDERAL COURTHOUSE BUILDING
800 LAFAYETTE STREET, SUITE 1300
LAFAYETTE, LA 70501
(337) 262-6871

1900 NORTH 18TH STREET, SUITE 805
MONROE, LA 71201
(318) 325-3320

HALE BOGGS FEDERAL BUILDING
501 MAGAZINE STREET, SUITE 1005
NEW ORLEANS, LA 70130
(504) 589-2531

CENTRAL LOUISIANA:
(318) 487-8445

August 13, 2002

Colonel Nicholas J. Buechler
Commander and District Engineer
U.S. Army Corps of Engineers
Galveston District
Post Office Box 1229
Galveston, TX 77553-1229

Dear Colonel Buechler:

I have been contacted by Mr. Norris East of Hackbay, Louisiana, regarding the proposed widening and/or deepening of the Sabine-Neches Waterway channel.

Please give the views and concerns of Mr. East every appropriate consideration within federal guidelines. Also, please investigate the enclosed correspondence sent to me and provide me with any information you might have which responds to the issues raised in his letter. Your reply may be forwarded to the attention of Noelie Zeringue.

Thank you for your attention and assistance.

Sincerely,

John

JOHN BREAUX
United States Senator

JB/nmz
Enclosure

CERN TO YOUR LETTER
4-17-02

DEAR SIRS 02 JUL 25 AM 9:19

I WOULD LIKE TO KNOW WHY YOU HAD TO PUT THE SALT WATER BARRIER AT LAKE CHARLES IF SALT WATER DOES NO DAMAGE TO CALCASIEU RIVER

I WOULD ASSUME THAT YOU HAVE NEVER BEEN THERE I HAVE SEEN LOT OF DAMAGE TO THE TREES GRASS BANK ERISION.

IN YOUR LETTER YOU STATED THAT A GAP AT CAMERON WOULD BE A HAZARD TO SHIPING

WELL WHAT WOULD YOU SAY ABOUT ALL THE LOCKS ON THE INTER COSTAL CANEL I SUPPOSE THAT IS NO HAZARD WELL FRIEND I HAPPEN TO BE A TUG BOAT CAPTAIN SO I KNOW FROM FIRST HAND WE DO NOT HAVE THE POWER OF THE SHIP'S TO CONTROL THE BARGES IF A SHIP CAPTAIN CANNOT PASS THRU A STRAIT CHANNEL HE BETTER GO BACK TO SCHOOL.

YOU STATED THAT WE ASSUMED THAT 400 FT CHANNEL WOULD DO NO DAMAGE

I RECENTLY TOOK A TRIP TO WA-
TON DC. I MET PRES BUSH.
I WILL WRITE HIM ABOUT THIS
SINCE TIME LIMIT WITH HIM COULD
NOT EXPLAIN ALL DETAILS.
WALK I AM ON THE SUBJECT ABOUT
THE CHANNEL I AM OPPOSED TO
PUT SPOIL IN CALCASIEU LAKE
UNTIL YOU FILL UP LAKE CHARLES
- PREIN LAKE - MOSS LAKE THE O
RIVER IN PREIN LAKE WOULD HOLD
A LOT OF SPOIL SENT THE BES
OUT THE CHANNEL TO GULF LIK
THE WATER GOES TO CONTSHELF
IT DOES NOT FILTER ALONG THE
BEACHES LIKE IT USE TO THE ST
OF LA SPENTS MILLIONS TO KEEP T
BEACHES FROM WASHING AWAY BE-
-CAUSE OF THE SHIP CHANNEL.
YOU SAY AT THE TIME FED. STUDIE
ESTIMATED SHORT TERM SALITINES
WELL CENTS THIS WAS 1968 WE ARE
NOW IN 2002. NEED I SAY MORE.

Norris East

SENDING COPY TO SAN BREAUX

Mr. Norris J. East
328 Channelview Dr.
Hackberry, LA 70645

TO THE ECOLGY WELL GENT'S
YOU HAVE ARUDE AWAKING COMING
TO YOU.
I WOULD LIKE TO KNOW WAY THE
CORP'S. IS DOING A STUDY OF WAAT
AHURRICANE WOULD DO TO NEW ORLEANS
AREA IS LARE CHARLES NOT AS
IMPORANT.
YOU CAN WORD THIS ANY WAY YOU WAN
TOO BUT YOU STILL HAVE THIS PROBLEM
WHIS IS FAR MORE SERIOUS THAN YOU
THINK
GOD FORBID IF AHURRICANE HITS
DIRECT AT CAMERON 45 YRS SINCE
LAST ONE ONLY YOU WILL HAVE TO
EXPLAIN TO LC. PEOPLE WHY
SO MUCH WATER GOT IN THEIR
HOMES THIS IS BEAD SERIOUS
BUT YOU WORRY MORE ABOUT
SHIP'S GOING THRU THAN PEOPLE
IF NO GAP HOW ABOUT A SET OF
LOCK AT CAMERON IM SURE THAT
THOUSAND'S OF SPORT FISHER MAN
WOULD GO ALONG WITH THIS
IT WOULD MAKE THIS A SPORTMAS PAR.

DEAR SEN BREAUX
A COPY OF COASTAL RESTRATION SHOULD
GIVE YOU PLENTY OF AMMO TO ARGUE
OUR CAUSE SINCE THIS WOULD BENEFIT
A FEW, WE ARE BUY THE THOUSAND'S
AGAINST THIS ESPICIALLY SALT WATER.
THANKS
Norris East

Mr. Norris J. East
328 Channelview Dr.
Hackberry, LA 70645

2405 Evergreen Lane
Pineville, LA 71360
August 23, 2003

Ms. Lizette Richardson
Galveston District
U.S. Corps of Engineers
P. O. Box 1229
Galveston, TX 77553-1229

Re: Proposed Enlargement of Sabine-Neches Navigation Channel.

Dear Ms. Richardson:

Please furnish me with documents from the public record for this project:

1. A copy of the sediment analysis

2. A copy of the draft EIS or EA for this project.

Thank you for your cooperation in this matter.

Sincerely,

Richard W. Bryan, Jr.

cc: Honorable Mary Landrieu

2405 Evergreen Lane
Pineville, LA 71360
August 28, 2002

Ms. Lizette Richardson
Galveston District, COE
P.O. Box 1229
Galveston, TX 77553-1229

Re: EA for Proposed Enlargement of Sabine-Neches Navigation Channel.

Dear Ms. Richardson:

Please address my comments in the final EA for the above proposal.

The first consideration must be the safety of the people of Beaumont, Port Arthur, Bridge City and the entire project area. The second must be the protection of the commercial and residential property in these cities and elsewhere in the project area.

We cannot afford a repeat, at public expense, of the Mississippi River Gulf Outlet Canal, which was built by the Corps of Engineers (COE) over the objections of farsighted people, who correctly warned of the eminent possibility of hurricane surge damage. Now COE has realized its mistake and is calling for the canal to be closed.

No benefit/cost ration on this project can be considered complete or legal, unless it takes into consideration the very real possibility of loss of both human life and property from this project.

The Cost of Anticipated Hurricane Damage

Can COE provide assurance no loss of life and property will occur from hurricanes or other storms because of this project?

If not, then the cost of both accident and property insurance must be considered as a project cost.

Also mandatory, is an accurate and realistic appraisal of transportation benefits, not inflated projections, which, for waterways like the Red River, Ouachita-Black and Tennessee-Tombigbee, have never materialized.

At the same time, the proposal demands, under NEPA, the very best possible projection of all potential wildlife losses (dealt with separately later in these comments). Prior to construction of the

Tenn-Tom in northeast Mississippi, the Tombigbee had 52 species of freshwater mussels, the largest and most diverse mussel population in the state, including 16 species found nowhere else in Mississippi.

Today, out of 10 federally listed species in the project area, 5 have been extirpated from the state.

At one time the Neches River was habitat for many of the numerous mussels which can still be found in the Calcasieu River basin in Louisiana. COE has a legal responsibility to the people of this country to make certain what happened on the Tombigbee doesn't occur on the Neches and other American rivers.

Benefits/Costs

To comply with the NEPA requirement to inform the public sufficiently that informed and reasonable choices can be made, the EA must convincingly demonstrate why the economic benefits to a few interests will outweigh the losses to the American public at large, in terms of safety, health, recreational opportunities, and the use and enjoyment of the resources of this area.

Here in Louisiana, we have been the recipients of the Ouachita-Black and Red River Navigation projects and numerous projects in the coastal swamps and marshes and the only tangible benefit I can see is that we are losing 50 square miles annually in one of the most productive marshes anywhere. And right here in my backyard we almost lost one of the 10 most important wetlands in North America, Catahoula Lake, courtesy of COE.

Another area of significence is, how much is enough? I've heard the original channel is 125-ft wide by 10-ft deep and now COE proposes to enlarge it to 400-ft wide by 50-ft deep. How long will it be before new technology in the shipping industry demands an even deeper, wider and more dangerous channel?

When do we reach the point where the benefits of one more deep water port fail to outweigh the benefits from consering our natural resources? And who gets to decide, the people who will foot the bill, or COE, which will benefit the most?

Since this project borders on Louisiana, I believe the Corps has a responsibility to access the cumulative impact of its projects in Louisiana ~~and the way~~ from the Pearl River all the way across the state to the Sabine.

From a legal standpoint, the need to do this is covered by Article 9, Section 1 of the Louisiana Constitution.

The project will almost certainly increase the potential for destructive surges from the Gulf, will require dredging on a regular basis and will will increase the possibility of stiring up toxic materials in Sabine Lake, etc. All of this must be discussed in the EA.

Mercury potential

Before any spoil is dredged, it must be tested for mercury and other contaminants, and plans must be formulated for handling it is a manner that won't pose health risks to humans or wildlife.

Spoil taken from 50-feet deep in the channel may not be suitable for creating wetlands or depositing in wetlands. The ability of this spoil to grow vegetation must be determined first.

A projection is needed on how often the channel will require redredging. In the event the material removed from the channel is contaminated by any of several materials, the periodic redistribution of these materials is a critical factor.

To avoid likely legal challenges, water quality testing for a 401 Water Quality Certification should be done by EPA, not some "captive" state agency.

Here in Louisiana, establishment of TMDLs has been taken out of the hands of LDEQ and this agency has been successfully sued on, what appears to be, a very similiar COE project on Little Lake and the Pearl River.

Wetlands

Any wetlands destroyed or degraded in the Sabine NWR or Texas Point NWR should be replaced adjacent to these refuges and the plans for all wetland mitigation under 404 of the Clean Water Act should be in place before the project is started. Under no circumstances should this mitigation be the pie in the sky by and by we've seen for the Red River Navigation Project, where after 30 years all the mitigation land has not been acquired.

In addition, mitigation must be included for all project induced damages, including, but not confined to:

1. The impact of wave action or salt water intrusion damage to:

   A. The western boundry of the Sabine NWR.

B. The eastern boundry of the Texas Point NWR

C. Privately owned wetlands anywhere on Sabine Lake.

D. The lighthouse(s) or other historic sites at Sabine Pass or elsewhere.

E. Damage to hwys 73, 82 and 87.

F. Sabine Island WMA.

G. Salt water intrusion into the coastal aquifer.

2. Damage to the Gulf ecosystem from dredging a channel 20-miles out from shore.

3. Damage if the channel induces the summer dead water from the Gulf to come inland.

4. Adverse impact on the terrestrial, avian and aquatic wildlife associated with the project area, including Sabine Lake, Sabine Pass, associated marshes and estuaries and the Gulf:

A. Sea turtles, crabs, shrimp, oysters, fish, sharks

B. Waterfowl, sea birds, shorebirds,

C. Neo-tropical migratory birds,

D. Raptors,

E. Whales, manatee, dolphins,

F. Plankton.

All the species in all the above categories must be studied for population numbers, and mitigation measures taken for any projected decline in their numbers as a result of the project.

5. In addition, COE has a legal responsibility under the provisions of the Endangered Species Act to consult with the U.S. Fish & Wildlife Service on the following federally listed species and include any correspondance or Memorandums of Understanding in the EA:

Sea Turtles:

Green, Hawksbill, Kemp's Ridley, Leatherback and Loggerhead.

Sabine-Neches Waterway

Whales:

Blue, Sei, Sperm and Finback.

Manatee:

West Indies Manatee

Water birds:

Brown Pelican

Shore birds:

Piping plover.

Raptors:

Bald esgle, peregrine falcon

In addition to the several federally listed species, numerous other species are listed as endangered by the state of Texas.

While I am not knowledgeable about the laws of Texas, any of species which occur on the Louisiana side of the project are protected under article 9, section one of the Louisiana constitution.

These species listed by Texas include:

Whales:

Gervais beaked, goose beaked, pigmy sperm, dwarf sperm, killer whale or orca, false-killer, short-finned pilot, pigmy killer, and black right.

Dolphin:

Atlantic spotted and rough toothed

Water birds:

Reddish egret, white-faced ibis, wood stork.

Raptors:

Swallow tailed hawk, common black hawk, northern aplomado falcon, gray hawk, zone-tailed hawk

Shorebirds

Sooty tern

River fish

Paddlefish, shovelnose sturgeon.

Please respond to my comments in the EA and provide me with a copy of this document.

Sincerely,

Richard W. Bryan, Jr.

**JOHN BREAUX**
LOUISIANA

MAJORITY
CHIEF DEPUTY WHIP

COMMITTEES:

COMMERCE, SCIENCE, AND TRANSPORTATION

FINANCE

RULES AND ADMINISTRATION

SPECIAL COMMITTEE ON AGING
CHAIRMAN

WASHINGTON OFFICE:
(202) 224-4623
TDD (202) 224-1986

senator@breaux.senate.gov
http://www.senate.gov/~breaux

**United States Senate**
WASHINGTON, DC 20510-1803

STATE OFFICES:

2237 SOUTH ACADIAN THRUWAY, SUITE 802
BATON ROUGE, LA 70808
(225) 248-0104

U.S. FEDERAL COURTHOUSE BUILDING
800 LAFAYETTE STREET, SUITE 1300
LAFAYETTE, LA 70501
(337) 262-6871

1900 NORTH 18TH STREET, SUITE 805
MONROE, LA 71201
(318) 325-3320

HALE BOGGS FEDERAL BUILDING
501 MAGAZINE STREET, SUITE 1005
NEW ORLEANS, LA 70130
(504) 589-2531

CENTRAL LOUISIANA:
(318) 487-8445

December 18, 2002

Colonel Nicholas J. Buechler
Commander and District Engineer
U.S. Army Corps of Engineers
Galveston District
Post Office Box 1229
Galveston, TX 77553-1229

Dear Colonel Buechler:

I have been contacted by Ms. Sherrill J. Sagrera of Abbeville, Louisiana, regarding the Sabine/Neches Channel.

Please give the views and concerns of Ms. Sagrera every appropriate consideration within federal guidelines. Also, please investigate the enclosed correspondence sent to me and provide me with any information you might have which responds to the issues raised in her letter. Your reply may be forwarded to the attention of Noelie Zeringue.

Thank you for your attention and assistance.

Sincerely,

JOHN BREAUX
United States Senator

JB/nmz
Enclosure

November 9, 2002

02 DEC 16 PM 6:37

U. S. Senator John Breaux
705 Jefferson St., Room 103
Lafayette, LA. 70501

Dear Senator Breaux,

The State, Federal and local Governments along with participation of the public has developed a comprehensive restoration plan (Coast 2050). All projects must be consistent with this plan.

The U. S. Army Corp of Engineers' New Orleans district has participated and signed off on the plan. All projects of navigation, shoreline protection, hydrologic restoration, river diversions and the like consider impact to their neighbors. It seems that the Corps is the Corps. Why is the Corps' Galveston district supporting the Sabine/Neches Channel, which is detrimental to the efforts that we, the New Orleans district and Coast 2050, are trying to achieve? Co-ordination between these two districts should be achieved. Some kind of consensus should be reached so we can save the coast/wetlands of Louisiana.

Funding is a critical issue. Funds that benefit one area should not be detrimental to the ongoing efforts of neighboring areas.

I don't want to stand in the way of economic progress. But economic progress should not be at the expense of the wetlands and the environment.

Respectfully,

Sherrill J. Sagrera
12139 W. LA. Hwy. 82
Abbeville, LA. 70510

## Stokes, Janelle S SWG

**From:** Tucker, James [James.Tucker2@twcable.com]
**Sent:** Wednesday, January 06, 2010 3:43 PM
**To:** Stokes, Janelle S SWG
**Cc:** Larive, Adam; Zapata, Juan
**Subject:** Sabine-Neches Waterway Channel Improvement Project

**Attachments:** GT PROJECT - SABINE-NECHES WATERWAY CHANNEL INPROVEMENT PROJECT 1999-2003 4319_001.pdf

GT PROJECT -
INE-NECHES W

Ms. Stokes attached is the approved permit showing where we have a fiber run 1

Under the channel.If any more Information is needed please let me know.

Thank You

JAMES TUCKER

TIME WARNER CABLE

DALLAS DESIGN DEPT.

(214)319-4816

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Mr. James Tucker
Time Warner Cable
Dallas Design Department
P.O. Box 650063
Dallas, TX 75265-0063

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for providing this information. |

January 10, 2010

USACE
Corps of Engineers
Galveston District
P O Box 1229
Galveston, TX 77553-1229

RE: Public Comments D.E.I.S.

Dear Ms. Stokes:

I would like to address some of my concerns with the dredge containment compartments used for dredging in the deepening and widening of waterways. My observations over the last 32 years of the containment areas on Pleasure Island have caused me to have concerns regarding the large impact on the marine life in the spoil areas. I have witnessed many fish and shrimp kills over the years and I am concerned that the original design of these compartments is not being adhered to. Below are my concerns.

TPWD Designation – TPWD has classified spoil area #10 & #11 as nursery areas for marine life. If this is indeed a nursery area how can spoil be placed in the compartments and destroy the nursery? 1

Effluent Ditches – The effluent ditches were designed to release the overflow of water from the spoil areas back out to the environment. Marine life travels though these ditches into and out of the spoil areas. The spoil placement in the dredge areas is not being monitored and the ditches are filled up with silt. In the case of spoil area #10 the ditch there is so filled with silt that the water is coming out over the road on the North effluent ditch. This has happened on the last two dredging operations. Apparently the dredging companies are not doing their jobs properly. If compartment #11 is monitored properly for silt placement, the two effluent ditches have the potential to be used for development of a marina and fishing area in the future. 2

Marine Life & Bird Sanctuary – All dredge areas contain marine that life that enter into the spoil areas due to high tides and storms. Then they become trapped and end up dying because of the climate changes. No one has ever spoken up about the impact on the marine life that is lost due to these sites. Bird life is impacted by the completion of these sites as well. Pleasure Island is a bird sanctuary and many avid bird watchers visit the Island every year. 3

Public Notice – After all construction is done and spoil area 10 and 11 is done and before any dredging starts I would ask the Corps of Engineers put into public record that all citizens can use these levee roads for fishing and bird watching. The Corps maintain the grassy areas adjacent to the roads. Over the years no one has wanted responsibility for the grass cutting. Without proper maintenance of the grassy areas access on the levee roads become impaired. 4

From 1977 through 1982 my brother and I had spoil area #11 leased for the research of aquaculture farming. With a grant from Texas A&M and Lamar University, the possibilities were very positive and the sites have great potential for the development of aquaculture. Under controlled conditions the marine life could be raised and returned to the environment. After 32 years observation we have witnessed the overall picture of the use of these dredge sites by the Corps of Engineers. 5

Respectfully,
Ronald R Moon
707 N 31st St
Nederland, TX 77627
409-721-9492 home
409-963-9872 cell

Mr. Ronald R. Moon
707 N 31st Street
Nederland, TX 77627

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The primary purpose of the two large placement areas on Pleasure Island (Placement Areas [PA] 8 and 11) is to store dredged material removed from the Sabine-Neches Waterway (SNWW). However, in 1997-1998, changes were made to PA 11 that allows it to serve as a nursery area for marine organisms while the area slowly fills with dredged material. Two drop-outlet structures in PA 11 were relocated to allow decanted water to exit into Sabine Lake during dredged material discharge operations. The relocation allows free tidal exchange and is providing a temporary increase in forage and nursery areas for sport and commercial fishery species. PA 11 will eventually be filled with sediments, slowly decreasing the size of the temporary forage and nursery areas. At that time, future management options, including effluent discharge locations, will be evaluated. No changes were made to outlet structures at PA 8 (referred to as PA 10 in the comment). |
| 2 | In the past at PA 8 (referred to as PA 10 in the comment), effluent did cover the road at times during dredging contracts. A construction contract underway at this time will rectify this situation by raising the elevation of the roadway. The roadway around PA 11 does not flood because the drop outlet structures drain the effluent, keeping it from overtopping the road. |
| 3 | The drop outlet structures are left open to facilitate marine life access, and therefore provide an escape route after high tides and storms. We must emphasize that the primary purpose of the PAs is the containment of dredged material. Wildlife utilizes the areas between placement episodes. |
| 4 | The roads are open to the public the majority of the time. Access is restricted during levee repair or construction contracts because it is not safe for the public to use the roads at those times. The U.S. Army Corps of Engineers (USACE) Port Arthur Area Office does not routinely maintain the grassy areas adjacent to the roads. The levee roads are public roadways in the City of Port Arthur. |
| 5 | Thank you for your comments. |

**Stokes, Janelle S SWG**

**From:** Raymond Johnson [raymondcomm1@hotmail.com]
**Sent:** Monday, January 25, 2010 1:38 PM
**To:** Stokes, Janelle S SWG
**Cc:** Ed Harvey; George E. Johnson Jr.; Joe Hill; montanocb@yahoo.com; S. Charles; Joann Benjamin
**Subject:** Economic Impact on Coastal Low Income Communities

Ms. Janelle Stokes

This Project will be or has been (per study) funded with Federal Dollars.
There needs to be consider and Added , what will be the Economic Affect on these Coastal Communities which are Black , Hispanic and large levels of unemployment and poverty. 1

I am Elected Official (commissioner) of Port Of Port Arthur , elected in 1987.

Raymond C. Johnson

---

Hotmail: Powerful Free email with security by Microsoft. Get it now. <http://clk.atdmt.com/GBL/go/196390710/direct/01/>

Mr. Raymond C. Johnson
Port of Port Arthur
P.O. Box 1428
Port Arthur, TX 77641

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The Final Environmental Impact Statement (FEIS) contains an evaluation of the socioeconomic effects of the proposed project on minority and low-income populations living within the study area (FEIS section 4.15.2.2 (Environmental Justice). No adverse impacts to these communities are anticipated. |

US Army Corps of Engineers
Galveston District

# COMMENT FORM

**Sabine - Neches Waterway Channel Improvement Project**
**January 26, 2010**
**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**

__ **I am a Public Official**

**Name and Mailing Address (Optional):**

**Name** C. Michael Foster

**Address** 2210 Eastex Fwy. Beaumont TX 77703

**Email Address**

**Phone** (409) 899 8444

**PLEASE CHECK THE APPROPRIATE ITEMS BELOW:**
**I am primarily interested in the project from the standpoint of a:**

__ **Residential property owner or renter** __ **Business property owner or lessee**
X **Other (Please explain)** Sabine Lake Foundation

**How did you learn about this meeting?**

__ Newspaper X Notice in the Mail __ Email

__ Other (Please explain)

**COMMENTS:** ~~I'm quite certain that this comment is really not going to take any difference~~ but placing maintenance dredge spoil on the "beaches" just on the other side of the jetties in both Texas and Lousisana is simply a matter of convenience. If there is a true concern about the erosion that is taking place, then place something substantial such as Chenier LNG did. All of the shell from their spoil is still in place - even after Ike. Jerry Mambretti, TP&W, Dr. Harrel and Dr. Whittle all agree that placing spoil with only 25% sand (according to you) does more damage than good. 1

It is my recommendation that it would be wiser to place this spoil farther off the beach and put something substantial along the shore. I'm obviously aware of the serious costs associated with all of this - but we learned from the last time this was done that the muck simply carries downshore and ruins SeaRim and McFaddin beaches. 2

**Please make additional comments on the back.**

These comment forms can be turned in tonight, mailed or emailed to the addressee below postmarked by February 10, 2010 to:

**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**
**Janelle.S.Stokes@usace.army.mil**

Mr. C. Michael Foster
Sabine Lake Foundation
2210 Eastex Freeway
Beaumont, TX 77703

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | FEIS section 2.5.3.2.2 (Gulf Shore Beneficial Use [BU] Feature) contains an in-depth evaluation of the anticipated effects of regular shoreline nourishment at Texas and Louisiana points using maintenance material from Sabine Pass. The proposed beneficial use was evaluated and approved by the Interagency Coordination Team (ICT). It is acknowledged that most of the material will be composed of fine-grained sediments, and that some of the material will be rapidly lost from the vicinity of the shoreline. The mobile material within the surf zone should generally migrate to the west at both Texas and Louisiana points. There, the additional fine-grained sediments could lower erosion rates through mudflat accretion and wave attenuation. |
| 2 | USACE assumes that "something more substantial" refers to dense clays that originate from channel or mooring basin deepening. The use of heavier clays from the deepening of the Sabine Pass Channel was evaluated and determined to be more costly than upland placement (FEIS section 5.4.1.2). A cost-share sponsor would be needed to adopt and implement this as a beneficial use measure, and no non-federal sponsor has been identified at this time. Use of heavier clays from the deepening was also evaluated as a potential mitigation measure (FEIS Section 5.4.2), but was not adopted because of high incremental costs. |

US Army Corps of Engineers
Galveston District

# COMMENT FORM

**Sabine - Neches Waterway Channel Improvement Project**
**January 26, 2010**
**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**

__ **I am a Public Official**

**Name and Mailing Address (Optional):**

**Name** Julia Zolandz
**Address** 1048 Oregon Ave APD Beaumont, TX 77705
**Email Address** jzolandz@gmail.com
**Phone**

**PLEASE CHECK THE APPROPRIATE ITEMS BELOW:**
**I am primarily interested in the project from the standpoint of a:**

X **Residential property owner or renter** __ **Business property owner or lessee**
__ **Other (Please explain)**

**How did you learn about this meeting?**

__ Newspaper __ Notice in the Mail __ Email
__ Other (Please explain) Professor

**COMMENTS:** The environmental research on impact of the project was conducted by the U.S. Army Corps of Engineers. This concludes me to believe the research false and biased. A nonaffiliated research team should be implemented. The cost of over 1 billion will be pushed onto the tax-payers while the oil companies will benefit primarily. Overall, I do not believe this project should be implemented due to the biased study on environmental impact. 1 2

**Please make additional comments on the back.**

These comment forms can be turned in tonight, mailed or emailed to the addressee below postmarked by February 10, 2010 to:

**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**
**Janelle.S.Stokes@usace.army.mil**

Ms. Julia Zolandz
1048 Oregon Avenue, Apt. D
Beaumont, TX 77705

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Extensive studies were conducted by USACE in compliance with Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations and in coordination with the ICT. These studies utilized the best available scientific information and reached objective, scientifically-based conclusions. The FEIS was also reviewed by a team of independent external peer reviewers, and revisions to the analyses were made based on their recommendations. |
| 2 | Direct and indirect economic benefits of the proposed deepening will accrue to all users of the SNWW, and to the regional and national economy. The economic analysis presented in Feasibility Report (FR) Section V.F establishes that there would be a net economic benefit to the nation from the proposed project. |

US Army Corps of Engineers
Galveston District

# COMMENT FORM

**Sabine - Neches Waterway Channel Improvement Project**
**January 26, 2010**
**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**

__ **I am a Public Official**

**Name and Mailing Address (Optional):**

**Name** Hubert Oxford III
**Address** 480 Calder
**Email Address** Hubert.oxford@Beaumontcity.com
**Phone** 409 833 9082

**PLEASE CHECK THE APPROPRIATE ITEMS BELOW:**
**I am primarily interested in the project from the standpoint of a:**

✓ **Residential property owner or renter** ✓ **Business property owner or lessee**
__ **Other (Please explain)**
**How did you learn about this meeting?**
✓ Newspaper __ Notice in the Mail ✓ Email
__ Other (Please explain) Navigation District Meeting

**COMMENTS:**
This is a Good Project – we need to have this project

1

**Please make additional comments on the back.**

These comment forms can be turned in tonight, mailed or emailed to the addressee below postmarked by February 10, 2010 to:

**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**
**Janelle.S.Stokes@usace.army.mil**

Mr. Herbert Oxford
4810 Calder Avenue
Beaumont, TX 77706

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for your comment. |

CHENIERE

Cheniere Energy, Inc.
700 Milam Street, Suite 800
Houston, Texas 77002
phone: 713.375.5000
fax: 713.375.6000

**Cheniere and its Sabine Pass LNG Terminal strongly supports the proposed deepening and widening project of the Sabine-Neches Waterway. We wish to see our waterway remain highly competitive with other ports and waterways by being able to ~~safely~~ accommodate the larger ships that now carry so much of the world's trade.** with a higher degree of safety.

**Of course, for our part, we are most interested in promoting the capability of the Sabine-Neches waterway to safely handle the world's largest existing LNG carriers. These ships are nearly 1,150 feet in length and 180 feet in breadth. These very large LNG carriers, like other large ships trading to our area, are presently limited to a forty feet fresh water draft when entering the Sabine-Neches. Many such vessels would come in deeper if the Waterway's channels were deeper and wider.** 1

**Any deepening or widening will make our waterway more competitive for business that uses the larger ships and automatically adds additional safety margins for the existing shipping already present. Cheniere supports this project and the U.S. Army Corps of Engineers and hopes the deepening and widening work will proceed without delay.** 2

**James E. Kaucher, P.E.**
**Plant Manager, Sabine Pass LNG Project**
**Cheniere Energy, Inc.**
**337-569-7701 (Offc)**
**281-705-4924 (Cell)**
***james.kaucher@cheniere.com***

Mr. James E. Kaucher, P.E.
Plant Manager, Sabine Pass LNG Project
Cheniere Energy, Inc.
700 Milam Street, Suite 800
Houston, TX 77002

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Transportation savings benefits of the proposed deepening are presented in FR Table V-52. The economic analysis includes deepening benefits associated with loading the Liquefied Natural Gas (LNG) vessels to 43 feet (ft). Benefits to LNG vessels with design drafts of 45 ft are possible. |
| 2 | Thank you for your comment. |

TEXAS ENERGY COALITION

6207 Inwood Drive
Houston, TX 77057
713-622-7388 (ph)

**Texas Energy Coalition – Comments Regarding**
**Proposed Sabine Neches Waterway Channel Improvement Project**

**USACE Public Meeting – January 26 and 27, 2010**

Good evening. My name is David Corban. I am a lawyer with Fulbright & Jaworski L.L.P, and I am authorized to make the following comments on behalf of Shell Pipeline, Explorer Pipeline, Enterprise Products, Kinder Morgan, and the other members of the Texas Energy Coalition. The Texas Energy Coalition was founded in 1995, and its membership is made up of pipeline transmission companies that work together on issues of common interest.

Prior to the release of the Sabine Neches Waterway draft feasibility report (DFR) on December 24, 2009, there was no prior communication by the sponsors of the proposed project with the pipeline industry regarding pipeline relocation issues. This was the case despite repeated requests to the Corps of Engineers for information about the proposed project's potential impact on the pipeline industry. 1

The DFR that was made available for the first time in late December describes a large number of pipeline relocations that the project will require. The replacement of pipelines that transport essential commodities such as natural gas is not only costly, it also requires years of advance planning and coordination, and it creates operational and engineering burdens for an industry that has strategic significance for the American economy. Yet the DFR provides little detail about the project's impact on pipeline operations, which pipelines will need to be relocated, where those pipelines are located, or how costs were estimated for pipeline relocations. 2

Given these circumstances, we believe it is unrealistic to expect that our members could provide any meaningful comments on the DFR by February 10, 2010. We believe that a more realistic comment period would allow at least 120 days, and we therefore respectfully request that the comment period be extended to at least April 26, 2010. In making this request, we assume that the Corps will promptly and definitively identify the pipelines that will need to be moved, the owner of each such pipeline, and sufficient information to understand and respond to the Corps' estimate of the costs for moving each such pipeline. 3

Based upon the DFR, we do understand the Corps of Engineers to have acknowledged that this project, as proposed, would be a deep-draft project for cost sharing purposes, and further, as required by the deep-draft cost-sharing provision of the Water Resources and Development Act of 1986, that the Corps will recommend that half of the pipeline relocation costs for this deep-draft project be borne by the pipeline owner and the other half by the local sponsor of the project. 4

Thank you for the opportunity to comment on the proposed project.

Mr. David Corban
Fulbright & Jaworski, LLP-Texas Energy Coalition
6207 Inwood Drive
Houston, TX 77057

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Owners of pipelines crossing the SNWW were contacted by U.S. Army Corps of Engineers (USACE) in 2002. USACE requested that they provide the most current "as-built" drawings and the location of SNWW crossings to enable our assessment of potential project impacts. The project's non-Federal sponsor has made numerous presentations to industry trade groups and community organizations throughout the study period, providing updates of the study and project descriptions. |
| 2 | The DFR provides sufficient information for feasibility-level planning. A list of potentially affected pipelines was provided to pipeline companies during the Draft EIS (DEIS) public comment period. The USACE list of potentially affected pipelines should not be considered definitive. This list will be refined based on information submitted to USACE during the public comment period and subsequent to the USACE/Pipeline Owner information meeting on January 25, 2011. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the preconstruction, engineering, and design (PED) and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. There will be sufficient time for pipeline companies to make necessary preparations after the project is approved. |
| 3 | The comment period was extended an additional 30 days to March 12, 2010. |
| 4 | Please see Section 2.4.1.12 of this Final EIS for a discussion of the allocation of pipeline relocation costs. |

# COMMENT FORM

US Army Corps of Engineers, Galveston District

**Sabine - Neches Waterway Channel Improvement Project**
**January 27, 2010**
**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**

__ I am a Public Official

**Name and Mailing Address (Optional):**

**Name** Robert Olson
**Address** 3535 Golden Bayou
**Email Address** Robertolson@Bandolon.com
**Phone** 409 839 1152

**PLEASE CHECK THE APPROPRIATE ITEMS BELOW**
**I am primarily interested in the project from the standpoint of a:**

__ Residential property owner or renter ✓ Business property owner or lessee
__ Other (Please explain)

**How did you learn about this meeting?**

__ Newspaper __ Notice in the Mail __ Email
✓ Other (Please explain) Navigation Meeting

**COMMENTS:** This is a Great Project for Southeast Texas and Southwest Louisiana (Cameron Parish)

We need this Project

**Please make additional comments on the back.**

These comment forms can be turned in tonight, mailed or emailed to the addressee below postmarked by February 10, 2010 to:

**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**
**Janelle.S.Stokes@usace.army.mil**

Mr. Hubert Oxford
3535 Calder Avenue
Beaumont, TX 77706

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for your comments. |

CHENIERE

Cheniere and its Sabine Pass LNG Terminal strongly support the proposed deepening and widening project of the Sabine-Neches Waterway. We wish to see our waterway remain highly competitive with other ports and waterways by being able to accommodate the larger ships that now carry so much of the world's trade, with a higher degree of safety.

Of course, for our part, we are most interested in promoting the capability of the Sabine-Neches waterway to safely handle the world's largest existing LNG carriers. These ships are nearly 1,150 feet in length and 180 feet in breadth. These very large LNG carriers, like other large ships trading to our area, are presently limited to a forty foot fresh water draft when entering the Sabine-Neches. Many such vessels would come in deeper if the Waterway's channels were deeper and wider. 1

Any deepening or widening will make our waterway more competitive for business that uses the larger ships and automatically adds additional safety margins for the existing shipping already present. Cheniere supports this project and the U.S. Army Corps of Engineers and hopes the deepening and widening work will proceed without delay. 2

James E. Kaucher, P.E.
Plant Manager, Sabine Pass LNG Terminal
Cheniere Energy, Inc.
337-569-7701 (Office)
281-705-4924 (Cell)

Mr. James E. Kaucher, P.E.
Plant Manager, Sabine Pass LNG Project
Cheniere Energy, Inc.
700 Milam Street, Suite 800
Houston, TX 77002

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Transportation savings benefits of the proposed deepening are presented in FR Table V-52. The economic analysis includes deepening benefits associated with loading the LNG vessels to 43 ft. Benefits to LNG vessels with design drafts of 45 ft are possible. |
| 2 | Thank you for your comment. |

## Stokes, Janelle S SWG

**From:** Jerry Norris [sabinecaptain@sabinelakefishing.com]
**Sent:** Thursday, January 28, 2010 11:47 AM
**To:** Stokes, Janelle S SWG
**Subject:** Sabine waterway dredge material placement

**Importance:** High

Ms. Stokes, I have reviewed the proposed project. I have comments on the placement of spoil near the Sabine Jetties. The rate of land loss on the Texas side of the Jetty along the beach front is documented at a loss that should be addressed with all of the spoil from the project near the beach front on the west side of the jetty. The Louisiana side of the jetty has minimal loss. This should be addressed on not a half and half basis as suggested by the current plan. The Texas side of the jetty is losing 95% more land per year than the Louisiana side. I was a party to the placement of the spoil during the process with Cheniere. 1

As noted in the findings a large majority of the spoil was washed through the cut on the east side of the jetty and lost due to the sediment type and currents. placing spoil on the Louisiana side of the jetty is not sound science and not in the best interest of addressing erosion along the Texas Point. Please reconsider and place all of the spoil on the Texas side each and every time the channel is dredged in that area. I am available for any questions or help that I can give on this matter. 2

Thank you Capt. Jerry Norris

Captain Jerry Norris
Sabine Lake Guide Service
3262 Bell Street
Port Arthur, TX 77640

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The dredged material that would be used for the Gulf Shore BU Feature originates from the Sabine Pass Channel. The state boundary between Texas and Louisiana follows this channel. Since the material comes from both states, the BU feature is designed to benefit both states and comply with Coastal Zone Management Act regulations promulgated by each state. |
| 2 | FEIS section 2.5.3.2.2 (Gulf Shore BU Feature) contains an in-depth evaluation of the anticipated effects of regular shoreline nourishment at Texas and Louisiana points using maintenance material from Sabine Pass. The proposed beneficial use was evaluated and approved by the ICT. All of the material cannot be used in Texas for reasons presented in the USACE response to Comment 1. |

**Stokes, Janelle S SWG**

**From:** Kim Prchal [nola4ne@hotmail.com]
**Sent:** Friday, January 29, 2010 11:04 AM
**To:** Stokes, Janelle S SWG
**Subject:** Sabine-Neches Waterway Project

Ms. Stokes, I have been reading the available on-line materials related to this project and I was wondering if the COE has a listing or map that identifies the locations and owners of the 42 pipelines that may have to relocated. I saw several references to the relocation issue but no where did I see those pipelines identified. Thank you for your assistance. 1

Kim Prchal

Kim

---

Hotmail: Trusted email with Microsoft's powerful SPAM protection. Sign up now.
<http://clk.atdmt.com/GBL/go/196390706/direct/01/>

Ms. Kim Prchal
Address unknown

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | A table of potentially affected pipelines which cross the SNWW was provided as requested. |

**Air Products and Chemicals, Inc.**
7201 Hamilton Boulevard
Allentown, PA 18195-1501
Telephone (610) 481-4911

Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229
(409) 766-3039

5 February 2010

Attn: Janelle Stokes

Ref.: Sabine-Neches Waterway Channel Improvement Project (SNWW CIP)

Dear Ms. Stokes:

This letter is in response to the invitation for written comments in the U.S. Army Corps of Engineers cover letters of 16 December 2009 and 18 December 2009. The cover letters accompanied a CD which contained several documents relating to the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). Air Products owns and operates and 10 inch diameter hydrogen pipeline that crosses the Neches River Channel (near 292+00). Based on the information contained in the provided documents, Air Products has the following comments:

1) In the Draft Feasibility Report for Sabine-Neches Waterway Channel Improvement Project Southeast Texas and Southwest Louisiana Volume I, Section VI: Description of Tentatively Recommended Plan, Deep-draft Utility Relocations and Removals, it is noted that the proposed channel improvements would require the relocation of 42 deep-draft utilities. **Air Products requests the list of the 42 deep-draft utilities designated for relocation.** 1

2) In the Draft Feasibility Report for Sabine-Neches Waterway Channel Improvement Project Southeast Texas and Southwest Louisiana Volume I, Appendix 1(Engineering Plats), cross sections of the Neches River at several stations are depicted on Drawing No. C-15. **Air Products requests a cross section for the location where the Air Products 10" diameter hydrogen pipeline crosses the Neches River (near 292+00). Additionally, Air Products requests the GPS coordinates of both the existing Neches River centerline and the proposed Neches River centerline at that location (near 292+00).** 2

3) In the Draft Environmental Impact Statement for Sabine-Neches Waterway Channel Improvement Project Southeast Texas and Southwest Louisiana, Volume IV, Appendix E: Clean Water Act section 404(b)(1) Evaluation, Section e: Description of the Proposed Discharge, Item (4): Time and Duration of Discharge, it is noted that contracts 6-12 would be constructed with hydraulic pipeline dredges. **Air Products requests further description of the hydraulic pipeline dredge process.** 3

Your feedback is greatly appreciated. The requested information will allow Air Products to gain a more complete understanding of the proposed Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). If you have any questions regarding these comments, please feel free to contact me via any of the provided means.

Thank you,

Daniel Stahl

Daniel Stahl
**Air Products and Chemicals, Inc.**
Project Engineering / Pipeline Maintenance
Phone: (610) 481-1707
Fax: (610) 706-6177
Email: stahld@airproducts.com

Mr. Daniel Stahl
Air Products and Chemicals, Inc.
Project Engineering / Pipeline Maintenance
Allentown, PA 18195-1501

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | A list of potentially affected pipelines was provided to the Texas Energy Coalition and individual pipeline companies during the DEIS public comment period. |
| 2 | FR, Appendix I (Drawing # C-15) shows cross sections on the Neches River Channel in the vicinity of the Air Products pipeline. More detailed information on channel design will be developed and provided to all pipeline and utility companies during the PED phase. |
| 3 | USACE met with pipeline owners at an information meeting on January 25, 2011. More information on the hydraulic pipeline dredging process was provided at that time, and additional information will be provided during the PED phase. This is the same process that is used currently to maintain the existing SNWW channels. |

TARGA

Targa Midstream Services Limited Partnership
1000 Louisiana, Suite 4300
Houston, Texas 77002
713.584.1000

February 5, 2010

Ms. Janelle Stokes
Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77563-1229
e-mail: janelle.s.stokes@usace.army.mil

Re: Sabine-Neches Waterway Project and Study

Dear Ms. Stokes:

On behalf of Targa Midstream Services Limited Partnership ("Targa"), formerly known as Dynegy Midstream Services Limited Partnership, I respectfully request an extension of the comment period currently to end on February 10, 2010, as set forth in the draft Feasibility Report (DFR) and the draft Environmental Impact Statement (DEIS) for the Sabine-Neches Waterway Improvement Project ("Project") that was received by Targa at the end of last year. Targa is requesting a minimum of sixty (60) days from that date to no earlier than April 10, 2010, to respond with our comments. 1

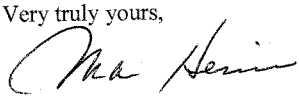
Prior to the release of the DFR, Targa was not provided any communication by the sponsor of the proposed Project regarding potential pipeline relocation issues. The DFR that was made available in December describes a large number of pipelines whose relocation or abandonment will be mandated by the Project. At least two of those pipelines are now owned by Targa. The limited time available since the release of the DFR has not provided Targa a sufficient opportunity for a complete analysis of the impact this significant undertaking will have on Targa. 2

It can certainly be said that the relocation of pipelines that transport essential energy commodities through Texas and Louisiana will not only be prohibitively expensive, it will also require years of advanced planning and coordination. Clearly, the relocation of pipelines creates operational and engineering burdens for an industry that is facing greater regulation and competition. The DFR and DEIS provide little discussion of the actual costs to a pipeline owner such as Targa, the impact of pipeline relocation will have on other pipelines that interconnect with Targa, the number of producers whose wells will be affected should a shut-in occur, the impact on the nation as a whole as a result of the disruption to the natural gas and petrochemical industry, or the potential unintended environmental consequences this Project could have on the coastal wetlands. 3

Therefore, Targa is respectfully requesting the comment period due date be no earlier than April 10, 2010.

We appreciate your consideration of this request.

Very truly yours,



Michael A. Heim
Executive Vice President and
Chief Operating Officer

Mr. Michael A. Heim
Executive Vice President and Chief Operating Officer
Targa Midstream Services Limited Partnership
1000 Louisiana, Suite 4300
Houston, TX 77002

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The public comment period was extended an additional 30 days to March 12, 2010. |
| 2 | Owners of pipelines crossing the SNWW were contacted by USACE in 2002. USACE requested that they provide the most current "as-built" drawings and the location of SNWW crossings to enable an assessment of potential project impacts. The project's non-Federal sponsor has made numerous presentations to industry trade groups and community organizations throughout the study period, providing updates of the study and project descriptions. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. There will be sufficient time for pipeline companies to make necessary preparations after the project is approved. |
| 3 | FEIS Section 1.4.3 presents industry concerns about the costs of moving pipelines to accommodate a deeper channel. FEIS Section 2.4.1.12 presents a discussion of the allocation of pipeline relocation costs. Potential environmental impacts of pipeline relocation are assumed to be minimal. However, each pipeline relocation is case specific, and coordination with USACE-Galveston Regulatory Branch would be required in each case. However, relocations to place a pipeline deeper would not necessarily require a new permit. If a pipeline is being moved to a new location, then the impacts would be evaluated by the environmental assessment performed in conjunction with the Department of Army permit. |

RONALD L. WALKER
County Judge

Jefferson County Courthouse
P.O. Box 4025
Beaumont, TX 77704

Beaumont (409) 835-8466
Pt. Arthur (409) 727-2191 Ext. 8466
Facsimile (409) 839-2311

February 8, 2020

USACE – Galveston District
Attn: Ms. Janelle Stokes
P.O. Box 1229
Galveston, TX 77553-1229

In Re: Sabine – Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

Please find our attached Comment Form relating to the Sabine – Neches Waterway Channel Improvement Project and a copy of the Resolution passed by the Jefferson County Commissioners' Court supporting same.

I would ask that you also extend our thanks and appreciation to Col. Weston and all of your staff for your efforts in formulating the project plans and then presenting same. I cannot overstate the importance of this proposed improvement project and our desire to see it proceed at the earliest date. With kindest regards, I remain, 1

Sincerely yours,

Ronald L. Walker, County Judge

Mr. Ronald L. Walker
County Judge
Jefferson County Courthouse
P.O. Box 4025
Beaumont, TX 77704

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for your comment. |

US Army Corps of Engineers®
Galveston District

# COMMENT FORM

**Sabine - Neches Waterway Channel Improvement Project**
**January 26, 2010**
**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**

✓ **I am a Public Official**

**Name and Mailing Address (Optional):**

**Name** FRED JACKSON
**Address** 1149 PEARL, 4TH FLOOR, BEAUMONT, TX 77701
**Email Address** fjackson@co.jefferson.tx.us
**Phone** (409) 835-8507

**PLEASE CHECK THE APPROPRIATE ITEMS BELOW:**
**I am primarily interested in the project from the standpoint of a:**

__ Residential property owner or renter __ Business property owner or lessee
__ Other (Please explain)
**How did you learn about this meeting?**
__ Newspaper ✓ Notice in the Mail ✓ Email
__ Other (Please explain)

**COMMENTS:** ENCLOSED PLEASE FIND ATTACHED RESOLUTION OF THE JEFFERSON COUNTY COMMISSIONERS' COURT AND COVER LETTER OF JUDGE RONALD L. WALKER SUPPORTING THIS PROJECT 1

**Please make additional comments on the back.**

These comment forms can be turned in tonight, mailed or emailed to the addressee below postmarked by February 10, 2010 to:

**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**
**Janelle.S.Stokes@usace.army.mil**

# Resolution

| | | |
|---|---|---|
| STATE OF TEXAS | § | COMMISSIONERS' COURT |
| | § | |
| COUNTY OF JEFFERSON | § | OF JEFFERSON COUNTY, TEXAS |

BE IT REMEMBERED at a meeting of Commissioners' Court of Jefferson County, Texas, held on the 8th day of February, 2010, on motion made by Everette D. Alfred, Commissioner of Precinct No. 4, and seconded by Mark L. Domingue, Commissioner of Precinct No. 2, the following Resolution was adopted:

## Resolution Concerning the Sabine-Neches Waterway Channel Project

**WHEREAS,** the U.S. Army Corps of Engineers (USACE), in concert with Sabine-Neches Navigation District has proposed a project to widen and deepen the Sabine-Neches Waterway; and

**WHEREAS,** the USACE has prepared a study analyzing the feasibility and environmental impacts of proposed modifications to the portions of the Sabine-Neches Waterway that serves the ports of Beaumont and Port Arthur, Texas; and

**WHEREAS,** the USACE study clearly demonstrates the necessity for these improvements to provide a safe waterway that will accommodate the current needs of our ports and industry; and

**WHEREAS,** the proposed improvements reasonably accommodate environmental concerns; and

**WHEREAS,** the proposed improvements are clearly cost effective and will provide a positive economic benefit and enable our ports to facilitate the handling of vital military cargo; and

**NOW THEREFORE,** be it resolved that the Commissioners' Court of Jefferson County, Texas Urges all elected officials and citizens to support this project and the adoption of the plan for these improvements as proposed.

SIGNED this 8th day of February, 2010.

JUDGE RONALD WALKER
County Judge

COMMISSIONER EDDIE ARNOLD
Precinct No. 1

COMMISSIONER MICHAEL S. SINEGAL
Precinct No. 3

COMMISSIONER MARK L. DOMINGUE
Precinct No. 2

COMMISSIONER EVERETTE D. ALFRED
Precinct No. 4

Mr. Fred Jackson
Jefferson County Courthouse
1149 Pearl Street, 4th Floor
Beaumont, TX 77701

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for your comment. |

Doré energy
CORPORATION
4823 Ihles Road • Lake Charles, LA. 70605

February 8, 2010

USACE – Galveston District
ATTN: Ms. Janelle Stokes
P. O. Box 1229
Galveston, TX 77553

Janelle.S.Stokes@usace.army.mil

RE: Draft Environmental Impact Statement for Sabine-Neches Waterway (SNWW) Channel Improvement Project Southeast Texas and Southwest Louisiana

Dear Ms. Stokes:

Doré Energy Corporation (DEC) strongly objects to the proposed improvements associated with the SNWW. DEC owns a large wetland tract in Cameron Parish, Louisiana, known locally as Cameron Meadows. The 18,611-acre tract is located north of Johnson's Bayou, south of, and adjacent to, the Sabine National Wildlife Refuge, and is within the SNWW Project and Study Area (study area). As a stakeholder, we respectfully submit the following comments and questions regarding the DEIS: 1

The project is economically driven by, and for, the State of Texas. It is understandable that Texas is willing to accept the projected detrimental environmental impacts as a tradeoff for the socioeconomic benefits that the improved ship channel is supposed to provide. Does the same hold true for the State of Louisiana? Would the DEIS authors identify, describe, and project all of the economic benefits, in terms of dollars, that the project would provide for Louisiana? 2

The DEIS states that the larger channel would cause greater tidal circulation and exchange, a minimal increase of water surface elevation, and marginally less fresh water retention. Increases in the tidal regime would have a very negative impact on the Cameron Meadows tract. The DEIS reports that 182,000 acres of intertidal marsh within the Louisiana portion of the study area would be indirectly, but adversely affected by "small increases in salinity levels". Projected impacts in Louisiana include a net loss of 1,499 Average Annual Habitat Units. Herein lies a major concern, these projections are based on salinity levels that are derived from modeling results, deemed likely by the DEIS preparers, and do not 3 4

represent high-end values. What if the modeling effort is too low in its estimates of increases in salinity levels resulting from the SNWW channel improvements? What would the losses to intertidal marsh in Louisiana, including losses on the Cameron Meadows tract, be as the result of the modeling values exceeding those projected in the DEIS?

Specifically, the DEIS acknowledges that the amount of upstream salinity transport may at times be underestimated by modeling results. The DEIS also acknowledges two uncertainties of salinity variations with ecological Wetland Value Assessment modeling: (1) model quality and (2) performance and model predictions. With this understanding and apparent acceptance of the possible factor of error, the DEIS suggests that the net change in salinity in Louisiana in the future with the project to be within the range of a low of 0.0 to a high of 1.8 parts per thousand (ppt). The Gammill et al. report, entitled *Hydrologic Investigation of the Louisiana Chenier Plain* (2002), cites modeling, identified channel improvement to 50-ft, would result in a 2 to 3 ppt increase in salinities in the Calcasieu-Sabine Basin. This difference in modeling results may seem small to the casual observer, but it is rather significant. While *Hydrologic Investigation of the Louisiana Chenier Plain* is cited elsewhere, this conflicting salinity data is conspicuously absent in the DEIS. Do the DEIS authors believe there is something wrong with this data? Why was it left out of the DEIS? Does not the combination of acknowledged modeling error and conflicting salinity modeling results indicate adverse indirect impacts, resulting from increased salinity levels, could/would affect more than the stated 182,000 acres of intertidal marsh identified in Louisiana's portion of the project area? Moreover, as marsh is lost, it is replaced with more tidal water which continues to exacerbate the conversion of marsh to water. Did the DEIS authors identify and evaluate this process and consider the likelihood that it would occur as the result of the SNWW improvements? 5

The best buy mitigation alternative is troublesome. A number of structures were identified in the DEIS, some of which would help protect Cameron Meadows from high saline waters, but were summarily dismissed as not being cost effective when compared to the need to provide marine organism access. Should not the long-term preservation of existing emergent marsh be more important than creating conditions (e.g., increasing cross-section of SNWW) that will increase the frequency, duration, and adverse effects of spikes of high saline water in sensitive wetland areas for the sake of maintaining study area marine organism access? 6

Louisianans have long recognized the importance of the state's coastal wetlands and have long supported the state's coastal restoration efforts. The State of Louisiana and United States of America have spent hundreds of millions of dollars on coastal restoration in the

past quarter of a century from funding through Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) and other programs. In fact, a CWPPRA project, located on the Cameron Meadows tract, was nominated last month for 2011 CWPPRA funding. Is not the proposed SNWW project in direct conflict with federal and state restoration efforts in Louisiana? How can the SNWW be justified with its significant and bantered projection of unmitigated marsh impacts? 7

In summary, the DEIS fails to provide: (1) the project's economic value to the State of Louisiana; (2) resolution to conflicting modeling results and how much marsh could/would be lost or adversely affected by the project due to higher salinity levels than projected; (3) full mitigation plan or compensation for projected losses of intertidal marsh in most of the Louisiana portion of the study area including Cameron Meadows; and (4) resolution to the conflict between navigation needs in Texas, the project's acknowledged detrimental impacts to Louisiana marshes, and ongoing publicly supported and funded coastal restoration efforts in Louisiana. 8 9

DEC is not against economic prosperity in and for the State of Texas. We just do not want to lose our land in the process.

Thank you for the opportunity to make these comments.

Sincerely yours,

William Doré
President

cc: Council on Environmental Quality
Louisiana Governor Bobby Jindal
U. S. Senator Mary Landrieu
U. S. Senator David Vitter
U. S. Congressman Charles Boustany
Cameron Parish Police Jury

Mr. William Doré
President
Doré Energy Corp.
4823 Ihles Road
Lake Charles, LA 70605

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for your comment. |
| 2 | The proposed SNWW CIP is a Federal Civil Works project, and as such, it would provide benefits to the Nation, not just one state. The economic analysis presented in FR section V.F establishes that there would be a net economic benefit to the United States from the proposed project. Direct and indirect economic benefits of the proposed deepening will accrue to all users of the SNWW, including the energy industries, and to the regional economy. |
| 3 | It appears that Cameron Meadows is located within LA-9, the East Johnsons Bayou hydro-unit. FEIS Chapter 4 fully evaluates potential impacts from the SNWW CIP to this unit. As noted in FEIS Section 4.6.2, the proposed project would result in a minimal increase in water surface elevation (averaging less than an inch), a slight increase the amount of tidal exchange, and a slight increase in the conveyance of inflows to the Gulf. All of these effects are minimal. |
| 4 | FEIS, Appendix C, Section 9.4 presents a sensitivity analysis of potential salinity impacts at the 95 percent confidence limit. Without the project, the hydrodynamic salinity (HS) and Wetland Value Assessment (WVA) models estimate that 4.0 percent of the marsh in the East Johnsons hydro-unit will be lost over 50 years. Potential land loss impacts from the proposed SNWW CIP range from 0 to 0.4 percent more than without the project. Proposed mitigation replaces estimated land loss with more than four times the amount of marsh projected to be lost, providing more than adequate mitigation for the full range of possible impacts. |
| 5 | USACE evaluated the modeling reported by Gammil et al. (2002) and decided not to use this model because of specific technical issues and non-coverage of the Texas portion of the study area. Hydrodynamic-salinity effects of channel deepening were modeled using the TABS-MDS code of ERDC-WES to compute hydrodynamics and salinity transport. This model has been used extensively over the last two decades in a variety of field investigations with excellent results. It has also has been certified for use by the USACE model certification program. The technical adequacy of the application of this model to the proposed project has been sustained by Agency Technical Review (ATR) and Independent External Peer Review (IEPR). The potential effect of higher salinity on land loss was evaluated by using the HS and WVA ecological model to estimate land loss due to the project. |
| 6 | USACE and the ICT made extensive efforts to identify effective mitigation measures that could minimize or eliminate the projected increase in salinity. The results of this effort are presented in FEIS Section 5.4.1.1. HS modeling and the WVA model were utilized to evaluate the effectiveness of salinity control structures. As described in FEIS Section 3.1.3, the WVA model was developed by a working group of state and federal agencies in Louisiana, and it is used extensively in Louisiana to prioritize Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). A projects for authorization. The value of marsh and open water habitats are both considered in this community model. |
| 7 | The relationship of the proposed SNWW CIP project to Louisiana coastal restoration and protection programs are described in FEIS Sections 7.26 through 7.30. The proposed project does not conflict with any of these plans. Impacts of the proposed project would be fully compensated by the Louisiana marsh mitigation measures. |
| 8 | Please refer to responses 1-7 above. |
| 9 | Thank you for your comment. |

**Stokes, Janelle S SWG**

**From:** LEAten@aol.com
**Sent:** Tuesday, February 09, 2010 10:43 AM
**To:** Stokes, Janelle S SWG
**Subject:** Note to Jan Stokes regarding the draft Sabine-Neches Waterway EIS:

Jan:

While many parts of my 1983 book (Indians of the Upper Texas Coast) are still relevant, the section on the Sabine Lake Area used in the draft EIS is quite out of date. And while the 2002 Aten and Bollich study (Late Holocene archeology of the Taylor Bayou Drainage Basin) is mentioned, none of its conclusions and recommendations have found their way into the summary of existing knowledge or the formulation of problems for a mitigation program in the draft EIS summary in Vol. II. Also, there is a new Aten and Bollich monograph now in press for publication in 2010 by TARL (this was mentioned in the December 2009 Friends of TARL Newsletter (pg. 14) on the subject of early ceramic sites in the Sabine Lake area. You may recall I sent an earlier version of this to you in 2007. 1

In addition to the sources (mostly surveys) mentioned in the draft EIS volume II section 3.13.1.1, I would recommend the following be reviewed and included:

Campbell, T. N., 1947, The Archaeology of the Texas Coast and its Relation to that of Mexico and the Lower Mississippi Valley. Unpublished Ph. D. dissertation, Harvard University. An early overall assessment that is still valuable in defining issues.

Stright, Melanie J., Eileen M. Lear, and James F. Bennett, 1999, Spatial Data Analysis of Artifacts Redeposited by Coastl Erosion: A Case Study of McFaddin Beach, Texas. Minerals Management Service, OCS Study MMS 99-0068, 2 volumes. A detailed study of mostly Paleo-Indian, Early and Middle Archaic lithic technology based, as you know, on the large collection from McFaddin Beach in the Sabine Area.

Aten and Bollich, 2002, Late Holocene Settlement in the Taylor Bayou Drainage Basin: Test Excavations at the Gaulding Site (41JF27), Jefferson County, Texas. Texas Archeological Society Special Publication No. 4, and Texas Archaeological Research Laboratory Studies in Archeology 40. Although this study is mentioned in the draft EIS, its importance in defining research issues in the region doesn't seem to be appreciated. This monograph lays out the need for and approach to geoarcheology and culture history mainly for the Late Archaic in the project area.

Aten and Bollich, 2010, "Early Ceramic Sites of the Sabine Lake Area, Coastal Texas and Louisiana." This monograph is finished and is being published by Texas Archeological Research Lab (UT-Austin) this year. It begins more or less where the 2002 Taylor Bayou study ends; it continues identifying Sabine Area study needs from the Late Archaic into ceramics using cultures. If a copy is needed sooner than sometime this year I'm sure you could get a photocopy from Dr. Creel at TARL.

Aten, 2004, Archeological Reconnaissance at Black Hill Mound (41JF24), Jefferson County, Texas. Research in fulfillment of Texas Antiquities Committee Archeology Permit No. 2902. This report is being incorporated in the Aten and Bollich 2010 now in press. But if you need something sooner you should be able to get a copy of this report from the Texas Historical Commission. The Black Hill site appears to include a little Middle Archaic and a lot of Early Ceramic. It also deals with other geoarcheology issues not included in the 2002 Taylor Bayou monograph.

Data on the Late Ceramic and Historic periods still are very scarce and new studies "from scratch" are needed for them. 2

Taken together these studies lay a wider basis for formulating new research for Paleo-Indian through Early Ceramic in the Sabine than is indicated in the draft EIS. Although data and concepts for the Late Ceramic through Historic periods are still weak, the basic formulations for the earlier periods are now coming into focus. Thirty years ago I could say there was little known of Sabine prehistory. But not now. Thanks for giving me the opportunity to comment.

Jan, please call on me, and I am sure Charlie Bollich also, if we can be of further assistance on the SNWW project.

Best regarads,

Larry

Lawrence E. Aten

2845 Arizona Terrace NW
Washington, DC 20016
(202) 363-4491
leaten@aol.com

Mr. Lawrence E. Aten
2845 Arizona Terrace NW
Washington, DC 20016

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | USACE appreciates the information and references provided, and will utilize them in the analysis of data from terrestrial archeological studies and the formulation of a mitigation program, if necessary, that will be conducted during PED pursuant to the Historic Properties Programmatic Agreement (FEIS Appendix H). |
| 2 | This information will be used in determining the significance of potential site impacts. |

TEXAS ENERGY COALITION

6207 Inwood Drive
Houston, TX 77057
713-622-7388 (ph)

**Written Comments by Texas Energy Coalition Regarding**
**Proposed Sabine Neches Waterway Channel Improvement Project DFR**

February 9, 2010

U. S. Army Corps of Engineers
Galveston District
Attn: Ms. Janelle Stokes [janelle.s.stokes@usace.army.mil]
P. O. Box 1229
Galveston, Texas 77553-1229

Re: Request for extension of time to comment and interim comments regarding DFR/DEIS for proposed Sabine Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

We write on behalf of the Texas Energy Coalition, a group of pipeline transmission companies that collaborate on issues of common interest. By this letter, the Coalition (1) requests an enlargement of time in which to comment upon the DEIS and DFR and (2) offers certain interim comments regarding the DEIS and DFR.

In late December 2009, we received your correspondence inviting comments on the "Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Draft Environmental Impact Statement Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Sites Designation" (referenced herein collectively as "DEIS"). We understand that as of yesterday, the deadline for comments on the DEIS has been extended from February 10, 2010, to March 12, 2010. Although your original letter and announcement were silent as to whether comments also were invited on the Draft Feasibility Report for the proposed Sabine Neches Waterway Channel Improvement Project (referenced herein as "DFR"), representatives of the Corps of Engineers subsequently advised that comments also were being accepted on the DFR and that the deadline for comments on the DFR was the same as for comments on the DEIS. We assume this deadline also will be extended to March 12, 2010, but would appreciate written confirmation of that decision. 1

The DFR and DEIS were made available to the public for the first time over the December holidays, at a time when many of our members' employees were on vacation. The practical and easily foreseeable effect of this timing, of course, was to delay the commencement of the review of the five volumes that comprise the DFR and DEIS. Furthermore, although the DFR and DEIS indicate that the proposed project will require a large number of pipeline relocations, there does not appear to have been any prior effort to coordinate the project's planning with pipeline owners and operators. This is the case even though it is common knowledge that pipelines lace the area impacted by the proposed project – a fact that is reflected in the DFR and DEIS as well (*see, e.g.,* DFR at pp. II-3, II-10, V-4-5, V-77, and VI-28). 2 3

The replacement of pipelines that transport essential commodities such as natural gas, natural gas liquids, crude petroleum and refined petroleum products is not only costly, it also requires years of advance planning and coordination, and it creates significant operational and engineering burdens for an industry that has strategic significance for the American economy. Particularly in congested areas such as the Sabine Neches Waterway, where there are multiple pipelines owned by multiple companies, the relocation of a significant number of pipelines must be preceded by a comprehensive and coordinated planning process regarding the relocation. Yet the DFR and DEIS provide little detail about the proposed project's impact on pipeline operations, which pipelines will need to be relocated, where those pipelines are located (other than the most general of descriptions), or how costs were estimated or projected for pipeline relocations. For example, the engineering narrative (located in chapter 13 of the DFR Appendix) indicates that "relocated lines were assumed to be directionally drilled, and bundled when possible," yet no detail is provided that would inform a reader which pipelines were assumed to be bundled, nor were other details provided that would permit our members to understand the logic – let alone the accuracy – of the Corps' feasibility and cost assumptions. There also appears to have been no consideration of the lead time requirements and additional expense that will be required for planning and coordination in the instance of multiple simultaneous pipeline relocations. 4

Besides relocations of existing pipelines, it also appears that the project may impact pipeline operations in other ways. Based upon one of the few references to particular pipelines in the entire DFR and DEIS (*see* Figure VII-3 of DFR), it appears that Placement Areas (both on-shore and off-shore) for the proposed project may impact a number of existing pipelines, appurtenances and their operations, yet there is no indication of whether those pipelines would be relocated or whether it is simply assumed that there would be no problems if additional overburden were to be added over those existing pipelines. For similar reasons, we need a better understanding of Beneficial Use Features. In other instances, it is unclear whether pipelines that operate near the Sabine Neches Waterway will be impacted by the project or whether the proposed project will require their relocation for other reasons. 5 6

On multiple occasions prior to the release of the DFR and DEIS, we have requested information from the Corps of Engineers (including through a series of requests under the Freedom of Information Act (FOIA) dating back to 2007) regarding the potential impact on pipeline operations of any project to deepen or widen the Sabine Neches Waterway. The Corps responded to each request by refusing to provide a single responsive document – that is, not until its production of a hard copy of the DFR and DEIS on December 24, 2009, in response to the Coalition's most recent FOIA request. Since then, the only document that the Corps has made available is a single spreadsheet with what appears to be a working list of pipelines that may be impacted by the project. This spreadsheet, which was not made available to the Coalition until January 12, 2010, has never previously been produced, even though it is dated September 30, 2005, and is clearly responsive to the Coalition's multiple FOIA requests to the Corps going back to 2007. 7

Under the circumstances, it is unrealistic to expect that the pipeline companies could provide any meaningful comments on the multi-volume DFR or DEIS by the original deadline of February 10, 2010, or even by the extended deadline of March 12, 2010. A more realistic comment period would allow at least 120 days from the date of issue (December 24, 2009), and we therefore respectfully request that the comment period be extended to at least April 26, 2010. 8

In making this request, we assume that the Corps will promptly and definitively identify the pipelines that will be impacted by the project, the owner of each such pipeline, and sufficient information to understand and respond to the Corps' estimate of the costs for removing or relocating each such pipeline. We also assume the Corps will promptly provide us with whatever additional documents are needed to understand the proposed project's impact on pipeline operations, including a projected timeline for when the relocations may actually be needed. Our members also believe that it is important for the Corps to meet with the Coalition and pipeline company representatives as soon as possible, in order to facilitate the information exchange. 9

Based upon the DFR, this project, as proposed, would be a deep-draft harbor project for cost sharing purposes under the Water Resources and Development Act of 1986. Under this law, half of the pipeline relocation costs for a deep-draft harbor project must be borne by the pipeline owner and the other half by the local sponsor of the project. Please confirm that this cost-sharing requirement will be part of any Chief's Report or other report or recommendation the Corps may make regarding the project. 10

Please advise the undersigned as soon as possible whether the comment period for the DFR and the DEIS will be extended, as requested above. We also ask that you contact Denis Calabrese (713-622-7388) or David Corban (713-651-5251) to coordinate the meeting requested above.

Very truly yours,

Denis Calabrese
Spokesperson

Mr. Denis Calabrese
Texas Energy Coalition
6207 Inwood Drive
Houston, TX 77057

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The comment period has been extended an additional 30 days to March 12, 2010. This information was placed on the USACE website at http://www.swg.usace.army.mil/pao/Docs/Extensionof PublicCommentPeriodtoMarch12.pdf on February 8, 2010. |
| 2 | The release of the Draft FR and DEIS was established based on the schedule requirements needed to complete a Chief of Engineers report in Fiscal Year 2010. |
| 3 | Owners of pipelines crossing the SNWW were contacted by USACE in 2002. USACE requested that they provide the most current "as-built" drawings and the location of SNWW crossings to enable our assessment of potential project impacts. The project's non-Federal sponsor has made numerous presentations to industry trade groups and community organizations throughout the study period, providing updates of the study and project descriptions. |
| 4 | A list of potentially affected pipelines was provided to pipeline companies during the DEIS public comment period. The USACE list of potentially affected pipelines was developed for the purpose of feasibility level planning, and should not be considered definitive. This list will be refined based on information submitted to USACE during the public comment period and subsequent to the USACE/Pipeline Owner information meeting on January 25, 2011. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. |
| 5 | As noted, pipelines cross beneath existing PAs that are proposed for use with the SNWW CIP. USACE will coordinate with pipeline owners during PED and Construction phases to avoid impacts to these pipelines. |
| 6 | FEIS Section 2.4.1.12 discusses the potential for pipelines to be affected by BU and marsh mitigation areas. It is recognized that additional pipeline searches and coordination with pipeline owners will be required prior to construction. USACE will coordinate with pipeline owners during PED and Construction phases to avoid impacts to these pipelines. |
| 7 | As noted, a list of potentially affected pipelines was provided to pipeline companies during the DEIS public comment period. |
| 8 | The comment period was extended an additional 30 days to March 12, 2010. |
| 9 | The USACE feasibility study estimate of pipeline relocation costs was developed by USACE to estimate the fully funded cost allocation between USACE and the non-Federal sponsor. A preliminary construction schedule has been developed (Engineering Appendix Addendum 2009, chapter 14.0 Revised Schedules for Design and Construction) and is available upon request. However, the actual time table for project construction is uncertain at this time because it is dependent upon ASA and OMB approval of the Chief's Report, Congressional authorization and Congressional appropriation of funds. There will be sufficient time for pipeline companies to make necessary preparations after the project is approved. As requested, USACE met with pipeline owners at an information meeting on January 25, 2011. |
| 10 | Please see Section 2.4.1.12 of this FEIS for a discussion of the allocation of pipeline relocation costs. |

## Stokes, Janelle S SWG

**From:** Texas Pipeline Association [texaspipelineassociation@yahoo.com]
**Sent:** Wednesday, February 10, 2010 2:34 PM
**To:** Stokes, Janelle S SWG
**Subject:** RE: Sabine-Neches Waterway Channel Improvement Project comments

Ms. Stokes:

We hope that our comments will be considered in their entirety and that it is noted we are requesting the comment period be extended 60 days, not 30 days, past the original February 10, 2010 date for reasons stated in the comments. 1

Thank you.

Angie Adams
Assistant to the Executive Director
Texas Pipeline Association
512/478-2871

--- On Wed, 2/10/10, Stokes, Janelle S SWG <janelle.s.stokes@usace.army.mil> wrote:

From: Stokes, Janelle S SWG <janelle.s.stokes@usace.army.mil>
Subject: RE: Sabine-Neches Waterway Channel Improvement Project comments
To: "Texas Pipeline Association" <texaspipelineassociation@yahoo.com>
Date: Wednesday, February 10, 2010, 1:09 PM

Ms. Adams,

The Galveston District, Corps of Engineers, is extending the CEQ public comment period for the Sabine-Neches Waterway Channel Improvement Project, and Proposed Ocean Dredged Material Disposal Site Designation, Southeast Texas and Southwest Louisiana. The comment period was originally set to end on 2/10/2010, but it has been extended 30 days to 3/12/2010.

Janelle Stokes
Regional Environmental Specialist
U.S. Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77573
409.766.3039
janelle.s.stokes@usace.army.mil <http://us.mc503.mail.yahoo.com/mc/compose?to=janelle.s.stokes@usace.army.mil>

-----Original Message-----
From: Texas Pipeline Association [mailto:texaspipelineassociation@yahoo.com <http://us.mc503.mail.yahoo.com/mc/compose?to=texaspipelineassociation@yahoo.com> ]
Sent: Wednesday, February 10, 2010 9:41 AM
To: Stokes, Janelle S SWG
Subject: Sabine-Neches Waterway Channel Improvement Project comments

Dear Ms. Stokes:

Attached are the comments of the Texas Pipeline Association regarding the Sabine-Neches Waterway Channel Improvement Project. We appreciate the

opportunity to submit comments.

Please contact us if you have any questions or need further information.

Thank you.

Angie Adams
Assistant to the Executive Director
Texas Pipeline Association
512/478-2871

Ms. Angie Adams
Texas Pipeline Association
604 West 14th Street
Austin, TX 78701

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The comment period was extended an additional 30 days to March 12, 2010. |

Texas Pipeline Association

Patrick J. Nugent
Executive Director

February 10, 2010

Ms. Janell Stokes
Department of the Army
Galveston District
Corps of Engineers
P.O. Box 1229
Galveston, Texas 77563-1229
e-mail: janelle.s.stokes@usace.army.mil

Re: Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

The Texas Pipeline Association (TPA) is an organization of thirty-four member companies which gather, process, treat, transport, deliver and store natural gas and natural gas products to marketers, commercial and industrial end users and residential consumers in Texas and the United States.

The U.S. Corps of Engineers (Corps) has released the Draft Feasibility Report (DFR) and the Draft Environmental Impact Statement (DEIS) for the above referenced project and announced that it will accept written comments postmarked by February 10, 2010. The Texas Pipeline Association requests that the comment period be extended for an additional 60 days for the following reasons: 1

1. The material which must be reviewed is voluminous. The DEIS is over 1500 pages and the DFR is over 700 pages. 2

2. There are a number of issues which the TPA believes will require additional data to determine the magnitude of the impact of the project. It appears that there are approximately 50 pipelines which must be relocated or removed to accommodate the project. The process of relocating or removing pipelines is both expensive and complicated. The TPA believes the actual costs of the relocation and removal of numerous pipelines will turn out to be substantially higher than currently anticipated. 3

3. It is clear that much of the pipeline capacity that delivers oil, gas and products between the Gulf Coast of Texas and the Gulf Coast of Louisiana will be out of service for a 4

604 West 14th Street, Austin, Texas 78701
phone: (512) 478-2871 fax: (512) 473-8476 Email: texaspipelineassociation@yahoo.com

period of time to accommodate the project. It has not yet been determined how much of that capacity will not be put back into service due to the cost of relocation or removal. Moreover, there are safety and environmental risks of such operations which must be taken into consideration.

4. Neither the Corps nor the energy industry yet knows how much oil and gas production will have to be shut in or the period of time we can expect production to be interrupted by the relocation and removal projects. 5

5. Neither the Corps nor the public yet knows how much of the Gulf Coast's gasoline and diesel fuel supplies will be interrupted or for what time period that disruption will last. It also appears that delivery of products such as ethylene, butadiene, oxygen and ammonia will be interrupted to those industries which are major employers on the Gulf Coast. 6

6. We would note that the State of Louisiana, through its Department of Natural Resources, Office of Coastal Management (DNR) has stated its concerns about whether the deepening will increase damage done by storm surges as well as its concerns about many of the same issues raised by the TPA. The DNR has asked for an additional 90 days to evaluate the impact of the project. 7

Given the extensive nature of the project, the amount of existing data to be reviewed in the DFR and the DREIS, and especially the amount of data which needs to be collected regarding the impact on both the energy industry and its customers, the TPA asks that the comment period be extended at least 60 days so that a useful analysis of the project's impact can be done.

If you have any questions, please do not hesitate to contact me at texaspipelineassociation@yahoo.com or 512/478-2871 or 604 West 14 Street, Austin, Texas 78701.

Sincerely,

Patrick J. Nugent

Patrick J. Nugent
Executive Director

Mr. Patrick J. Nugent
Executive Director
Texas Pipeline Association
604 West 14th Street
Austin, TX 78701

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The comment period was extended an additional 30 days to March 12, 2010. |
| 2 | The length of these documents is commensurate with the size and complexity of the proposed project. |
| 3 | The USACE feasibility study estimate of pipeline relocation costs was developed by USACE to estimate the fully funded cost allocation between USACE and the non-Federal sponsor. A list of potentially affected pipelines was provided to pipeline companies during the DEIS public comment period. The USACE list of potentially affected pipelines should not be considered definitive. This list will be refined based on information submitted to USACE during the public comment period and subsequent to the USACE/Pipeline Owner information meeting on January 25, 2011. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. |
| 4 | Channel deepening will be accomplished with numerous dredging contracts over many years, and associated pipeline relocations will similarly occur in increments, so no large disruptions in pipeline service are anticipated. USACE will ensure that channel construction contractors work with pipeline companies as needed to accommodate all parties for a safe and effective working plan. |
| 5 | See USACE response to Comment 4. |
| 6 | See USACE response to Comment 4. |
| 7 | A sensitivity analysis using the ADCIRC model was performed to determine what effect the proposed SNWW CIP might have on surge levels in the study area (Wamsley et al., 2010). The results of this analysis are presented in FR Chapter VIII, FEIS Section 4.1.5. The comment period was extended an additional 30 days to March 12, 2010. |

**Stokes, Janelle S SWG**

**From:** Fontenot, Chuck [Fontenot@pbworld.com]
**Sent:** Thursday, March 11, 2010 12:49 PM
**To:** Stokes, Janelle S SWG
**Cc:** Praesel, Jr, Arthur Gus; Mayorga, Masao; Hall, John; Reichwein, Tim
**Subject:** Draft Environmental Impact for Sabine Neches Waterway

**Attachments:** PBESS Neches Pipeline Overlay.pdf; 1127 Sasol 6 inch Neches-1 Model (1).pdf; 1146 Entergy 24 inch Neches-1 Model (1).pdf; PBESS Neches Crossings.pdf; TECHNICAL CONSIDERATIONS FOR CROSSINGS RIVER.pdf

PBESS Neches Pipeline Overlay.... | 1127 Sasol 6 inch Neches-1 Mod... | 1146 Entergy 24 inch Neches-1 ... | PBESS Neches Crossings.pdf | TECHNICAL ISIDERATIONS FOR

Ms. Stokes,

I am with PB Energy Storage Services. I spoke with you recently on the phone in relation to the Draft Environmental Impact Study on the Sabine Neches Waterway. I am submitting a short technical evaluation on the impact of the project to PBESS's Pipeline Operation. We have looked at the deepening and widening of the channel as well as the location of the spoil areas in relation to our pipelines. Depending on where the centerline of the channel will be we do not see a big impact on our systems. We would like to point out that the spoil areas are directly over portions of both pipelines. As we do not know the finished depth of the spoil in these areas we are somewhat concerned. 1
I have attached a letter as well as drawing that show the location of the pipelines, most recent profiles as well as Google Photos with GPS Coordinates. I also super imposed the drawing from your impact study with our pipelines.

Please feel free to contact me if you require more information or if we can help in any way.

Thanks

Chuck Fontenot

Operations Manager

PB Energy Storage Services, Inc.

A Parsons Brinckerhoff Company

16285 Park Ten Place, Suite 400, Houston, TX 77084 (New)

6950 Sulphur Drive, Beaumont, TX 77705

(409) 839-4602 (Beaumont Office)

(281) 589-5845 (Houston Office)

(281) 923-0317 Mobile

(409) 839-0510 Fax

E-mail Address: fontenot@pbworld.com <blocked::mailto:fontenot@pbworld.com>

PBESS Website : http://www.pbenergy.com <http://www.pbenergy.com/>

Mr. Chuck Fontenot
Operations Manager
PB Energy Storage Services, Inc.
16285 Park Ten Place, Suite 400
Houston, TX 77084

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and your concerns will be addressed at that time. |

**PB Energy Storage Services, Inc**
ENGINEERING – CONSTRUCTION – OPERATIONS – MAINTENANCE

*16285 Park Ten Place, 4th Floor*
*Houston, Texas 77084*

*Telephone (281) 496-5590*
*Fax (281) 589-5865*

**Department of the ARMY**
**Galveston District, Corps of Engineers**
**P.O. BOX 1229**
**Galveston, TX 77553**
**Subject: PB ESS Technical Requirements for our Pipelines due to Sabine Neches, Waterway Channel Improvement Project**
**Date: February 2nd, 2010**

**To: Ms Janelle Stokes**

PB Energy Storage Services is responsible for the operation of two pipelines crossing under the natural bottom of the Neches River as per attached drawings and pictures. One pipeline is 24" OD natural gas pipeline and the other is 6.625" OD ethane pipeline. The 24" OD Pipeline is required for the Gas Supply to Entergy's Bridge City Power Plant. 1
The 6.625" OD pipeline is the ethane feedstock pipeline to Sasol NA's Westlake Power Plant. While we realize that this release is related to environmental impact particularly on the spoil areas, we wanted to make sure that the location of our pipelines related to both the spoil areas and river excavation were considered as soon as possible.

PB has reviewed the documents from Department of the ARMY, and applied standards and applicable specifications including DOT 195, DOT 192, ASME B31.4 (Liquids) and 2
ASME B31.8 (Gas), to determinate the minimum necessary requirements for the proposed project.

**The primary guidelines for this project to be considered are:** 3

- All buried pipelines for river and stream crossings shall be installed below the normal level of bottom of river with a minimum cover not less than 48 inches, PBESS considers this to be adequate under the most perfect conditions of water movement, this depth should be increased as per calculations based on real conditions.

- Crossings of rivers, streams, lakes, and inland bodies of water are individual problems, and the designer shall investigate composition of bottom, variation in banks, velocity of water, scouring, and special seasonal problems. Where required,

detailed plans and specifications shall be prepared taking into account these and any special considerations or limitations imposed by the regulatory body involved.

- Underwater crossings modifications as this case, plans and specifications shall describe the position of the line, showing relationship of the pipeline to the natural bottom and the depth below mean low water level when applicable. To meet the conditions set out here, heavier wall thickness could be necessary. Approach and position of the line in the banks is important, as is the position of the line across the bottom. Special consideration shall be given to depth of cover and other means of protecting the pipeline in the surf zone. Special consideration shall be given to protective coating and the use of concrete jacketing or the application of river weights.

- Complete inspection shall be provided and all precautions shall be taken during construction to limit stress below the level that would produce buckling or collapse due to out-of-roundness of the complete pipeline.

- Plans and specifications shall describe alignment of the pipeline, depth below mean water level, and depth below bottom if ditched. Special considerations shall be given to use of weight coating(s), anchors, or other means of maintaining position of the pipeline under anticipated conditions of buoyancy and water motion. Complete constructions inspection and monitoring shall be provided. Precautions shall be taken during construction to limit stress below the level that would produce buckling or collapse due to out-of-roundness of the pipeline.

- Where pipelines and mains cross areas that are normally under water or subject to flooding (i.e., lakes, bays, or swamps), sufficient weight or anchorage shall be applied to the line to prevent flotation.

- Because submarine crossings may be subject to washouts due to the natural hazards of changes in the waterway bed, water velocities, deepening of the channel, or changing of the channel location in the waterway, design considerations shall be given to protecting the pipeline or main at such crossings. The depth of the line, location of the bends installed in the banks, wall thickness of the pipe, and the weighting of the line shall be selected on the characteristics of the waterway.

**After analysis, PB ESS requirements:** 4

- PB ESS has not in this case studied the soil conditions and water velocity for these crossings, due to the unpredictable conditions for this river, we want to keep the minimum depth as per drawings, which is 14.5' at TOP for both pipelines, unless than proper studies show than a shallower depth would not be a risk.

- If it becomes necessary that a minimum depth would be less than 14.5' and in the case that the pipeline could have the possibility of future exposure, the guidelines suggested above shall be considered and approved by PB ESS.

- If the width or depth of the river excavation makes the replacement of the pipeline necessary, then a new section of pipeline would be necessary and mainline block valves should be installed on the upstream side of major river crossings. Either a block or check valve shall be installed on the downstream side of major river crossing.

- PB ESS will require that a representative of our company be on-site at all times, during all excavation activities in the vicinity of these pipelines.

- Another issue that we have is regarding to the "Dredged Material Placement Areas", because these are exactly above both pipelines. PB ESS will need maintenance access to the pipelines. If the depth of these spoil areas is significant 5
then we may have issues with spoil placement. Attached to this document are pictures showing the approximate location of the pipelines. We are supplying the GPS coordinates in the Vicinity of the river. If possible we would like to avoid these areas above the pipelines.

PB ESS is would be happy to review all information related to these pipelines with your engineers. We look forward to working with the Corp of Engineers in order to support this 6
operation, with as little impact as possible to existing structures.

All technical questions should be directed to Mr. Masao Mayorga (mayorgam@pbworld.com) or Mr. Chuck Fontenot (fontenot@pbworld.com)

Sincerely,

***Masao Mayorga***
**Principal Pipeline Engineer**
**PB Energy Storage Services, Inc.**
*A Parsons Brinckerhoff Company*
**16285 Park Ten Place Floor 4th, Houston, TX 77084**
**(281) 589-5983 (Houston Office)**
**(713) 817-3045 Mobile**
**(281) 589-5865 Fax**
**E-mail Address: mayorgam@pbworld.com**
**PBES Website :** http://www.pbenergy.com
**PB Website :** http://www.pbworld.com

Mr. Masao Mayorga
Principal Pipeline Engineer
PB Energy Storage Services, Inc.
16285 Park Ten Place Floor 4th
Houston, TX 77084

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for providing this information. |
| 2 | Comment noted. |
| 3 | The USACE Galveston District guidance for DEEP DRAFT CHANNELS DISTRICT POLICIES AND PRACTICES can be found at http://www.swg.usace.army.mil/items/hgnc/#MEMO. The "primary guidelines" refer to the "normal level of bottom of river", "natural bottom" and this is not equivalent to the authorized depth of the federal channel. |
| 4 | Please refer to USACE response to Comment 3. |
| 5 | Maintenance access will be provided upon request. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and your concerns will be addressed at that time. |
| 6 | USACE met with pipeline owners at an information meeting on January 25, 2011. More information on project features that could affect pipelines will be provided as detailed plans are developed during PED and Construction phases. |

# Coastal Environments , Incorporated

**Services:**

Applied Science & Planning

Environmental Restoration & Monitoring

Cultural Resources Management

Geographic Information Systems

Litigation Support

**Website:**

www.coastalenv.com

**Corporate Office:**

1260 Main Street
**Baton Rouge, LA** 70802
Ph (225) 383-7455
F (225) 383-7925

**Other Locations:**

127 Babcock Farm Road
**Appomattox, VA** 24522
Ph/F (434) 352-4168
cpear2@hughes.net

525 S. Carancahua Street
**Corpus Christi, TX** 78401
Ph (361) 854-4885
Ph (361) 884-6626
F (361) 884-1844
bguevin@coastalenv.com

812 Water Street
**Biloxi, MS** 39530
Ph (228) 385-5547
F (228) 385-5548
rellis@coastalenv.com

302 Saint John Street
**Madisonville, LA** 70447
Ph/F (985) 845-2879
mgagliano@coastalenv.com

February 22, 2010

USACE – Galveston District
ATTN: Ms. Janelle Stokes
P. O. Box 1229
Galveston, TX 77553

RE: Draft Environmental Impact Statement (DEIS) for Sabine-Neches Waterway Channel Improvement Project Southeast Texas and Southwest Louisiana (SNWW)

Dear Ms. Stokes:

This letter of objection is written on behalf of Doré Energy Corporation (DEC), a landowner in Cameron Parish, LA. DEC owns an 18,611-ac tract, known as Cameron Meadows, which is comprised of coastal marsh that abuts the south side of the Sabine National Wildlife Refuge.

As we understand, the existing channel SNWW is currently 40-ft deep and the project calls for it to be extended into the gulf, widened, and deepened to 48 ft. A projected 98 M cu yds of material would be dredged during project construction with a maintenance requirement of 650 M cu yds that would be dredged over the following 50 years. The cited need for the project is attributed to current SNWW depth/channel configurations and ship congestion that impede shipments of crude oil in larger ships to existing oil refineries and petrochemical related facilities.

We believe that the SNWW is very comparable to the Mississippi River Gulf Outlet (MRGO), located in St. Bernard Parish, Louisiana. The MRGO has now been de-authorized by the U. S. Congress and a rock dam placed across the channel near its seaward end and a surge structure across its upper end at a cost in excess of one billion dollars. A Congressional authorized study is currently underway by the USACE, New Orleans District, to develop a plan for mitigation of environmental damages resulting from the MRGO. Estimates for implementing the environmental plan are between 1.5 and 2B dollars. Have similar costs been factored into the SNWW? 1

A report, prepared by the USACE, New Orleans District, entitled *Habitat Impacts of the Construction of the MRGO* (December, 1999), states that the 76-mile, waterway was dredged to its authorized 500-ft width and 35-ft depth by 1965. The USACE, New Orleans District, state on pg 1 of the report that "(c)onstruction of the MRGO and subsequent erosion has caused extensive loss of land in St. Bernard Parish". Authors of the report calculated that thousands of wetland acres were lost as the result of the MRGO not only in St. Bernard Parish, but in *all* of the parishes that surround Lake Pontchartrain. Did the USACE, Galveston District, review and evaluate *Habitat Impacts of the Construction of the MRGO*? Does the USACE, Galveston District, know that navigation channels are a primary cause for coastal wetland loss and degradation in Louisiana? If so, why was a discussion on same not included in the DEIS? 2

The numbers of movements of ships in the DEIS are only provided by the SNWW percentage of nationwide totals. What is the numerical summary of the number of existing and projected shipments with and without the project? What is the numerical breakdown on types of vessels (including lengths, widths, drafts) documented as historically using the SNWW historically as well as the present time? What is the current frequency of marine movements by type of vessel? Where is the data that documents delays, accidents, near-misses, etc.? Where is data that identifies and documents specific areas of congestion along the SNWW that could be possibly "fixed' as a reasonable partial alternative to the preferred action? The need to bring crude oil shipments to refineries with 45-ft draft, vessels should be justified by a realistic and defendable projection of movements. 3

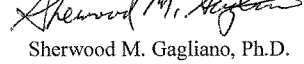
Several alternatives included the use of, or similarities to, the Louisiana Offshore Oil Port. the DEIS concludes that local interests along the existing SNWW do not want to invest their own resources into a solution that would not adversely affect Louisiana's wetland resources. Business interests would rather have the channel improved at the public and Louisiana's expense. Why would the USACE, Galveston District, not take a more in-depth look at the alternatives reviewed in the DEIS and attempt to identify new alternatives that would not adversely affect Louisiana? For instance, an authority or consortium of users could be formed that could investigate the feasibility of developing a partnered public and private funded offshore oil port or lightering system for large tankers. 4

The State of Texas would obviously benefit from the SNWW project; but how would the State of Louisiana benefit? 5

The DEIS states that the deepening and widening of the SNWW channel will increase the amplitude and salinities of incoming tides, shorten durations of freshwater retention, and increase overall water levels in the DEIS study area. These changes in environmental conditions will significantly affect wetlands and wetland productivity on the Cameron Meadows tract. The DEIS includes some breadcrumb mitigation offerings in Louisiana in the form of several relatively small wetland restoration projects at the Sabine National Wildlife Refuge and private lands, located north of the refuge. Why has no mitigation been proposed at Cameron Meadows? How does the USACE, Galveston District, plan to mitigate or compensate for the project's adverse, long-term cumulative impacts at Cameron Meadows and other wetland areas in Cameron Parish? 6 7 8

Thank you for the opportunity to make these comments.

Sincerely yours,



Sherwood M. Gagliano, Ph.D.
Chief Executive Officer

xc: Louisiana Governor Bobby Jindal
U. S. Senator Mary Landrieu
U. S. Senator David Vitter
U. S. Representative Charles Boustany
Cameron Parish Police Jury

Mr. Sherwood M. Gagliano, Ph.D.
Chief Executive Officer
Coastal Environments, Inc.
1260 Main Street
Baton Rouge, LA 70802

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Costs cited in the comment are specific to the Mississippi River-Gulf Outlet (MRGO) project and cannot be extrapolated directly to the proposed SNWW CIP. The cost to mitigate unavoidable environmental impacts have been included in the project cost estimate. |
| 2 | Galveston District is aware of the referenced document. The fact that navigation channels are one of the causes of coastal wetland loss in Louisiana is acknowledged in the FEIS (see Sections 1.4.2, 3.5, 3.9.4, 4.6 and 4.10) and this is reflected by the proposed mitigation plan for the project. |
| 3 | Requested information is presented in FR Chapter 5, and DFR Appendix 2. The DFR and DEIS are designed to complement one another, and both were provided for public review. The economic analysis presented in FR section V.F establishes that there would be a net economic benefit to the United States from the proposed project. |
| 4 | Non-structural alternatives, including new offshore ports like Louisiana Offshore Oil Port (LOOP) are thoroughly analyzed and presented in FR Chapter IV.D. |
| 5 | The proposed SNWW CIP is a Federal Civil Works project, and as such, it would provide benefits to the Nation, not just one state. The economic analysis presented in FR section V.F establishes that there would be a net economic benefit to the United States from the proposed project. Direct and indirect economic benefits of the proposed deepening will accrue to all users of the SNWW, including the energy industries, and to the regional economy. |
| 6 | It appears that Cameron Meadows is located within LA-9, the East Johnsons Bayou hydro-unit. FEIS Chapter 4 fully evaluates potential impacts from the SNWW CIP to this unit. As noted in FEIS Section 4.6.2, the proposed project would result in a minimal increase in water surface elevation (averaging less than an inch), a slight increase the amount of tidal exchange, and a slight increase in the conveyance of inflows to the Gulf. All of these effects are minimal. |
| 7 | The proposed mitigation replaces estimated land loss with more than four times the amount of marsh projected to be lost, providing more than adequate mitigation for the full range of possible impacts. The ICT, which includes several Louisiana resource agencies, selected all of the mitigation areas included in the mitigation screening. This screening process and the incremental cost analysis are described in FEIS Section 5.4. The proposed mitigation measures are located in the hydro-units with the highest predicted impacts. |
| 8 | As demonstrated in FEIS Section 4.16, the proposed SNWW CIP would not contribute to cumulative impacts in the study area because all impacts of the proposed SNWW CIP would be fully offset by compensatory mitigation measures, and the proposed project would have net beneficial effects on wetlands, water quality and SAV due to the extensive BU feature on the Neches River and the Gulf Shore BU feature. |

**Stokes, Janelle S SWG**

**From:** CUPERO, KELLY M [KCUPERO@entergy.com]
**Sent:** Thursday, February 18, 2010 8:39 AM
**To:** Stokes, Janelle S SWG
**Subject:** Sabine-Neches Waterway DEIS

Janelle:

It was a pleasure visiting with you the other day. On behalf of Entergy Texas, Inc., I appreciate your efforts to address all parties' concerns, particularly those of ETI, with respect to this project.

As mentioned, Entergy Texas, Inc. would like to be included in all mailings/publications/announcements/etc. regarding the project. Please include the following individuals on your notification list: 1

Kelly M. Cupero, Senior Counsel

Entergy Services, Inc.

P.O. Box 2951

Beaumont, Texas 77706

Telephone: (409) 981-2790

Facsimile: (409) 981-3016

kcupero@entergy.com

Anne Demuth

Entergy Texas, Inc.

Environmental Services

P.O. Box 888

Bridge City, Texas 77611

Telephone: (409) 734-3350

Facsimile: (409) 734-3347

ademuth@entergy.com

Fred Manhart

Entergy Services, Inc.

Environmental Services

10055 Grogans Mill Road

Parkwood II Building, Suite 500

The Woodlands, Texas 77380

Telephone: (281) 297-3304

Facsimile: (281) 297-3004

fmanhar@entergy.com

Hunt Sproull

Corporate Real Estate

Entergy Services, Inc.

639 Loyola Avenue

L-ENT-3L

New Orleans, Louisiana 70113

Telephone: (504) 576-4136

Facsimile: (504)-4001

hsproul@entergy.com

Thank you for your attention to this matter. Please feel free to contact me if you have any questions.

Kelly Cupero

Senior Counsel

Entergy Services, Inc.

(409) 981-2790

Ms. Kelly Cupero
Entergy Services, Inc.
P.O. Box 2951
Beaumont, TX 77706

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Entergy representatives have been added to the SNWW CIP mailing list as requested. |

Entergy

**Entergy Texas**
P.O. Box 2951
Beaumont, TX 77704
Tel 409 981 2135
Fax 409 981 2075

**Vernon Pierce**
**Director of Customer Service**

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

March 3, 2010

Ms. Janelle Stokes
Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

RE: Comments to the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

On behalf of Entergy Texas, Inc. ("ETI"), an investor-owned electric utility operating in Southeast Texas, I appreciate the opportunity to submit comments to the U.S. Army Corps of Engineers' Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project ("Project").

After reviewing the information provided by the U.S. Army Corps of Engineers in its December 18, 2009 mailing, ETI became concerned that property owned by ETI had been identified as a "beneficial use" area and that dredge spoils could be deposited on this ETI-owned property. The property at issue is identified by the Corps as the Old River Cove area in the Corps' Figure VI-7, also noted as TX6-1a on Drawing No. C-25. Upon further review, ETI determined that most, if not all, of the Old River Cove area is owned by ETI and is subject to a public hunting license agreement between ETI (through its predecessor, Gulf States Utilities Company) and Texas Parks and Wildlife Department. 1

ETI has not yet fully investigated the potential impact that the placement of dredge spoils on this property may pose to ETI or the Texas Parks and Wildlife Department. However, with the close proximity of the Old River Cove area to ETI's Sabine Generating Plant (which lies immediately north of the Old River Cove area) and its associated intake and outfall canals, additional review and investigation as to the potential impact to the plant's operations must be evaluated. Due to the critical nature of Sabine Generating Plant's electric generation operations to the ETI system, any potential impact on the plant's operations must be reviewed and considered very carefully. ETI's concern exists irrespective of whether dredge spoils are placed on the ETI-owned property or placed on property not owned by ETI but within the vicinity of the ETI intake and outfall canals. Additionally, while not impacted by the proposed beneficial use of the Old River Cove area, ETI transmission facilities and gas pipeline facilities also may be impacted by the Project. 2 3

ETI appreciates being invited to participate in the comment process, and we look forward gathering more information as this Project progresses. If you have any questions or would like to discuss this matter further, please feel free to contact Kelly Cupero at (409) 981-2790 or Fred Manhart at (281) 297-3304.

Sincerely,

Vernon Pierce

VP/th

Mr. Vernon Pierce
Director of Customer Service
Entergy Texas
P.O. Box 2951
Beaumont, TX 77704

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for this information. Maps in the FR and FEIS will be revised to accurately reflect ownership of this tract. The tract in question is the location of a proposed BU feature (Old River Cove, TX 6-1). |
| 2 | USACE would work with Entergy during the PED and/or Construction phase to develop a detailed design plan that does not impact Entergy's intake and outfall canals, or impact plant operations during construction. |
| 3 | USACE would work with Entergy during the PED and/or Construction phase to develop a detailed design plan that does not impact Entergy's transmission facilities and gas pipelines. |

# Golden Triangle Audubon Society

The National Audubon Society Chapter in Southeast Texas
Post Office Box 1292, Nederland, Texas 77627-1292


March 9, 2010

United States Army Corps of Engineers
Attn: Ms. Janelle Stokes
P.O. Box 1229
Galveston, Texas 77553

Re: Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

Please find enclosed Golden Triangle Audubon Society's comments on the draft Environmental Impact Statement.

Yours sincerely.

John A. Whittle
Secretary

**Comments on the Draft EIS for the**
**Sabine Neches Waterway Channel Improvement**

**March 9, 2010**

These comments are submitted on behalf of Golden Triangle Audubon Society. Our territory covers Jefferson, Orange and Hardin counties in Texas and a few close-by communities.

Our major concern is that the coastal marshes and wetlands, Sabine Lake, and the wildlife that uses them be protected from the adverse effects of increased salinities and unnatural increased water flows from the Gulf under all conditions both normal and abnormal such as during major hurricanes. We fully understand the beneficial function of coastal marshes in attenuating the inflow of water from tropical storms and hurricanes, but equally understand that they will not do this if they are already degraded at the time of the event. This requires that salinity levels not be allowed to increase and existing channels not be exposed to increased exchange with Gulf salt water. 1

The first issue that we would raise is one of alternatives. The only alternatives to "No action" that are comprehensively addressed are those in which the only difference is in the depth to which it is proposed to dredge the channel. These are, in the larger picture, only relatively small changes in one major alternative. We believe that NEPA and common sense require a broader approach to the issues, so that an outcome that solves the problem and that is the best possible from an environmental perspective can be selected. 2

The first obvious alternative, briefly discussed in the draft document, involves an offshore oil terminal after the manner of the Louisiana Offshore Oil Port or LOOP. This has been successful, has involved only vanishingly small environmental impacts during construction and operation, and has survived two or three major hurricanes without environmental damage, being restored to full commercial operation in remarkably short times after such events. Such a port could be located so as to be capable of accommodating the Very Large Crude Carriers of today – LOOP is reported to be the only port in the nation so capable at present – while the proposed increase in the depth of the channels in the Sabine Neches Waterway System will only have a comparatively small effect on the capacity of tankers that can be accommodated. This alternative is dismissed in the draft document with minimal discussion, apparently in part because the proponents of such a port have not yet coalesced into a partnership with the resources and desire to pursue it in the immediate future in a Sabine-Neches related location. However, we do not believe this should prevent it from being a preferred alternative in a NEPA EIS. It is also indicated that such a port would not address the prime objective of increasing the "efficiency" the waterway system, because it would serve only one commodity, namely oil. Yet it is clear that the root cause of any current inefficiency is the number of oil tankers using the waterway system, and that there is no record of significant demonstrated need to use larger draft ships by other users of the waterway. If much of the tanker traffic is removed from the waterway system, the vessel traffic will be cut to a fraction of its current volume, and the "lack of efficiency" will be no more. The oil pipeline industry's environmental safety record is excellent, and we suggest is much better than the oil tanker industry record. Any spills that occur from pipelines are typically localized and do not affect large areas or numbers of people. This would make the "No action" alternative the logical preferred alternative from an environmental perspective in as far as the narrower scope of the current proposal is concerned, because such an oil port would not significantly impact the environment or add any additional risk to the coastal wetlands and communities except to the extent that pipeline construction does, and that would be a project under the jurisdiction of other agencies. An offshore oil port could provide more additional capacity than channel deepening, and would not leave an ongoing environmental impact when, at some time in the next generation, the world reduces its reliance on oil in favor of "renewable" energy sources. 3 4

One could also envisage other alternatives that would deepen the channel only as far north as Sabine Pass where tankers could be offloaded into a pipeline system for onward transportation and an alternative that would deepen the Channel only as far north as Port Arthur. Each of these would almost certainly involve more environmental impact, but the overall environmental impact versus benefits to the local communities and the nation ought to be examined, although it seems unlikely they would be more beneficial overall than an offshore port. 5

We are concerned about what appears to us to be a lack of detailed consideration of the effects on wildlife. There are brief and rather vague descriptions of the birds in the areas to be impacted, taken it seems from broad-brush state and region-wide distribution data, albeit reliable in what it attempts to do. More site specific Christmas Bird Count data, which is available for the area of the proposed Gulf Shore Beneficial Use area, does not seem to have been used, nor is there any detailed discussion of the impacts in the short or long term or of cumulative impacts over time. We would note that, as yet, there is minimal documented input from the biological scientific staff of agencies with lands in the areas of potential impact. LDWF appears, even aside from its parochial concerns, not to be in support of the changes or the proposed mitigation, while US Fish and Wildlife Service appears yet to be heard from officially. We believe the professional opinions of the biologists in these agencies on likely effects on the marshes on either side of the channel near the coast should be solicited and fully considered. 6 7 8

We are concerned about the manner or placement of beneficial use dredge material along the Texas and Louisiana Coasts either side of the Channel from Texas Point westwards and Louisiana Point eastwards. If we understand correctly that the proposal is to deposit dredge material on shore along the current beaches at six year intervals, we believe the effect on wildlife could be very serious. The immediate beach area that is used by a number of wintering shorebird species including Piping Plovers, Whimbrel, Dunlins, and Black-bellied Plovers would be disrupted by the deposits, and would likely have just recovered fully when the next deposit was scheduled. The dredge material cannot be expected to immediately have the crustacean and invertebrate communities needed to provide shorebird food. On the Texas side, schemes that place the material near the jetty so that it is carried by the prevailing westerly currents along the shore in a more natural fashion over time should be planned. Alternatively, the material should be deposited a short distance offshore to be carried gradually on shore. There is also a need to monitor the dredge material to ensure that it does not contain any heavy metals or other contaminants. 9 10 11

There is an apparent absence of adequate consideration of potential storm and hurricane effects if the preferred alternative is implemented. This area remembers all too well the effects of recent hurricanes, Hurricane Ike in particular, and there is much evidence from the New Orleans area of the adverse consequences of the Mississippi River Gulf Outlet (MRGO) during Hurricane Katrina. It is worth comparing the MRGO with the current and proposed Sabine-Neches Waterway (SNWW) channels. The MRGO was 76 miles long (somewhat longer than the SNWW), only 36 feet deep (less than the current SNWW channels) and 500 feet wide (very roughly the same as the current average SNWW width). In response to local pressure and increasing evidence that the MRGO significantly contributed to the disaster in New Orleans during Hurricane Katrina, the MRGO was closed in July 2009. On November 18, 2009, the US District Court for the Eastern District of Louisiana found that the Corps was responsible for damages to many plaintiffs because, among other things, the original EIS was arbitrary and capricious, and because the Corps failed to protect the environment (mostly marsh) surrounding the MRGO. The most scientifically valid modeling suggests that the existence of the MRGO intensified the storm surge in Katrina by 20 percent, raised the wall of water 3 feet and increased the velocity of the surge from 3 ft/sec to 8 ft/sec. While that 12

modeling compared the existing MRGO versus no MRGO, and there are existing channels in the Sabine Neches system, there is no reason not to believe that increasing the depth of the channels would allow more wind driven storm surge into Sabine Lake and Bridge City and the Sabine River into Orange, and increased and possibly significant storm surge up the Neches through Port Neches to Beaumont and the salt water barrier, and up all the various bayous such as Taylor Bayou and Hillebrandt Bayou. The magnitude of such an increase will be difficult to predict accurately, but the effect will be there, and any increase in storm surge carries with it the inevitability of greater areas and areas further from the lakes, channels, rivers and bayous being impacted by waters driven by the storm surge. In a storm of the magnitude of Hurricane Ike, it is inevitable that near the coast, the storm surge will cover all the land. However, deeper channels reaching inland will be capable of carrying larger volumes of water for longer periods even before the storm surge has covered any land, and consequently, more water will be driven by the winds up these channels by the south winds on the east sides of storms. To conclude that such effects will be minimal is wishful thinking in the light of the MRGO experience in Katrina. In such a storm or hurricane event, some of the marshes adjacent to the Channel would receive a greater surge, would be able to absorb a lower fraction of the storm surge, would be damaged by salt water to a greater extent, and would therefore take much longer to recover. The cumulative effects of additional salt water exchanges would likely degrade more marsh, much as has happened south of New Orleans and all along the Louisiana coast. In short, the proposed increase in the channel depth will significantly increase the impact on the environment and the damage to communities in any future hurricane storm surge.

John A. Whittle, Secretary
Golden Triangle Audubon Society
P.O. Box 1292
Nederland, Texas 77627-1292

Mr. John Whittle
Golden Triangle Audubon Society
P.O. Box 1292
Nederland, TX 77627-1292

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The FEIS thoroughly presents potential impacts associated with channel deepening (see particularly FEIS Sections 1.4.2, 3.5, 3.9.4, 4.6 and 4.10). A sensitivity analysis using the ADCIRC model was performed to determine what effect the proposed SNWW CIP might have on surge levels in the study area (Wamsley et al., 2010). The results of this analysis are presented in FR Chapter VIII, FEIS Section 4.1.5. All impacts of the proposed SNWW CIP would be fully offset by compensatory mitigation measures, and the proposed project would have net beneficial effects on wetlands, water quality and SAV due to the extensive BU feature on the Neches River and the Gulf Shore BU feature. |
| 2 | The No Action and 3 Non-Structural alternatives are thoroughly analyzed and presented in FEIS Section 2.2 and FR Chapter IV.D. |
| 3 | USACE disagrees with the assertion that and offshore oil port is dismissed with minimal discussion. FEIS Section 2.2.2.3 presents the results of an in-depth economic analysis in an extensive discussion of this alternative. |
| 4 | The DFR and DEIS are designed to complement one another, and both were provided for public review. The economic analysis presented in FR Chapter 5, and FR Appendix 2, describes significant benefits from the proposed channel deepening for refined petrochemical products, LNG, and dry bulk products, in addition to crude oil. The analysis acknowledges that an expansion of LOOP or construction of a similar facility in Texas would reduce the vessel traffic on the Neches River, and this would reduce (but not eliminate) the economic viability of the proposed SNWW CIP. |
| 5 | Past and present trends in infrastructure and fleet investments indicate that industry intends to continue using the Neches River Channel. An increase in the number of specially designed SNWW vessels was recently completed by one company, and another has invested in Neches River dock modifications for larger vessels. Significant facilities located on the Neches River Channel continue to be a focus of industry investment. Alternatives such as an unloading terminal along the Sabine Pass or Port Arthur Canal are discussed in FR Chapter IV (Non-Structural Alternatives-Alternative Mode of Commodity Transport) but would not address the needs of these users. |
| 6 | FEIS Sections 3.1.3 and 4.1.4 described the WVA community model, an ecological model that was used to assess and quantify impacts to fish and wildlife and their habitats. FEIS Appendix C, Section 2.6, describes all of the fish and wildlife species that were considered in developing the WVA model. Use of this model ensured appropriate consideration of the proposed project's effects on wildlife. |
| 7 | As demonstrated in FEIS Section 4.16 (Cumulative Impacts), the proposed SNWW CIP would not contribute to cumulative impacts in the study area because all impacts of the proposed SNWW CIP would be fully offset by compensatory mitigation, and the proposed project would have net beneficial effects on wetlands, water quality and SAV due to the extensive BU feature on the Neches River and the Gulf Shore BU feature. |
| 8 | FEIS Section 1.6 describes the ICT which is comprised of thirteen resource agencies from Texas, Louisiana and the Federal government. All of these agencies were involved throughout the study in determining what environmental studies needed to be done, |

| | |
|---|---|
| | reviewing study results, and screening and approving BU features and mitigation measures. The FEIS is explicit about the extensive involvement of all of these agencies in plan development. The resource agencies prepared their formal comments during the public comment period, and they are included in the FEIS, Appendix A. U.S. Fish and Wildlife Service (USFWS), which submitted its comments in the Coordination Act Report, agrees with the predicted project impacts, and proposed BU features and mitigation measures. U.S. Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), and the Texas Parks and Wildlife Department (TPWD) have also expressed approval of impact assessments, and BU and mitigation measures. |
| 9 | Potential impacts to shorebirds and the wintering Piping plover are presented in FEIS Section 4.12.2, 4.13.2, 7.6, and Appendix G. The USFWS has concurred that the Gulf Shore BU feature is not likely to adversely affect the Piping plover or its critical habitat. Effects on other wading shorebirds are expected to be similar. |
| 10 | FEIS section 2.5.3.2.2 (Gulf Shore BU Feature) contains an in-depth evaluation of the anticipated effects of regular shoreline nourishment at Texas and Louisiana points using maintenance material from Sabine Pass. The mobile material within the surf zone should generally migrate to the west at both Texas and Louisiana points. The additional fine-grained sediments could lower erosion rates in Texas through mudflat accretion and wave attenuation. If material was placed closer to the west jetty, it would likely migrate to the east, contributing to the Sabine fillet, rather than being carried further westward. |
| 11 | FEIS Sections 3.3, 3.4, 4.4 and 4.5 summarize water and sediment quality in the study area. Sampling will be performed by USACE as part of its maintenance dredging program. |
| 12 | Information presented relative to the MRGO project cannot be extrapolated directly to the proposed SNWW CIP. USACE has performed a suite of studies and modeling specifically for this project area, the results of which support the environmental impacts and proposed mitigation presented in the FEIS. A sensitivity analysis using the ADCIRC model was performed to determine what effect the proposed SNWW CIP might have on surge levels in the study area (Wamsley et al., 2010). The results of this analysis are presented in FR Chapter VIII, FEIS Section 4.1.5. All impacts of the proposed SNWW CIP would be fully offset by compensatory mitigation measures, and the proposed project would have net beneficial effects on wetlands, water quality and SAV due to the extensive BU feature on the Neches River and the Gulf Shore BU feature. |

# COMMENTS ON THE DRAFT EIS FOR THE SABINE NECHES WATERWAY IMPROVEMENT PROJECT

These comments are submitted on behalf of the Golden Triangle chapter of the Sierra Club. Our chapter includes members from Jefferson, Hardin, Orange and Chambers Counties.

We have four issues to raise with respect to the draft EIS for the Sabine-Neches Waterway channel Improvement project. These are:

(1) Inadequate assessment of the potential for continued degradation of critical marshland in the vicinity of a further channelized Sabine Neches waterway. The subsequent impact on residential communities and industry from potential further loss of these wetlands is not fully addressed in the EIS. 1

(2) Failure to consider the impact of dredge material disposal on wildlife and appropriateness of this material for beach replenishment to enhance desirability of local beaches for human use. 2

(3) No assessment of alternative concepts to satisfy the needs of the current waterway users with respect to offloading oil, which appears to be the primary driver for a deeper channel. 3

(4) Lack of documented input from USFWS and TPWD on impact of additional channelization on adjacent marshes, fishery nursery areas, and on wildlife in the several WMAs and NWRs located adjacent to the waterway and encompassed by the proposed project. 4

These issues are elaborated further in the following remarks.

(1) Deepening the channel may well add significantly to the total volume of constricted water susceptible to being wind driven in a storm surge. It is now well understood what happens to a constricted waterway when a hurricane moves up a channel as was the case during Katrina in New Orleans. The Mississippi River Gulf Outlet, somewhat similar to the Sabine waterway, and built by the Corps, was found to contribute significantly to the New Orleans disaster. Indeed, the U.S. District Court for the Eastern District of Louisiana found that the Corps was responsible for much damage to plantiffs because, in part, of an arbitrary and capricious EIS and a failure on the part of the Corps to protect the marshes in the vicinity of the river outlet.

The initial Sabine Waterway construction has contributed significantly to marsh degradation over most of the 20th century but in recent years through massive and costly efforts by state and local officials, stabilization of marshlands in the vicinity of the waterway has been somewhat achieved. Hurricane Ike demonstrated the need for adequate marsh lands to absorb storm surge.

In light of these recent disasters, the finding by the US. District court and coupled with knowledge of the impact of the Sabine waterway, as it currently

exists, on surrounding marshland leads us to conclude that a risk-benefits analysis of further channelization should be undertaken. Input from hurricane and disaster specialists, biologists, ecologists and community leaders are required before such a project is undertaken. We believe that such a study may well show that the risks to the larger community of proceeding with this project may far outweigh the perceived financial benefit to one small segment of the population.

(2) Every dredging project requires spoils disposal and this project will generate significant spoils for disposal. The upper Texas coast has much experience with dredging for beach replenishment from dredging Rollover Bay for Bolivar beaches to offshore Galveston area dredging to replenish beaches to support a dynamic tourist trade on Galveston Island. Geologists and ecologists have learned that only certain types of dredge material will suffice for beach replenishment. There is no evidence whatsoever from the EIS that the dredge material from Sabine Neches is suitable for beach replenishment to sustain beach wildlife or to create an aesthetically pleasing environment for human use. In fact, the proposal to dump some of the spoils along the Texas and Louisiana beaches seems more along the lines of the mindset of the 19th century when the beach was the dumping ground for all manner of waste. We believe a careful scientific assessment of the material from such a dredge project should be undertaken with a view that all possibilities need be considered with respect to what to do with the dredge material. This might consist of construction of birding islands in Sabine Lake, such as those built in Galveston Bay following dredging of the Houston ship channel or other such uses as might be deemed appropriate. The arbitrary decision to dump spoils at Texas Point may well have disastrous impact of shore bird populations and the viability of the Texas Point National Wildlife Refuge.

(3) The project goal is to increase the efficiency of the waterway yet alternatives to the proposed project have been only cursorily considered. For example, construction of an offshore oil port would remove most of the tanker traffic from the Sabine waterway and significantly improve its efficiency. This is a viable and proven alternative as has been demonstrated with the Louisiana Offshore Oil facility. It benefits from minimal environmental impact, is easy to expand as tankers increase in size and is done without cost to the taxpayer. Oil transport from the port via pipeline is safe and much more environmentally friendly than moving large tankers through narrow constricted waterways. The recent oil spill due to collision in the narrow Sabine waterway attests to this fact as a near environmental disaster akin to the Exxon –Valdez spill was only narrowly averted by the heroic actions of Coast Guard, state and local officials.

(4) The upper Texas coast and the La coastal areas are among the richest fishing grounds in the world and supply nearly half of the seafood across the U.S. These fisheries are dependent on a healthy marsh system as nursery grounds. Increasing salinities endanger these fishing grounds and hence endanger a significant food supply across the U.S. We believe it is imperative that input from USFWS and TPWD be aggressively sought and considered before a project that could

substantially impact Texas and La commercial and recreational fishery is undertaken. Further, three federal NWR and three state WMA are encompassed by this project. These refuges were acquired at great public expense to protect and nurture wildlife. We find little or no comment in the EIS on the impact this project will have on these sensitive set-aside areas. Finally, we noted that the National Marine Fishery Agency has expressed grave concerns about the potential for damage to marsh, Sabine lake fishery nursery areas and indeed damage to the entire lower Sabine-Neches watershed . (page 698 of EIS draft under Public comments). We find their assessment most alarming.

Lastly, we have reviewed the many public comments appended to the EIS and find recommendations cited in three of these documents as particularly compelling for follow through. We believe each of the 244 recommendations proposed by the Stream Properties Management Group, Inc. (Lake Charles, La) in the public comments (pages 739-754) should be carefully evaluated and discussed individually in the EIS; we recommend the technical analysis proposed by TPWD (page 709) be implemented; and we concur with the recommendations proposed by the Louisiana Sierra Club (page 786).

We also request you elaborate further on the adverse environmental impact and unavoidable consequences of the dredge disposal plan documented by your consulting group on page 870 of the draft EIS.

John Wesley Paul, Ph.D
Conservation Chair
Golden Triangle Sierra Club
13005 Beaverbrook St.
Lumberton, Texas 77657

Mr. John Wesley Paul, Ph.D.
Conservation Chair
Golden Triangle Sierra Club
13005 Beaverbrook Street
Lumberton, TX 77657

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Potential impacts of the proposed SNWW CIP to marsh in the study are thoroughly analyzed in the FEIS (see Sections 1.4.2, 3.5, 3.9.4, 4.6 and 4.10). All impacts of the proposed SNWW CIP would be fully offset by compensatory mitigation measures, and the proposed project would have net beneficial effects on wetlands, water quality and SAV due to the extensive BU feature on the Neches River and the Gulf Shore BU feature. USACE has performed a suite of studies and modeling specifically for this project area, the results of which support the environmental impacts and proposed mitigation presented in the FEIS. A sensitivity analysis using the ADCIRC model was performed to determine what effect the proposed SNWW CIP might have on surge levels in the study area (Wamsley et al., 2010). The results of this analysis are presented in FR Chapter VIII, FEIS Section 4.1.5. |
| 2 | FEIS section 2.5.3.2.2 (Gulf Shore BU Feature) contains an in-depth evaluation of the anticipated effects of regular shoreline nourishment at Texas and Louisiana points using maintenance material from Sabine Pass. Potential impacts to shorebirds and the wintering Piping plover are presented in FEIS Section 4.12.2, 4.13.2, 7.6, and Appendix G. The USFWS has concurred that the Gulf Shore BU feature is not likely to adversely affect the Piping plover or its critical habitat. The proposed Gulf Shore BU feature is supported by USFWS, NMFS, TPWD and the Texas Point National Wildlife Refuge. |
| 3 | The DFR and DEIS are designed to complement one another, and both were provided for public review. The economic analysis presented in FR Chapter 5, and FR Appendix 2, describes significant benefits from channel deepening for refined petrochemical products, LNG, and dry bulk products, in addition to crude oil. The analysis acknowledges that an expansion of LOOP or construction of a similar facility in Texas would reduce the vessel traffic on the Neches River, and this would reduce (but not eliminate) the economic viability of the proposed SNWW CIP. |
| 4 | FEIS Section 1.6 describes the ICT which is comprised of thirteen resource agencies from Texas, Louisiana and the Federal government and includes representatives from NWRs and WMAs in the study area. All of these agencies were involved throughout the study in determining what studies needed to be done, reviewing study results, and screening and approving BU features and mitigation measures. The FEIS is explicit about the extensive involvement of all of these agencies in plan development. The resource agencies prepared their formal comments during the public comment period, and they are included in the FEIS, Appendix A. USFWS, which submitted its comments in the Coordination Act Report, agrees with the predicted project impacts, and proposed BU features and mitigation measures. EPA, NMFS, and TPWD have also expressed approval of impact assessments, and BU and mitigation measures. |

TARGA

Targa Midstream Services Limited Partnership
1000 Louisiana, Suite 4300
Houston, Texas 77002

March 10, 2010

**VIA E-MAIL AND REGULAR MAIL**

Ms. Janelle Stokes
Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77563-1229
**E-Mail:** janelle.s.stokes@usace.army.mil

Re: Targa Resources, Inc.
Sabine-Neches Waterway Project and Study

Dear Ms. Stokes:

On behalf of Targa Midstream Services Limited Partnership, we are submitting comments concerning the Draft Feasibility Report (DFR) and the Draft Environmental Impact Statement (DEIS) concerning the above referenced project. Prior to the release of the DFR on December 24, 2009, there was no prior communication by the sponsor of the proposed project with Targa regarding potential pipeline relocation issues or the project in general. The DFR that was made available in December describes a large number of pipelines which carry a variety of products whose relocations will be required by the project. At least two of those pipelines identified in the project are owned by Targa Midstream Services Limited Partnership (successor to Dynegy Midstream Services Limited Partnership). Our review of the DFR and DEIS prompts Targa to submit the following comments for your consideration:

1. **There appears to be inadequate evaluation of the costs associated with relocation of the pipelines at issue.** 1

The DFR and DEIS indicate that 42 pipelines will require relocation and 6 abandoned pipelines will require removal. (Review of documents provided by the Corps suggests that number may be as high as 50 pipelines.) While there is a recognition in the DFR and DEIS that 50% of the costs would be borne by the non-federal sponsor, it is also suggested that the remaining 50% would be borne by pipeline owners. The DFR does not provide any confirmation by the sponsoring entity (Sabine Neches Navigation District) that it has the financial wherewithal to be responsible for the 50% stated by the Corps. More importantly, there is no detailed discussion within the DFR or DEIS which indicates the true anticipated costs of these proposed relocations. Targa's pipelines are in open water and many different considerations must be taken into account than for lines that are onshore. Not only is timing an important consideration as to when an offshore pipeline can be relocated or abandoned, plans to decommission and relocate/abandon a pipeline must also have other federal agency approval. As the Corps is aware, the Department of Interior – Mineral Management Services ("MMS") determines how pipelines in the Gulf are to be relocated or abandoned. Performing a relocation or removal of a

pipeline would require at the very least: retention of barge(s) to provide divers to survey the area and confirm the location and depth of Targa's line(s) in the Outer Continental Shelf; provision of protocols that ensure all applicable environmental standards and requirements are incorporated into the relocation/abandonment; shut in of gas from the producers on the pipeline; flushing and pigging the pipeline; exposing the line; 'jetting' the line to lower it; cutting and capping in order to remove a portion of the line for the required depth; installation of the required length of pipe once the fairway has been jetted to the required depth; covering of the line; hydrotesting and pigging the line for water removal; and purging and filling the line with gas prior to operation. It has been the experience of Targa that even simply capping and abandoning a pipeline can cost multiple millions of dollars. The above costs for such a forty year old line could range from $5 to $10 million or more.

Likewise, there is no discussion in the DFR or DEIS as to the mechanism by which the pipeline owners will be compelled to pay 50% of the costs. What is the Corps timetable for its recommendation of funding of the project by the Sabine Neches Navigation District (the "District")? It should be noted that a number of the pipelines were placed pursuant to permits which may not have included such requirements. Thus, the ultimate cost of relocation of those pipelines may be the subject of expropriation litigation; and there is no discussion if the DFR or the DEIS about the costs associated with that type of litigation and/or the results of same. Further, there is no discussion as to whether these potential costs would be included in the 50% reimbursable costs by the District.

2. **There is no discussion in the DFR or DEIS concerning scheduling of the proposed relocations.** 2

As noted by one previous commentator, the relocation of pipelines requires years of advance planning and coordination and generates significant operational and engineering burdens on the pipeline owners industry in general. Likewise, there are a limited number of pipeline construction companies with limited assets; and there is no discussion in the DFR or DEIS about the availability of equipment and engineering expertise to plan and coordinate the pipeline relocations and no discussion on the impact on the Nation as a whole of this massive disruption of current pipeline capacity.

3. **There is no discussion in the DFR or DEIS regarding the impact on wells serviced by the pipelines or customers served by the pipelines.** 3

There is no doubt that, when a pipeline is to be relocated, the wells serviced by that pipeline must be shut in and the lines purged. In such an instance, a number of those wells will not return to production; and there is no discussion in the DFR or DEIS regarding the number of such wells and the impact (both with regard to well owners and the American economy in general) resulting therefrom. In addition, there is no discussion as to the potential expropriation and/or damage litigation which may result from the loss of such wells. Further, as the Corps is aware, all production leases currently in the outer continental shelf are leased from the Mineral Management Services. There is no discussion as to how the interruption in production will impact on these individual producers and/or the MMS (for the benefit of the public) who has royalty interest in these wells. More importantly, there is no discussion as to the impact non-production of the wells will have on any termination provisions in these MMS leases.

In addition, the impacted pipelines provide a substantial portion of the energy supplies to both residential customers and industrial/power plant customers. The timing of the relocations and the coordination of such efforts is needed to reduce the impact on those customers of suddenly losing their supplies when the pipelines are taken out of service so that they can be relocated. Targa believes this issue has not been adequately addressed nor does there seem to be a plan in place to mitigate the harm

to customers, whether those are customers who depend on natural gas for household use or depend on the feedstock and fuel to keep industrial facilities and electric generation plants running.

4. **There is no discussion in the DFR or DEIS regarding the potential environmental impacts associated with relocating 42 pipelines** 4

As noted above, the relocation of a pipeline will require significant planning and creates an environmental risk of releases during relocation activities. The documents provided by the USACE indicate that the pipelines carry a variety of products including natural gas, ethylene, oxygen, nitrogen, butadiene, hydrogen, ethanes, and refined products; and there is no discussion in the DFR or DEIS regarding the potential environmental impacts associated with a release of such products during relocation activities. As to relocation of pipelines in the Outer Continental Shelf, there are regulations relating to searching for any possible obstructions, historic relics, environmental contaminants, etc., and there is no discussion regarding the magnitude of such potential hazards or the costs of avoiding same. In addition, the physical act of relocating pipelines causes disruptions to the seabed; and there is no discussion in the DFR or DEIS regarding potential environmental impacts associated with this significant amount of offshore construction.

5. **There is no discussion in the DFR or DEIS regarding potential alternative channel extensions.** 5

Neither the DRF or DEIS discusses alternative channel extension locations and there is no discussion whether any such alternatives would reduce the negative impacts discussed above. There does not appear to have been any analysis done as to alternative locations for the placement of spoil or different angles of approach for the channel extension. It would appear that changes in the angle and location of the spoil would eliminate the impact on at least some of the pipelines at issue.

6. **There has been inadequate discussion of alternative methods to achieve economic growth in the area in question.** 6

Several participants at various public meetings expressed serious concern about the environmental impacts associated with deepening the existing channel and creating a channel extension as discussed in the DFR and DEIS with particular concern to damage to Louisiana's wetlands estuaries and wildlife. Those commentators inquired as to whether comparable economic benefit could be obtained by the construction of an offshore port with a pipeline into the port at issue. Neither the DFR nor the DEIS discuss these comments or appear to consider this alternative.

7. **There is no discussion in the DFR or DEIS regarding the potential environmental impacts associated with storm surges resulting from the deepening the channel in relationship to on-shore facilities.** 7

While there has been some discussion (minimal at best) in the DFR and/or DEIS about the environmental impact of relocating or abandoning of lines, there is no discussion as to the impact on on-shore facilities from possible storm surges that could result from the deepening of the Sabine Pass, the Sabine Pass Jetty Channel, Sabine Pass Outer Bar Channel and the widening, deepening and extending of the Sabine Bank Channel. The Corps itself acknowledges that the only connection with the Gulf of Mexico is a long narrow pass called the Sabine Pass Benters from deep water in the Gulf through the Entrance Channel, which is divided into the Sabine Bank Channel and the Sabine Pass Outer Bar Channel. Targa has plants no more than twenty five miles from the mouth of the Sabine Pass. As the Corps is acutely aware, the deepening of the waterways in St. Bernard Parish was a cause

of most of the flooding that occurred in New Orleans during Hurricane Katrina in 2005. Indeed, a lawsuit against the Corps after Hurricane Katrina argued that the deepening of the St. Bernard waterway resulted in providing no protection to those persons and property on shore. The DFR and DEIS fail to address any flood protection system for those oil and gas facilities on shore should another Category 3 or greater hurricane come on shore at or near that part of Louisiana and Texas.

Targa believes that the real impact – and the real cost – of the project cannot be estimated with any accuracy until the issues identified have been addressed. Targa would, therefore, request that the Corps not recommend proceeding with requiring the relocation or abandonment of the affected pipelines until the impact, the cost and the reimbursement of costs have been fully addressed and costs obtained with reasonable certainty. 8

Targa appreciates being given the opportunity to provide these comments and stand ready to provide the Corps with any additional information it may request.

Respectfully submitted,

TARGA MIDSTREAM SERVICES
LIMITED PARTNERSHIP

By: _____
Roy E. Johnson
Executive Vice President

Mr. Roy Johnson
Executive Vice President
Targa Midstream Services Limited Partnership
1000 Louisiana, Suite 4300
Houston, TX 77002

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The USACE feasibility study estimate of pipeline relocation costs was developed by USACE to estimate the fully funded cost allocation between USACE and the non-Federal sponsor. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. FEIS Section 2.4.1.12 presents a discussion of the allocation of pipeline relocation costs between the non-Federal sponsor and pipeline owners. |
| 2 | A preliminary construction schedule has been developed (Engineering Appendix Addendum 2009, chapter 14.0 REVISED SCHEDULES FOR DESIGN AND CONSTRUCTION) and is available upon request. However, the actual time table for project construction is uncertain at this time because it is dependent upon ASA and OMB approval of the Chief's Report, Congressional authorization and Congressional appropriation of funds. |
| 3 | USACE will provide estimated construction contract start and end dates as soon as they are available, so that owners can schedule their relocations as they see fit, ensuring completion of the relocation prior to the award of the contract for that portion of the channel. USACE will ensure that channel construction contractors work with pipeline companies as needed to accommodate all parties for a safe and effective working plan. |
| 4 | Potential environmental impacts of relocating pipelines to a deeper depth are assumed to be minimal. However, each pipeline relocation is case specific, and coordination with USACE-Galveston Regulatory Branch would be required in each case. Relocating a pipeline and placing it deeper would not necessarily require a new permit. If a pipeline is being moved to a new location, then the impacts would be evaluated by the environmental assessment performed in conjunction with the DOA permit. |
| 5 | Alternatives to the proposed channel extension are limited due to the bearing of the existing Sabine Bank Channel. Alternatives for offshore placement areas are thoroughly discussed in FEIS, Appendix B. |
| 6 | Non-structural alternatives, including new offshore ports like LOOP are thoroughly analyzed and presented in FR Chapter IV.D and FEIS Section 2.2.2. |
| 7 | A sensitivity analysis using the ADCIRC model was performed to determine what effect the proposed SNWW CIP might have on surge levels in the study area (Wamsley et al., 2010). The results of this analysis are presented in FR Chapter VIII, FEIS Section 4.1.5. |
| 8 | See USACE response to Comment 1. In addition, USACE recognizes that project costs may change as definitive plans for relocations (including utility relocations) are developed. FR Section XIII.D makes provisions for updating the economic evaluation to reflect additional associated costs identified during preparation of contract plans, and for notifying the affected pipeline owners. |

# COMMENT FORM

**Sabine - Neches Waterway Channel Improvement Project**
**January 27, 2010**
**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**

US Army Corps of Engineers
Galveston District

__ I am a Public Official

Name and Mailing Address (Optional):

Name David Richard
Address P.O. Box 40, Lake Charles, LA 70602
Email Address drichard@streamcompany.com
Phone 337-433-1055 ext. 119

**PLEASE CHECK THE APPROPRIATE ITEMS BELOW:**
**I am primarily interested in the project from the standpoint of a:**

__ Residential property owner or renter __ Business property owner or lessee
__ Other (Please explain) Large Private Wetland Owner adjacent to Sabine Lake & GIWW

How did you learn about this meeting?

__ Newspaper __ Notice in the Mail ✓ Email

__ Other (Please explain) _____

COMMENTS: I do not feel the mitigation requirements meet the changes in hydrology caused by the channel improvements. No plans have been submitted to combat increases in tidal amplitude and salinity in Sabine Lake and the vast marshes that are influenced by these detrimental factors to mitigate the effects. The dredging of the GIWW is not acceptable as a source of dredged material for beneficial use applications as proposed. Erosion on the GIWW currently is not addressed & the deepening of the GIWW will cause more land loss and endanger a huge pipeline corridor on the South Embankment. The Sabine River will need these beneficial use areas in the future so this option with no land rights is unacceptable. 1 2

Please make additional comments on the back.

These comment forms can be turned in tonight, mailed or emailed to the addressee below postmarked by February 10, 2010 to:

**USACE – Galveston District**
**Attn: Ms. Janelle Stokes**
**P.O. Box 1229**
**Galveston, Texas 77553-1229**
**Janelle.S.Stokes@usace.army.mil**

Mr. David Richard
P.O. Box 40
Lake Charles, LA 70602

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Given the fact that impacts of the proposed SNWW CIP are related primarily to salinity intrusion, extensive efforts have been made to identify effective mitigation measures that could minimize or eliminate the projected increase in salinity and tidal amplitude. The results of this effort are presented in FEIS Section 5.4.1.1. None of the salinity control structures were selected because the net effect of the structures was determined to be negative. Beneficial salinity effects were modest and could not overcome the adverse effects of restrictions to marine organism access. |
| 2 | Engineering design would minimize impacts to the Gulf Intracoastal Waterway (GIWW) shoreline to the greatest extent possible; instability of emergent shorelines is not anticipated because dredging would remove accumulated maintenance material only, as described in FEIS Section 5.5.2. In situ sediments beside and below the existing GIWW channel would not be disturbed. However, should analyses determine that stabilization of small areas is needed, USACE would propose stabilization plans at that time. |

## Stokes, Janelle S SWG

**From:** Winn, Melinda [Melinda_Winn@kindermorgan.com]
**Sent:** Friday, March 12, 2010 12:52 PM
**To:** Stokes, Janelle S SWG
**Subject:** Kinder Morgan Comments regarding DFR/DEIS for proposed Sabine Neches Waterway Channel Improvement Project

**Attachments:** Janelle_Stokes_US_Army_Corps_03122010.pdf

Janelle_Stokes_US_
Army_Corps_0...

Ms. Stokes,

Please find attached here Kinder Morgan's comments to the (1) Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Draft Environmental Impact Statement Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Sites Designation and (2) the Draft Feasibility Report for the proposed Sabine Neches Waterway Channel Improvement Project. Please include them in the administrative record.

Thank you,

Melinda K. Winn
Assistant General Counsel

Kinder Morgan Energy Partners, L.P.
One Allen Center
500 Dallas St., Ste 1000
Houston, TX 77002

Phone 713.369.8780
Fax 303.984.3737

KINDER MORGAN

March 12, 2010

***VIA EMAIL TO Janelle.s.stokes@usace.army.mil***
***And First Class U.S. Mail***
U. S. Army Corps of Engineers
Galveston District
P. O. Box 1229
Galveston, Texas 77553-1229

Attn: Ms. Janelle Stokes

Re: Comments regarding DFR/DEIS for proposed Sabine Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

Kinder Morgan affiliates include pipeline companies that have facilities located within the project area of the proposed Sabine Neches Waterway ("SNWW") Channel Improvement Project. Kinder Morgan is diligently performing a review of the proposed project. We have assembled a team comprised of land, legal, environmental, engineering, and operations representatives that is reviewing and analyzing the preliminary project plans and the limited information regarding existing pipeline river crossings in the DFR and DEIS.

By this letter, Kinder Morgan offers its comments on (1) the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Draft Environmental Impact Statement Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Sites Designation (collectively, the "DEIS") and (2) the Draft Feasibility Report for the proposed Sabine Neches Waterway Channel Improvement Project (the "DFR"). Your original letter and announcement were silent as to whether comments also were invited on the DFR, but representatives of the Corps of Engineers (the "Corps") subsequently advised that comments also were being accepted on the DFR.

The DFR and DEIS indicate that the proposed project will require a large number of pipeline relocations and removals, including at least six owned by Kinder Morgan affiliates, but Kinder Morgan is unaware of any prior effort to coordinate the project's planning with pipeline owners and operators, even though it is common knowledge that pipelines lace the area impacted by the proposed project. In fact, Kinder Morgan understands that the Corps declined to meet with representatives of the pipeline industry. Kinder Morgan's comments in this letter are intended to be as complete as possible given the lack of important details in the multi-volume DFR or DEIS and the Corps's refusal of the pipeline industry's request for additional 1

information and a more realistic comment period (120 days from the date of issue on December 24, 2009). Kinder Morgan reserves its rights to comment further upon receipt of additional information about the project.

The replacement of pipelines like Kinder Morgan's, that transport essential commodities such as natural gas and natural gas liquids, is not only costly, it also requires years of advance planning and coordination, and creates significant operational, engineering and environmental permitting burdens. Particularly in congested areas such as the Sabine Neches Waterway, where there are multiple pipelines owned by multiple companies, the relocation of a significant number of pipelines requires a comprehensive and coordinated planning process. Yet the DFR and DEIS provide little detail about the proposed project's impact on pipeline operations, which pipelines will need to be relocated, the depths and locations to which those pipelines will be relocated, how Corps permits for these pipeline relocations would be addressed, or how costs were estimated or projected for pipeline relocations. In fact, the DFR and DEIS appear to be based on a single spreadsheet, *dated September 30, 2005*, with what appears to be the Corps's working list of pipelines that may be impacted by the project. The engineering narrative (chapter 13 of the DFR Appendix) indicates that "relocated lines were assumed to be directionally drilled, and bundled when possible," but no detail is provided that would identify which pipelines were assumed to be bundled, or permit a reader to understand the logic – let alone the accuracy – of the Corps' feasibility and cost assumptions. Nor do the DFR and DEIS reflect any consideration of the lead time and expense required to obtain the permits required for the pipeline relocations, *e.g.*, environmental studies, environmental surveys, agency reviews and evaluations. 2

Finally, Kinder Morgan asks that the Corps reject the ongoing behind-the-scenes effort to circumvent the long-established federal law for 50/50 cost-sharing on pipeline relocations in deep-draft projects and declare its opposition to any change in the cost-sharing allocation. The SNWW project proposed by the Corps and the local sponsor has an authorized depth of 48 feet and so clearly constitutes a deep-draft project. Federal law (the Water Resources and Development Act of 1986, known as "WRDA 86") mandates that in all deep-draft projects, the costs of utility (pipelines) relocations must be DIVIDED EQUALLY between the pipeline owner and the local sponsor of the project. The Corps acknowledges this federal legal requirement in the "Cost Sharing" section of the DFR: "In accordance with Section 101(a)(4) of WRDA 86, 50 percent of deep-draft utility (pipeline) relocations would be borne by the utility owner and 50 percent would be borne by the non-Federal sponsor," *i.e.*, the Sabine Neches Navigation District (page XI-5). The campaign to sidestep WRDA 86 and shift costs to private industry ignores the fact that pipeline operations will not benefit from the project and will be forced, even under the 50/50 formula, to incur substantial out-of-pocket costs and relocation-related service interruptions. 3

Kinder Morgan respectfully requests that the Corps promptly: 4

1. definitively identify the Kinder Morgan pipelines that will be impacted by the project;
2. provide Kinder Morgan sufficient information to understand the Corps' estimate of the costs for removing or relocating each such pipeline;

3. provide Kinder Morgan with whatever additional documents or information are needed to understand the proposed project's impact on Kinder Morgan pipeline operations, including a projected timeline for when the relocations may actually be needed and how Corps permits would be addressed;
4. establish a working group or other appropriate method to bring the Corps and pipeline company representatives together to facilitate an information exchange; and
5. confirm that the cost-sharing requirement specified by WRDA 86 will be part of any Chief's Report or other report or recommendation the Corps makes regarding the project.

At your convenience, please contact me at the below telephone number.

Sincerely,

Dwayne Burton
Kinder Morgan Energy Partners, LP
Vice President, Operations and Engineering

713-369-9356 - office

Mr. Dwayne Burton
Vice President, Operations and Engineering
Kinder Morgan Energy Partners, LP
500 Dallas, Suite 1000
Houston, TX 77002

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The comment period on the DFR and DEIS was extended an additional 30 days to March 12, 2010. USACE met with pipeline owners at an information meeting on January 25, 2011. More information on project features that could affect pipelines will be provided as detailed plans are developed during PED and Construction phases. |
| 2 | The FR provides sufficient information for feasibility-level planning. A list of potentially affected pipelines was provided to pipeline companies during the DEIS public comment period. The USACE list of potentially affected pipelines should not be considered definitive. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. There will be sufficient time for pipeline companies to make necessary preparations after the project is approved. Each pipeline relocation is case specific, and coordination with USACE-Galveston Regulatory Branch would be required in each case. Relocating a pipeline and placing it deeper would not necessarily require a new permit. If a pipeline is being moved to a new location, then the impacts would be evaluated by the environmental assessment performed in conjunction with the DOA permit. |
| 3 | Please see Section 2.4.1.12 of this FEIS for a discussion of the allocation of pipeline relocation costs. |
| 4 | Please refer to USACE responses 1-3 above. |

## Stokes, Janelle S SWG

**From:** Keeter, Lori [LKeeter@eprod.com]
**Sent:** Friday, March 12, 2010 9:53 AM
**To:** Stokes, Janelle S SWG
**Subject:** Comments regarding DFR/DEIS for Proposed Sabine Neches Water Channel Improvement Project

**Attachments:** SNWW Project - Enterprise Comment Ltr 3-12-10.pdf; image001.jpg

SNWW Project - Enterprise Comm... image001.jpg

Ms. Stokes – Attached please find a letter from Enterprise Products Company (EPC) providing comments to the DFR and DEIS for the proposed Sabine Neches Waterway Channel Improvement Project. A hard copy of this letter is being sent to your attention via First-Class U.S. Mail.

Please contact me if you have any questions. Regards, Lori Keeter

Gloria L. (Lori) Keeter / Senior Manager / Land Department

PO Box 4324, Houston, TX 77210-4324

2727 North Loop West, Houston, TX 77008-1044

713.803.2555 office / 713.301.0665 cell / 713.803.2627 fax

PLEASE NOTE THAT MY EMAIL ADDRESS HAS CHANGED TO: glkeeter@eprod.com
<mailto:glkeeter@epco.com>

EnterpriseProductsLogo.bmp

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This message (including any attachments) is confidential and intended for a specific individual and purpose. If you are not the intended recipient, please notify the sender immediately and delete this message.

Enterprise Products

SENT VIA EMAIL TO Janelle.s.stokes@usace.army.mil AND FIRST-CLASS U.S. MAIL

March 12, 2010

U. S. Army Corps of Engineers
Galveston District
Attn: Ms. Janelle Stokes
P. O. Box 1229
Galveston, Texas 77553-1229

Re: Comments regarding DFR/DEIS for proposed Sabine Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

Enterprise Products Company ("EPC") is a pipeline company with facilities located within the project area of the proposed Sabine Neches Waterway ("SNWW") Channel Improvement Project (referenced herein as "SNWW Project").

The Enterprise family of companies is one of North America's largest midstream energy networks, providing services to producers and consumers of natural gas, natural gas liquids (NGLs), crude oil, refined products, liquefied petroleum gases (LPGs) and petrochemicals. The assets of the combined entities include more than 48,000 miles of onshore and offshore pipelines that gather and transport natural gas, NGLs, crude oil, petrochemicals, LPGs and refined products such as gasoline, diesel and jet fuel.

In late December 2009, EPC received correspondence inviting comments on the "Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Draft Environmental Impact Statement Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Sites Designation" (referenced herein collectively as "DEIS") and the Draft Feasibility Report (referenced herein as "DFR"). The deadline for comments on these reports is Friday, March 12, 2010.

EPC is diligently performing a review of the SNWW Project, and the following summarizes the ongoing activities. We have assembled a SNWW Project team comprised of corporate management, land, legal, regulatory, engineering, and operations department representatives. The EPC team is reviewing and analyzing the preliminary project plans and the limited information regarding existing pipeline river crossings in the DFR and DEIS.

The EPC team is also reviewing EPC pipeline asset records, and has identified pipeline facilities located in the SNWW Project area that may be effected by the proposed project. Approximately fifteen (15) EPC pipeline crossings ranging in size from 8-inch to 30-inch diameter have been identified as being located in the SNWW Project area. The Pipeline and Utility Table prepared by the U.S. Army Corps of Engineers ("COE") has tentatively identified six (6) EPC pipeline river crossings that may have to be relocated to accommodate the Project. Neches River pipeline crossing site visits and preliminary field survey reconnaissance operations have been conducted by EPC engineering and operations team representatives. Pipeline river crossing field survey and mapping operation plans are under development. A preliminary project composite base mapping system has been developed that is being utilized to composite and analyze EPC pipeline river crossing and SNWW Project information.

The purpose of this letter is to offer certain questions and comments regarding the DEIS and DFR.

1. Has a preliminary COE project schedule and project execution plan been developed? 1
2. Has a COE existing pipeline river crossing disposition evaluation plan and evaluation schedule been developed? 2
3. Has a COE existing pipeline river crossing relocation design and construction plan review and approval process been developed? 3
4. Since the project is designated in the DFR as a deep-draft harbor project, EPC requests a copy of the cost sharing and/or cost reimbursement plan that has been developed by the COE for pipeline relocation activities. Why hasn't the plan been made public as required by WRDA-86? 4
5. Has a pipeline relocation construction schedule and execution plan been developed? 5
6. Has COE developed any preliminary pipeline crossing relocation cost estimate information? 6
7. Have COE and other regulatory agency pipeline waterway crossing relocation permit requirements been determined and has the permit acquisition related time line been incorporated into the overall SNWW Project schedule? 7
8. Given the complexity of the relocations, has the COE factored into the time schedule the required logistics to coordinate multiple pipeline relocation construction operations between pipeline owners and operators? 8
9. Has the COE defined the location of all of the dredge disposal sites? The information provided for review is inadequate, and EPC requests more detailed information to determine effect on existing facilities. 9

Based upon the DFR, this project, as proposed, would be a deep-draft harbor project for cost sharing purposes under the Water Resources and Development Act of 1986. Under this law, half of the pipeline relocation costs for a deep-draft harbor project must be borne by the pipeline owner and the other half by the local sponsor of the project. Please confirm that this cost-sharing requirement will be part of any Chief's Report or other report or recommendation the Corps may make regarding the project. 10

The replacement of pipelines that transport essential commodities that EPC handles is costly and requires years of advance planning and coordination. A project such as this creates substantial operational and engineering burdens for an industry that has strategic significance for the American economy. In congested areas such as the Sabine Neches Waterway, the relocation of a significant number of pipelines must be preceded by a comprehensive and coordinated planning process. The DFR and DEIS provide little detail about the proposed project's impact on pipeline operations, which pipelines will need to be relocated, where those pipelines are located, or how costs were estimated for pipeline relocations. There also appears to have been no consideration of the lead time requirements and additional expense that will be required for planning and coordination in the instance of multiple simultaneous pipeline relocations.

EPC believes that it is important for the COE to meet with EPC representatives and other pipeline company representatives in order to address the numerous questions detailed herein and facilitate an exchange of information. However, EPC understands that the COE is refusing such a meeting. We do not understand how a lack of communication helps anyone in dealing with issues as complicated as pipeline relocations in an area as congested with pipeline operations as the Sabine Neches Waterway, and we respectfully request that the COE reconsider its position and allow an adequate opportunity for dialogue and for meaningful comment.

At your convenience, please contact Lori Keeter, Senior Land Manager, at 713-803-2555.

Very truly yours,

Delbert W. Fore

Delbert W. Fore
Vice President, Governmental Affairs

Mr. Delbert W. Fore
Vice President, Governmental Affairs
Enterprise Products
2727 North Loop West
Houston, TX 77008

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | A preliminary construction schedule has been developed (Engineering Appendix Addendum 2009, chapter 14.0 REVISED SCHEDULES FOR DESIGN AND CONSTRUCTION) and is available upon request. However, the actual time table for project construction is uncertain at this time because it is dependent upon ASA and OMB approval of the Chief's Report, Congressional authorization and Congressional appropriation of funds. |
| 2 | USACE has developed a preliminary pipeline river crossing evaluation plan. More information on project features that could affect pipelines will be provided as detailed plans are developed during the PED and Construction phases. |
| 3 | The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED or Construction phase, and decisions regarding relocations will be made individually for each pipeline at that time. For the feasibility study, it was assumed that existing pipelines would require, as a minimum, 5 feet of cover if the pipeline has been installed by directional drilling; or 8 feet of cover if it had been ditched/trenched and backfilled. |
| 4 | Please see Section 2.4.1.12 of this FEIS for a discussion of the allocation of pipeline relocation costs. |
| 5 | During the PED and Construction phases, USACE will provide estimated construction contract start and end dates to pipeline owners as soon as they are available, so that owners can schedule their relocations as they see fit, ensuring completion of the relocation prior to the award of the contract for that portion of the channel. |
| 6 | The USACE feasibility study estimate of pipeline relocation costs was developed by USACE to estimate the fully funded cost allocation between USACE and the non-Federal sponsor. |
| 7 | Potential environmental impacts of relocating the pipelines and replacing them at a deeper depth are assumed to be minimal. However, each pipeline relocation is case specific, and coordination with USACE-Galveston Regulatory Branch would be required in each case. Relocating a pipeline and placing it deeper would not necessarily require a new permit. If a pipeline is being moved to a new location, then the impacts would be evaluated by the environmental assessment performed in conjunction with the DOA permit. |
| 8 | USACE will ensure that channel construction contractors work with pipeline companies as needed to accommodate all parties for a safe and effective working plan. |
| 9 | Yes, all locations of the dredge material placement areas have been defined and described in the FR/FEIS (FR Chapter VI; FEIS Section 2.4). |
| 10 | Please see Section 2.4.1.12 of this FEIS for a discussion of the allocation of pipeline relocation costs. |

Chevron

Global Gas

Dolores Barnhill
Senior VP, Asset Management

Chevron Pipe Line Company
4800 Fournace Place
Bellaire, TX 77401

March 12, 2010

U. S. Army Corps of Engineers
Galveston District
Attn: Ms. Janelle Stokes
P. O. Box 1229
Galveston, Texas 77553-1229

Re: Comments regarding DFR/DEIS for proposed Sabine Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

Chevron Pipe Line Company on its own behalf and on behalf of certain affiliated companies ("Chevron") operates pipeline assets that transport crude oil, petroleum products, liquefied petroleum gas, natural gas and chemicals within the United States and its territorial waters. Chevron has facilities located within the proposed Sabine Neches Waterway ("SNWW") Channel Improvement Project area, and to the extent possible has been diligently performing a review of the proposed project. We have assembled a team comprised of land, legal, environmental, engineering, and operations representatives that is reviewing the preliminary project plans and the limited information provided regarding impacts on existing pipeline river crossings.

With the time provided and limited pipeline specific data, Chevron is struggling to provide any meaningful comments by the specified deadline of March 12, 2010. A more realistic comment period would allow at least 120 days from the date of issue (December 24, 2009), and we therefore respectfully request that the comment period be extended to at least April 26, 2010. However, by receipt of this letter, Chevron offers initial comments on (1) the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Draft Environmental Impact Statement Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Sites Designation (collectively, the "DEIS") and (2) the Draft Feasibility Report for the proposed Sabine Neches Waterway Channel Improvement Project (the "DFR"). 1

The DFR and DEIS indicate that the proposed project may require a large number of pipeline relocations and removals, possibly at least four operated by Chevron, but we are

unaware of any ongoing efforts by any governmental agencies to coordinate the project's planning with pipeline owners and operators, even though it is common knowledge that pipelines significantly impact the proposed project area. The replacement of pipelines that transport essential commodities such as natural gas, natural gas liquids and chemicals is not only costly, it also requires years of advance planning and coordination, and creates significant operational, engineering and environmental permitting burdens. In congested areas such as the Sabine Neches Waterway, where there are multiple pipelines owned by multiple companies, the relocation of a significant number of pipelines requires a comprehensive and coordinated planning process.

The DFR and DEIS, however, provide little detail about the proposed project's impact on (1) pipeline operations, (2) horizontal and vertical pipeline relocations, or (4) methodology for relocation cost estimates. In fact, the DFR and DEIS appear to be based on a single spreadsheet, *dated September 30, 2005*, with what appears to be the Corps's working list of pipelines that may be impacted by the project. The engineering narrative (chapter 13 of the DFR Appendix) indicates that "relocated lines were assumed to be directionally drilled, and bundled when possible," but no detail is provided that would identify which pipelines were assumed to be bundled, or permit a reader to understand the accuracy of the Corps' feasibility and cost assumptions. The DFR and DEIS do not reflect any consideration for the lead time and expense required obtain the permits required for the pipeline relocations, *e.g.*, environmental studies, environmental surveys, agency reviews and evaluations.

Chevron respectfully requests that the Corps promptly:

1. definitively identify the Chevron pipelines that will be impacted by the project; 2
2. provide Chevron sufficient information to understand the Corps' estimate of the costs for removing or relocating each such pipeline; 3
3. provide Chevron with whatever additional documents or information are needed to understand the proposed project's impact on Chevron's pipeline operations, including a projected timeline for when the relocations may actually be needed and how Corps permits would be addressed; 4
4. establish a working group or other appropriate method to bring the Corps and pipeline company representatives together to facilitate an information exchange; and 5
5. confirm that the cost-sharing requirement specified by WRDA 86 will be part of any Chief's Report or other report or recommendation the Corps makes regarding the project. 6

At your convenience, please contact Rania Yacoub, at 713-432-3557.

Respectfully,

Dolores Barnhill

Ms. Delores Barnhill
Senior VP, Asset Management
Chevron Pipe Line Company
4800 Fournace Place
Bellaire, TX 77401

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The comment period was extended an additional 30 days to March 12, 2010. |
| 2 | A list of potentially affected pipelines was provided to pipeline companies during the DEIS public comment period. The USACE list of potentially affected pipelines should not be considered definitive. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. |
| 3 | The USACE feasibility study estimate of pipeline relocation costs was developed by USACE to estimate the fully funded cost allocation between USACE and the non-Federal sponsor. |
| 4 | A preliminary construction schedule has been developed (Engineering Appendix Addendum 2009, chapter 14.0 REVISED SCHEDULES FOR DESIGN AND CONSTRUCTION) and is available upon request. However, the actual time table for project construction is uncertain at this time because it is dependent upon ASA and OMB approval of the Chief's Report, Congressional authorization and Congressional appropriation of funds. Potential environmental impacts of relocating the pipelines and placing them at a deeper depth are assumed to be minimal. However, each pipeline relocation is case specific, and coordination with USACE-Galveston Regulatory Branch would be required in each case. Relocating a pipeline and placing it deeper would not necessarily require a new permit. If a pipeline is being moved to a new location, then the impacts would be evaluated by the environmental assessment performed in conjunction with the DOA permit. |
| 5 | USACE met with pipeline owners at an information meeting on January 25, 2011. More information on project features that could affect pipelines will be provided as detailed plans are developed during PED and Construction phases. |
| 6 | Please see Section 2.4.1.12 of this FEIS for a discussion of the allocation of pipeline relocation costs. |

TEXAS ENERGY COALITION

6207 Inwood Drive
Houston, TX 77057
713-622-7388 (ph)

**Supplemental Written Comments by Texas Energy Coalition Regarding**
**Proposed Sabine-Neches Waterway Channel Improvement Project DFR**

March 12, 2010

U. S. Army Corps of Engineers
Galveston District
Attn: Ms. Janelle Stokes [janelle.s.stokes@usace.army.mil]
P. O. Box 1229
Galveston, Texas 77553-1229

Re: Supplemental comments regarding DFR/DEIS for proposed Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

I am writing once again on behalf of the Texas Energy Coalition, a group of pipeline transmission companies that collaborate on issues of common interest. In my letter of February 9, 2010, the Coalition offered certain preliminary comments regarding the DEIS and DFR for the proposed Sabine-Neches Waterway Channel Improvement Project. The Coalition also posed a number of requests, which I will restate in summary fashion.

First, the Coalition requested an extension of time up to and through April 26, 2010, in which to make comments. 1

We have not received any response to that request.

Second, the Coalition requested that the Corps identify all pipelines that will be impacted by the project, provide sufficient information to understand and respond to the Corps' estimate of the costs for removing or relocating each such pipeline, and provide whatever additional documents are needed to understand the proposed project's impact on pipeline operations, including a projected timeline for when the relocations may actually be needed.

Again, the Corps has made no response to these requests. 2

Third, the Coalition also requested that the Corps meet with the Coalition and pipeline company representatives as soon as possible to facilitate the exchange of information and to confirm that the cost-sharing requirements for deep-draft relocations set forth in WRDA-86 will be part of any Chief's Report or other report or recommendation the Corps may make regarding the project.

Yet again, the Corps has made no response to these requests. 3

The Corps' refusal to provide sufficient information to make a reasoned response to the DFR and DEIS on a project estimated to cost more than $1 billion is troubling. The Corps' persistent refusal to produce documents related to pipeline relocations on this project – coupled with its refusal even to meet with representatives of the pipeline industry regarding a project that is located in one of the nation's most concentrated areas of pipeline development – is even more troubling. 4

The Coalition sees no rational basis for the manner in which the DFR and DEIS for this project have been presented and objects to the lack of transparency in the process of seeking public input on the project.

The Coalition reserves the right to make additional comments if and when the Corps reconsiders its position on these issues. If you wish to discuss them, please contact Denis Calabrese (713-622-7388) or David Corban (713-651-5251).

Very truly yours,

Denis Calabrese
Spokesperson

Mr. Denis Calabrese
Texas Energy Coalition
6207 Inwood Drive
Houston, TX 77057

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | USACE posted notice that the comment period was extended an additional 30 days to 3-12-2010 on the USACE website at http://www.swg.usace.army.mil/pao/Docs/Extensionof PublicCommentPeriodtoMarch12.pdf on February 8, 2010. |
| 2 | A list of potentially affected pipelines was provided to pipeline companies during the DEIS public comment period. The USACE list of potentially affected pipelines should not be considered definitive. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. There will be sufficient time for pipeline companies to make all of the necessary preparations after the project is approved. The USACE feasibility study estimate of pipeline relocation costs was developed by USACE to estimate the fully funded cost allocation between USACE and the non-Federal sponsor. |
| 3 | USACE met with pipeline owners at an information meeting on January 25, 2011. Please see Section 2.4.1.12 of this FEIS for a discussion of the allocation of pipeline relocation costs. |
| 4 | See USACE responses to Comments 2 and 3 above. |

**Colonial Pipeline Company**

**Sam Whitehead**
**Government Affairs Manager**

Phone: 678/762-2333
Fax: 678/762-2465
swhitehe@colpipe.com

SENT VIA EMAIL TO Janelle.s.stokes@usace.army.mil

March 12, 2010

U. S. Army Corps of Engineers
Galveston District
Attn: Ms. Janelle Stokes
P. O. Box 1229
Galveston, Texas 77553-1229

Re: Comments regarding DFR/DEIS for proposed Sabine Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

Colonial Pipeline Company has two pipelines within the project area of the proposed Sabine Neches Waterway ("SNWW") Channel Improvement Project. Each day, these two pipelines transport an average of 100 million gallons of gasoline, diesel fuels and national defense fuels to shipper terminals in 12 states and the District of Columbia.

I write today to comment on the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project, Southeast Texas and Southwest Louisiana and the Draft Environmental Impact Statement Sabine-Neches Waterway Channel Improvement Project, Texas Ocean Dredged Material Disposal Sites Designation (collectively, the "DEIS") and the Draft Feasibility Report for the proposed Sabine Neches Waterway Channel Improvement Project (the "DFR").

The DFR and DEIS indicate that the proposed project will require a large number of pipeline relocations and removals, possibly including the two owned by Colonial Pipeline Company. However, the documents outlined above offer very little information as to the impact to our pipelines, in terms of both operations and financial costs. As you are aware, the replacement of pipelines that transport essential commodities, such as refined petroleum products in Colonial's case, requires significant planning and coordination, and creates operational, engineering and environmental permitting burdens. In addition, the DFR nor DEIS reflect any consideration of the lead time and expense required to obtain the permits for the pipeline relocations.

At this time, it is difficult for Colonial to comment on the impact of the project. The DEIS and DFR are almost silent in respect to the impact of the project on energy infrastructure and

1185 Sanctuary Parkway, Suite 100 Alpharetta, Georgia 30009-4765
P.O. Box 1624 Alpharetta, Georgia 30009-9934

production facilities. This is despite more than 50 pipelines potentially being impacted. While we understand the basic project scope is to deepen and widen the Sabine Neches Waterway in order to accommodate larger ships, we do not have a clear understanding of the project scope and the impact of those plans on pipeline infrastructure because of the lack of detail in the Corps' documents. 1

We would hope the Corps would be willing to meet with representatives of Colonial, and the pipeline industry, to discuss important issues related to the project. This will help us determine the potential impact to our facilities and what steps need to be taken in order to plan and implement any facility relocations or removal of those facilities. 2

Further, we feel it is important to comment on the federal law that calls for the equal sharing of costs during projects of this nature. The Corps has also acknowledged this federal legal requirement in the "Cost Sharing" section of the DFR: "In accordance with Section 101(a)(4) of the Water Resources and Development Act of 1986, known as "WRDA 86", 50 percent of deep-draft utility (pipeline) relocations would be borne by the utility owner and 50 percent would be borne by the non-Federal sponsor," *i.e.,* the Sabine Neches Navigation District (page XI-5). It is our understanding that there has been some effort to circumvent this long-established federal law. We would formally request that the Corps declare its opposition to any change in the cost-sharing allocation. 3

Colonial Pipeline Company asks that you establish a working group or other appropriate method to bring the Corps and pipeline company representatives together to facilitate an information exchange; and confirm that the cost-sharing requirement specified by WRDA 86 will be part of any Chief's Report or other report or recommendation the Corps makes regarding the project.

Sincerely,

Sam Whitehead

Sam Whitehead

Mr. Sam Whitehead
Government Affairs Manager
Colonial Pipeline Company
1185 Sanctuary Parkway, Suite 100
Alpharetta, GA 30009-4765

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | The FR provides sufficient information for feasibility-level planning. A list of potentially affected pipelines was provided to pipeline companies during the DEIS public comment period. The USACE list of potentially affected pipelines should not be considered definitive. The individual circumstances of each pipeline will be evaluated by USACE in consultation with the non-Federal sponsor and the pipeline owner during the PED and Construction phases, and decisions regarding necessary actions will be made individually for each pipeline at that time. There will be sufficient time for pipeline companies to make necessary preparations after the project is approved. Each pipeline relocation is case specific, and coordination with USACE-Galveston Regulatory Branch would be required in each case. Relocating a pipeline and placing it deeper would not necessarily require a new permit. If a pipeline is being moved to a new location, then the impacts would be evaluated by the environmental assessment performed in conjunction with the DOA permit. |
| 2 | USACE met with pipeline owners at an information meeting on January 25, 2011. More information on project features that could affect pipelines will be provided as detailed plans are developed during PED and Construction phases. |
| 3 | Please see Section 2.4.1.12 of this FEIS for a discussion of the allocation of pipeline relocation costs. |

# Appendix A6

# Tribal Coordination

1813

April 7, 2003

Environmental Section

Mr. Earl Barbry, Sr., Chairman
Tunica-Biloxi Indian Tribe
P.O. Box 331
Marksville, Louisiana 71351

Dear Mr. Barbry:

The Corps of Engineers, Galveston District, in cooperation with the Jefferson County Waterway and Navigation District, is planning on making improvements to the Sabine/Neches Waterway in Jefferson and Orange Counties, Texas and Cameron Parish, Louisiana. These plans consist in widening and deepening the channel from the city of Beaumont to the end of the waterway in the Gulf of Mexico as shown on the attached map. All construction will be confined to the existing channel. Dredge material placement will occur, either in existing placement areas along the channel, the Gulf of Mexico or in Sabine Lake. As you will notice the study area marked on the enclosed map extends well outside the area of construction. This larger area marks places where the project team considered secondary effects such as saltwater intrusion into the coastal marshes.

As required under Section 106 of the National Historic Preservation Act 36CFR Part 800.3(f)(2) we are contacting you to determine if your tribe can assist us in identifying any historic properties or areas of religious and cultural interest in the project area. Your help in identifying such properties will be greatly appreciated.

Thank you for your cooperation in this matter. If you have any questions regarding this project, please contact Ms. Janelle Stokes, Galveston District Tribal Coordinator, at (409)766-3039.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Enclosure

IDENTICAL LETTER SENT TO ADDRESSEES ON ATTACHED LIST

STOKES/3039
7 Apr 03



MURPHY
PE-PR

IDENTICAL LETTER SENT TO:

RET TO
PE-PR

Mr. Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
P.O. Drawer 1210
Durant, OK 74702

MAIL

Ms. LaRue Parker, Chairman
Caddo Indian Tribe of Oklahoma
P.O. Box 487
Binger, OK

Mr. Tarpie Yargee, Chief
Alabama-Quassarte Tribal Town
P.O. Box 187
Wetumka, Oklahoma 74883

Leland Thompson
Cultural Resource Coordinator
Coushatta Indian Tribe
P.O. Box 967
Elton, LA 70532

Mr. Earl Barbry, Sr., Chairman
Tunica-Biloxi Indian Tribe
P.O. Box 331
Marksville, LA 71351

CF w/o Encl:
PE-PR, Ms. Stokes

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229
FEBRUARY 7, 2007

Environmental Section

Mr. Earl J. Barbry, Sr., Chairman
Tunica-Biloxi Indian Tribe
P.O. Box 331
Marksville, LA 71351

Dear Mr. Barbry:

The US Army Corps of Engineers, Galveston District (USACE), proposes to initiate a Programmatic Agreement (PA) to avoid and mitigate, if necessary, impacts to historic properties that may occur during construction and operation of the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). The SNWW CIP includes improvements to the existing navigation channel, a Dredged Material Management Plan (DMMP) and an ecological impacts mitigation plan. A full description and maps of the proposed channel improvements can be found in the enclosed Background Report (Enclosure 1).

The USACE proposes negotiation of a four-party PA which outlines procedures to be followed for Section 106 compliance as per 36 CFR 800.6(c) to address potential impacts to historic properties identified in the Background Report for the SNWW CIP project area (Enclosure 1). The four parties include the USACE, the Jefferson County Waterways and Navigation District (JCWND) and the Texas and Louisiana State Historic Preservation Officers (SHPOs) The draft PA will also be coordinated with interested Native American Indian tribes in accordance with 36 CFR 800.3 (f)(2). Attached, as Enclosure 2, is a draft PA prepared by the USACE that has been informally coordinated with the JCWND. The intent of the PA is to avoid or mitigate impacts to historic properties in areas directly affected by new dredging and channel construction, construction staging and access areas, extensions of existing placement areas, ecological mitigation features, areas affected by the beneficial uses of dredged material, and ongoing maintenance dredging and placement activities related to the SNWW CIP.

As required under Section 106 of the National Historic Preservation Act 36 CFR Part 800.3(f)(2) we are contacting you to determine if your tribe can assist us in identifying any historic properties or areas of religious and cultural interest in the project area. Your help in identifying such properties will be greatly appreciated.

Thank you for your cooperation in this matter. If you have any questions regarding this project, please contact Ms. Nicole Cooper Minnichbach, Galveston District Archeologist, at (409)766-3878.

Sincerely,

for Carolyn Murphy
Chief, Environmental Section

Enclosures
1 Background Report
2 Draft Programmatic Agreement

IDENTICAL LETTER SENT TO ADDRESSEES ON ATTACHED LIST

IDENTICAL LETTERS SENT TO:

Mr. Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
P.O. Drawer 1210
Durant, OK 74702

Ms. LaRue Martin Parker, Chairperson
Caddo Nation of Oklahoma
P.O. Box 487
Binger, OK 73009

Mr. Tarpie Yargee, Chief
Alabama-Quassarte Tribal Town
P.O. Box 187
Wetumka, OK 74883

Mr. Leland Thompson
Cultural Resource Coordinator
Coushatta Indian Tribe
P.O. Box 967
Elton, LA 70532

Mr. Earl J. Barbry, Sr., Chairman
Tunica-Biloxi Indian Tribe
P.O. Box 331
Marksville, LA 71351

**DEPARTMENT OF THE ARMY**
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229
MARCH 7, 2007

Environmental Section

Ms. Beryl Battise
Historic Preservation Officer
Alabama-Coushatta Tribe of Texas
571 State Park Road 56
Livingston, TX 77351

Dear Ms. Battise:

The US Army Corps of Engineers, Galveston District (USACE), proposes to initiate a Programmatic Agreement (PA) to avoid and mitigate, if necessary, impacts to historic properties that may occur during construction and operation of the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). The SNWW CIP includes improvements to the existing navigation channel, a Dredged Material Management Plan (DMMP) and an ecological impacts mitigation plan. A full description and maps of the proposed channel improvements can be found in the enclosed Background Report (Enclosure 1).

The USACE proposes negotiation of a four-party PA which outlines procedures to be followed for Section 106 compliance as per 36 CFR 800.6(c) to address potential impacts to historic properties identified in the Background Report for the SNWW CIP project area (Enclosure 1). The four parties include the USACE, the Jefferson County Waterways and Navigation District (JCWND) and the Texas and Louisiana State Historic Preservation Officers (SHPOs) The draft PA will also be coordinated with interested Native American Indian tribes in accordance with 36 CFR 800.3 (f)(2). Attached, as Enclosure 2, is a draft PA prepared by the USACE that has been informally coordinated with the JCWND. The intent of the PA is to avoid or mitigate impacts to historic properties in areas directly affected by new dredging and channel construction, construction staging and access areas, extensions of existing placement areas, ecological mitigation features, areas affected by the beneficial uses of dredged material, and ongoing maintenance dredging and placement activities related to the SNWW CIP.

As required under Section 106 of the National Historic Preservation Act 36 CFR Part 800.3(f)(2) we are contacting you to determine if your tribe can assist us in identifying any historic properties or areas of religious and cultural interest in the project area. Your help in identifying such properties will be greatly appreciated.

Thank you for your cooperation in this matter. If you have any questions regarding this project, please contact Ms. Nicole Cooper Minnichbach, Galveston District Archeologist, at (409)766-3878.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Enclosures
1 Background Report
2 Draft Programmatic Agreement

Ms. Janelle Stokes
CESWG-PE-PR

Ms. Nikki Minnichbach
CESWG-PE-PR

IDENTICAL LETTER SENT TO ADDRESSEES ON ATTACHED LIST

IDENTICAL LETTERS SENT TO:

Mr. Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
P.O. Drawer 1210
Durant, OK 74702

Ms. LaRue Martin Parker, Chairperson
Caddo Nation of Oklahoma
P.O. Box 487
Binger, OK 73009

Mr. Tarpie Yargee, Chief
Alabama-Quassarte Tribal Town
P.O. Box 187
Wetumka, OK 74883

Mr. Leland Thompson
Cultural Resource Coordinator
Coushatta Indian Tribe
P.O. Box 967
Elton, LA 70532

Mr. Earl J. Barbry, Sr., Chairman
Tunica-Biloxi Indian Tribe
P.O. Box 331
Marksville, LA 71351

**Stokes, Janelle S SWG**

**From:** Bryant J. Celestine [celestine.bryant@actribe.org]
**Sent:** Friday, February 26, 2010 11:32 AM
**To:** Stokes, Janelle S SWG
**Subject:** Sabine-Neches Waterway DEIS

Dear Ms. Stokes:

On behalf of Mikko Oscola Clayton Sylestine and the Alabama-Coushatta Tribe, our appreciation is expressed on your efforts to consult us regarding the Draft Environmental Impact Statement for the Sabine-Neches Waterway Channel Improvement Project.

Our Tribe maintains ancestral associations throughout the state of Texas and Louisiana despite the absence of written documentation to completely identify Tribal activities, villages, trails, or religious sites. However, it is our objective to ensure significances of Native American ancestry, especially of the Alabama-Coushatta Tribe, are administered with the utmost considerations.

Upon review of the December 18, 2009 materials, no impacts to religious, cultural, or historical assets of the Alabama-Coushatta Tribe of Texas should occur in conjunction with this proposal. However, in the event of inadvertent discovery of human remains and/or archaeological resources, activity in proximity to the location must cease and appropriate authorities, including this office, notified without delay. 1

Should you require further assistance, please do not hesitate to contact us.

Sincerely,

Bryant J. Celestine
Historic Preservation Officer
Alabama-Coushatta Tribe of Texas
571 State Park Rd 56
Livingston, Texas 77351
936 - 563 - 1181
celestine.bryant@actribe.org

Mr. Bryant J. Celestine
Historic Preservation Officer
Alabama-Coushatta Tribe of Texas
571 State Park Road 56
Livingston, TX 77351

RESPONSE TO COMMENTS

| Comment No. | Response |
|---|---|
| 1 | Thank you for reviewing the proposed Sabine-Neches Waterway Channel Improvement Project for potential impacts to tribal resources. The Alabama-Coushatta Tribe of Texas will be contacted in the event of an inadvertent discovery of human remains or archeological resources as required by Stipulations II and IV of the Historic Properties Programmatic Agreement (Final Environmental Impact Statement Appendix H). |

# Appendix B

# Ocean Dredged Material Disposal Sites Final Environmental Impact Statement

Document No. 050232
PBS&J Job No. 100007609

# ENVIRONMENTAL IMPACT STATEMENT
# SABINE-NECHES WATERWAY
# CHANNEL IMPROVEMENT PROJECT, TEXAS
# OCEAN DREDGED MATERIAL DISPOSAL SITE DESIGNATION

Prepared for:

U.S. Army Corps of Engineers
Galveston District
2000 Fort Point Road
Galveston, Texas 77550

Prepared by:

PBS&J
6504 Bridge Point Parkway
Suite 200
Austin, Texas 78730

June 2010

*Printed on recycled paper*

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## Acronyms and Abbreviations

| | |
|---|---|
| °F | degrees Fahrenheit |
| BEG | Bureau of Economic Geology |
| BU | beneficial use |
| BV&A | Barry A. Vittor & Associates |
| CFR | Code of Federal Regulations |
| CIP | Channel Improvement Project |
| cm/sec | centimeters per second |
| cy | cubic yards |
| CZM | Coastal Zone Management Act |
| CZMP | Coastal Zone Management Plan |
| DMF | Dredged Material Fate |
| DMMP | Dredged Material Management Plan |
| DO | dissolved oxygen |
| EFH | essential fish habitat |
| EIS | Environmental Impact Statement |
| EPA | U.S. Environmental Protection Agency |
| ERL | Effects Range Low |
| FDA | U.S. Food and Drug Administration |
| FEIS | Final Environmental Impact Statement |
| FR | Federal Register |
| FWPCA | Federal Water Pollution Control Act |
| $g/m^2$ | gram/square meter |
| GIWW | Gulf Intracoastal Waterway |
| mcy | million cubic yards |
| mg/L | milligrams per liter |
| MLLW | mean lower low water |
| MMS | Minerals Management Service |
| mph | miles per hour |
| MPRSA | Marine Protection, Research and Sanctuaries Act of 1972 |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NWR | National Wildlife Refuge |
| ODMDS | Ocean Dredged Material Disposal Site |
| PA | placement area |
| RSM | Regional Sediment Management |
| SAI | Science Applications, Inc. |
| SH | State Highway |
| SHPO | State Historic Preservation Officer |

| | |
|---|---|
| SNWW | Sabine-Neches Waterway |
| SP | solid phase |
| SPP | suspended particulate phase |
| TOC | total organic carbon |
| TPNWR | Texas Point National Wildlife Refuge |
| TPWD | Texas Parks and Wildlife Department |
| USACE | U.S. Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |
| WQC | Water Quality Criteria |
| ZSF | Zone of Siting Feasibility |

# 1.0 PURPOSE AND NEED FOR THE ACTION

## 1.1 INTRODUCTION

The existing Federal project deep-draft channel (Figure 1-1), with a total length of roughly 65 miles, was first authorized to a depth of 25 feet in 1912 (Rivers and Harbor Act of July 25, 1912). It was deepened to 30 feet in 1922, 34 feet in 1935, 36 feet in 1946, and authorized to the present 40 feet in 1962 (Rivers and Harbor Act of October 23, 1962), although construction ran from 1965 to 1972. It extends from about a mile upstream of the Beaumont Turning Basin to the 42-foot contour in the Gulf of Mexico (Gulf). Bottom widths are 800 feet in the Entrance Channel, narrowing to 500 feet at the inland portion of the Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and 400 feet to the Beaumont Turning Basin.

As part of the National Environmental Policy Act (NEPA) process for the Sabine-Neches Waterway (SNWW) Channel Improvement Project (CIP), the U.S. Environmental Protection Agency (EPA), as a cooperating agency, is proposing to designate one or more Ocean Dredged Material Disposal Sites (ODMDSs) for placement of the construction and maintenance dredged material from an extension of the SNWW, roughly 13.2 miles farther into the Gulf. As part of the process, the existing ODMDSs will be examined for capacity and compatibility with the construction material and the greater quantity of maintenance material associated with the larger and deeper existing offshore channel. This ODMDS Designation Final Environmental Impact Statement (FEIS) was circulated for review with, and as part of, the FEIS for the SNWW CIP. Table 1-1 presents the quantities of dredged maintenance material from the existing and proposed channels and the construction (new work) material anticipated from the proposed SNWW CIP.

EPA's action for which this document was prepared is the designation of a site or sites for the ocean placement of new work (construction) material to be dredged from the SNWW Entrance Channel and Extension, and future maintenance material from the 13.2-mile SNWW Entrance Channel Extension. An FEIS for the maintenance dredging of the SNWW Entrance Channel (for the authorized 40-Foot Project [42 feet in the Entrance Channel]), was prepared by the U.S. Army Corps of Engineers (USACE, 1975). Four offshore sites are currently in use for the existing channel. These sites were designated by EPA for the continued placement of dredged material removed from the SNWW Entrance Channel (Federal Register [FR] Vol. 52, No. 175, September 10, 1987, page 34218; FEIS, 1983 [EPA, 1983a]). This Environmental Impact Statement (EIS) for the proposed new ODMDSs is included as an appendix to the Integrated Feasibility Report/EIS for the SNWW CIP. The purpose of EPA's action is to designate, based on 40 Code of Federal Regulations (CFR) 228, ocean disposal sites that would provide environmentally acceptable and economically and physically feasible areas for the placement of the construction material from the SNWW Entrance Channel and future maintenance material from the Entrance Channel Extension for the SNWW CIP.

Table 1-1

Existing and Proposed Entrance Channel Ocean Dredged Material Disposal Site Quantities

**New Work Material**

| PA | Contributing Channel Channel Station | | Existing Project | Proposed Project Quantity[1] (cy) | |
|---|---|---|---|---|---|
| 4 | -214+88 | 0+00 | Not Applicable | 2,978,000 | |
| 3 | 0+000 | 18+000 | Not Applicable | 5,923,000 | |
| 2 | 18+000 | 53+000 | Not Applicable | 7,051,000 | |
| 1 | 53+000 | 95+734 | Not Applicable | 8,307,000 | |
| | | | | 24,259,000 | Total |
| A | 95+734 | 114+000 | Not Applicable | 4,592,000 | |
| B | 114+000 | 132+000 | Not Applicable | 5,296,000 | |
| C | 132+000 | 150+500 | Not Applicable | 4,648,000 | |
| D | 150+500 | 165+443 | Not Applicable | 4,201,000 | |
| | | | | 18,737,000 | Total |

**Maintenance Material**

| PA | Contributing Channel Channel Station | | Frequency (years) | Existing Project Quantity per year[2] (cy) | Existing Project Quantity per cycle (cy) | Proposed Project Quantity per year (cy) | Proposed Project Quantity per cycle[1] (cy) | |
|---|---|---|---|---|---|---|---|---|
| 4 | 0+00 | -214+88 | 5 | 227,700 | 1,138,500 | 270,540 | 1,352,700 | |
| 3 | 0+00 | 18+000 | 1 | 1,993,700 | 1,993,700 | 4,473,000 | 4,473,000 | |
| 2 | 18+000 | 53+000 | 4 | 430,600 | 1,722,400 | 1,565,500 | 3,131,000 | |
| 1 | 53+000 | 95+734 | 4 | 628,200 | 2,512,800 | 377,000 | 1,508,000 | |
| | | | | 3,280,200 | 7,367,400 | 6,686,040 | 10,464,700 | Totals |
| | | | | | 164,010,000 | | 334,302,000 | Total per 50 years[3] |
| A | 95+734 | 114+000 | 4 | | Not Applicable | 197,750 | 791,000 | |
| B | 114+000 | 132+000 | 4 | | Not Applicable | 194,750 | 779,000 | |
| C | 132+000 | 150+500 | 4 | | Not Applicable | 200,250 | 801,000 | |
| D | 150+500 | 165+443 | 4 | | Not Applicable | 161,750 | 647,000 | |
| | | | | | | 754,500 | 3,018,000 | Totals |
| | | | | | | | 37,725,000 | Total per 50 years[3] |

[1] From USACE SNWW CIP Engineering Appendix

[2] Based on historic data for maintenance material going into PA 1, the farthest offshore of the existing ODMDSs.

[3] These numbers are slightly larger than the 50-year Dredged Material Management Plan summary table because they include two additional years of material for reaches with 4-year cycles.

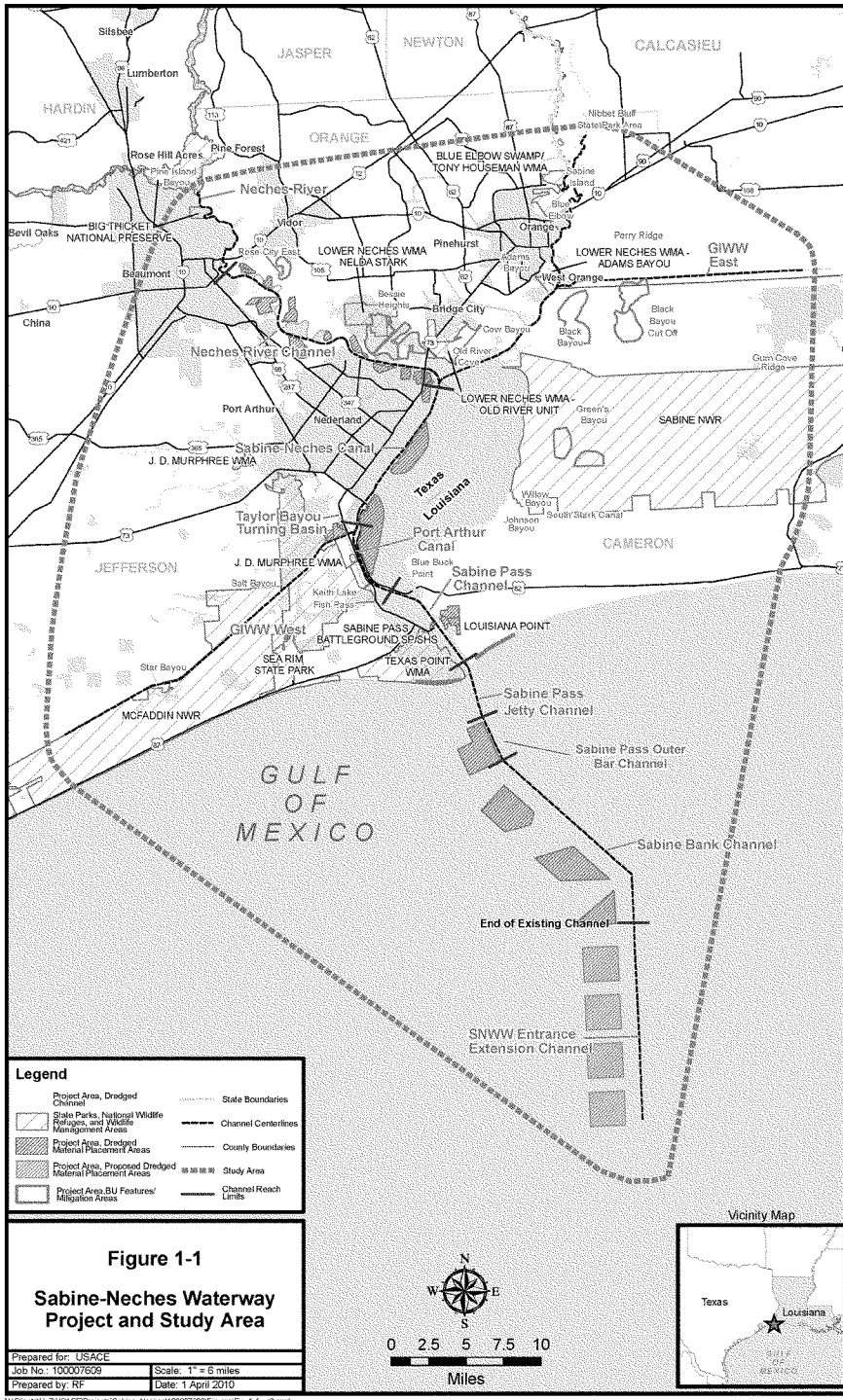


**Figure 1-1**

**Sabine-Neches Waterway Project and Study Area**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 6 miles |
| Prepared by: RF | Date: 1 April 2010 |

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## 1.2 LEGISLATIVE BACKGROUND AND PROPOSED ACTION

Ocean disposal of dredged material was not specifically regulated in the United States until passage of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA). Limited regulation was provided by the Supervisors' Act of 1888 and the Refuse Act of 1899. Under these acts, transportation and navigation factors, rather than environmental considerations, guided selection of placement locations by the USACE and the issuance of permits for ocean disposal.

Although the Fish and Wildlife Coordination Act of 1958 initially referred to inland tidal waters, it included consideration of the effects of dredged material on commercially important marine species. This act, together with subsequent judicial decisions, empowered the USACE to refuse permits if the dredging or filling of a bay or estuary would result in significant, unavoidable damage to the marine ecosystem.

MPRSA and the Federal Water Pollution Control Act (FWPCA), later amended by the Clean Water Act of 1977, both passed in 1972 and specifically addressed waste disposal in the aquatic and the marine environment. The FWPCA and the Water Quality Improvement Act of 1970 set up specific water quality criteria to be used as guidelines in controlling discharges into marine and aquatic environments. These water quality criteria applied to placement of dredged material only in cases where fixed pipelines were used to transport and discharge dredged material into the environment at discrete points. MPRSA, however, specifically regulates the transport and ultimate disposal of waste materials in the ocean. Under Title I of MPRSA, the primary regulatory vehicle of the act, a permit program for the disposal of dredged and nondredged materials was established that mandates determination of impacts and provides for enforcement of permit conditions.

The August 1975 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Convention) is the principal international agreement governing ocean dumping. The Convention specifies that contracting nations will regulate disposal in the marine environment within their jurisdiction, disallowing all disposal without permits. The nature and quantities of all waste material and the circumstances of disposal must be periodically reported to the International Maritime Organization (formerly the Inter-Governmental Maritime Consultative Organization), which administers the Convention.

In October 1973, the EPA issued the final Ocean Dumping Regulations and Criteria (the Regulations, or Ocean Dumping Regulations), revised in January 1977 (40 CFR Parts 220 to 229). These regulations established procedures and criteria for review of ocean disposal permit applications (Part 227), assessment of impacts of ocean disposal and alternative disposal methods, enforcement of permits, and designation and management of ocean disposal sites (Part 228). They also established procedures by which the EPA is authorized to designate ODMDSs and times for ocean disposal of acceptable materials under Section 102(c) of the MPRSA and the criteria for site designation, including general and specific criteria for site selection.

## 1.3 U.S. ARMY CORPS OF ENGINEERS

The USACE is mandated by the U.S. Congress to maintain (i.e., remove accumulated sediment) authorized navigation channels in the navigable waters of the United States on an ongoing basis. The material thus removed (maintenance material) must subsequently be discharged. The USACE was authorized by the U.S. Senate in 2000 to begin investigating the feasibility of modifying the SNWW in the interests of commercial navigation. The FEIS for the SNWW CIP, to which this ODMDS Designation FEIS is attached, is the culmination of that authorization. To continue to maintain the Nation's waterways and to construct projects authorized by Congress, the USACE considers it essential that environmentally acceptable ocean disposal sites be identified, evaluated, and designated for continued or one-time use pursuant to Section 102(c) of MPRSA. Section 103 of MPRSA requires the USACE to consider the effects of ocean disposal of dredged material on human health, welfare, amenities, the marine environment, ecological systems, and economic potentialities in its evaluation of Federal projects and Section 103 permit applications.

The existing SNWW project provides deep-draft access from the Gulf to the cities of Beaumont, Port Arthur, and Orange. Entrance from the Gulf is provided by a jettied channel at Sabine Pass. The Entrance Channel, comprising the Sabine Bank Channel and the Outer Bar Channel, provides for a project depth of 42 feet over a channel bottom width of 800 feet and extends roughly 18.1 miles into the Gulf (see Figure 1-1). The proposed Entrance Channel Extension for the SNWW proposed 48-foot CIP has a depth of 50 feet and would extend approximately 13.2 miles farther into the Gulf than the present channel. The channel reach immediately outside of the jetties at the Sabine Pass Outer Bar Channel is proposed to be 800 feet wide; the remainder of the Entrance Channel through its terminus in the Gulf is proposed to be 700 feet wide.

## 1.4 U.S. ENVIRONMENTAL PROTECTION AGENCY

The EPA is mandated with the authority to regulate ocean dumping and with the responsibility for site designation, monitoring, and management by Congress as stated specifically in 40 CFR 228.4(e)(1). The EPA has been requested by the USACE to designate an ocean disposal site(s) for the placement of construction and maintenance material from the SNWW CIP. While EPA is a member of the Interagency Coordination Team and is reviewing and commenting on the navigation project, EPA is not advocating expansion of the waterway. EPA is a cooperating agency insofar as it is responsible for designating ocean dumping sites according to Section 102 of the MPRSA, and such sites may be necessary for construction and maintenance of the SNWW 48-Foot Project.

Site designation by EPA does not authorize any dredging project nor does it permit disposal of any dredged material. Sites are designated in areas where a need for ocean disposal has been indicated, based on past dredging demands and/or projected demands associated with new or expanded projects. However, site designation does not in and of itself preclude the consideration of other placement options, including beneficial use options or the no action alternative. Once designated as an approved ocean disposal site, the

appropriateness of ocean disposal is determined on a case-by-case basis in accordance with the ocean dumping criteria. For instance, the fuel costs cited as precluding some of the beneficial use options (Section 2.3.2.1) could change in the future or alternative transportation options might make beneficial use options more viable in the future. If so, those options can be considered at that time.

## 1.5 COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Act (CZM) of 1972, as amended (16 USC 1451 et seq.), states in Section 307 (1) (A) "Each Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone shall be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved State management programs." Both Texas and Louisiana have developed Coastal Zone Management Plans (CZMPs), which have been approved by the National Oceanic and Atmospheric Administration (NOAA), the designee of the Secretary of Commerce for CZMP approval. This FEIS addresses consistency with these Plans by assessing impacts to critical coastal zone habitats and resources, as presented in Appendix I to the SNWW CIP FEIS.

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# 2.0 ALTERNATIVES

## 2.1 NO-ACTION ALTERNATIVE

The No-Action Alternative entails that the EPA refrain from designating new ODMDSs for the placement of 18.7 million cubic yards (mcy) of virgin (construction or new work) material from the SNWW Entrance Channel Extension during construction and 37.7 mcy of maintenance material over the 50-year life of the project. While modeling has shown (Section 2.3.4.2) that the existing ODMDSs are of sufficient size to contain both virgin and maintenance material from the Entrance Channel and the Extension, they are designated only for dredged material from the SNWW Entrance Channel (EPA, 1983a) and, therefore, could not be used for the material from the proposed Entrance Channel Extension without modification to the designation. Even if designation were to be modified to allow placement of Extension material at the existing ODMDSs, the cost of transporting the construction and maintenance material from the Extension to the existing ODMDSs would be prohibitive (Section 2.3.4.1.1). Without ODMDS designation or designation modification, use of upland placement areas (PAs) would be required, which would greatly increase dredging costs because of double handling and the long distances involved in transporting the dredged material from offshore. The economic benefits of the navigation improvements would not be sufficient to justify the higher costs. Therefore, in the absence of Federal action to designate new ODMDSs for the 48-Foot Project, the existing Federal project would continue to be maintained at its current dimensions and dredged material would be disposed in compliance with the applicable Dredged Material Management Plan (DMMP). Maintenance material from the Entrance Channel would continue to be placed in existing ODMDSs 1–4. Foregoing navigation improvements to the SNWW would have the following impacts: (1) long-term increases in transportation costs to navigation relative to those that would result from project implementation; (2) loss of potential for increased channel usage, since a widened channel would permit limited two-way traffic; and (3) decreased safety in the segment of the channel south of Port Arthur that is proposed for widening. Therefore, the No-Action Alternative is not considered viable.

## 2.2 NONOCEAN DISPOSAL

Dredged material placement alternatives evaluated in this document consist of upland placement, beneficial use, and ocean placement. Alternate dredging methods include the use of dipper dredges, ladder dredges, and bucket dredges. However, through the years, only hopper dredges and cutterhead suction pipeline dredges have proved to be both safe and efficient for nearshore and offshore use, and hopper dredges are preferred for offshore dredging. A review of the status of the dredging industry to the present confirms that the hopper dredge is still the most economical and feasible means for dredging at sea, although beneficial uses of the nearer-shore dredged material would require the use of a pipeline dredge. Material would have to be transported on a hopper dredge with pumpout capabilities from 20 to 38 additional miles back to the mainland, which would require mooring and connecting to the discharge pipe for each load of dredged material. The technology of the other forms of dredging has not progressed

sufficiently to be suitable alternatives to hopper dredging. Relative to land-based areas in lieu of ocean placement, the USACE has determined that no suitable land-based areas exist that have sufficient capacity and that the costs of transport are uneconomical. The nearest available land placement area (PA 5) is 38 miles away from the seaward end of the project and is not large enough to accommodate the anticipated volume of offshore construction and maintenance material. PA 5 is also needed for future maintenance of the Sabine Pass Channel. Therefore, use of this site for offshore construction material, in addition to being economically unfeasible, would require the acquisition of new areas for placement of construction and routine maintenance material from the inland portions of the channel. Since the surrounding land areas are wetlands or chenier habitats, it is not likely that a suitably sized replacement area could be obtained without a significant loss of quality habitat. A land-based alternative would therefore offer no environmental benefit to ocean placement.

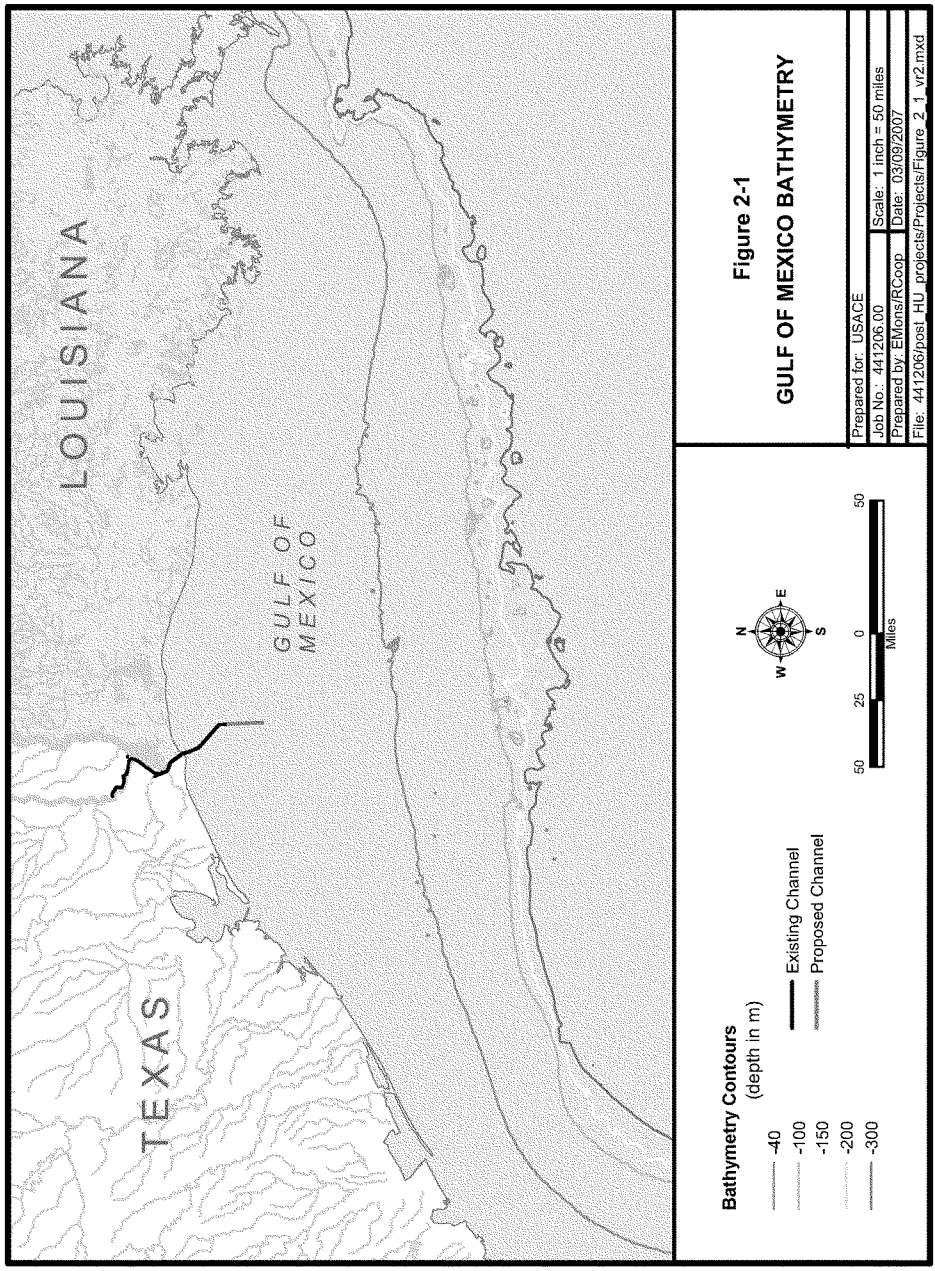
After a review of the options, it is concluded that for this project, land-based alternatives offer no environmental or economical advantages over placement of construction and maintenance material in the ocean. Further, the current methods of dredging and placement are still considered to be both environmentally and economically viable. All alternatives, including the No-Action Alternative, have consequences associated with them.

## 2.3 OCEAN DISPOSAL

Potential placement sites were evaluated in the nearshore environment, the mid-shelf, and the continental slope. Additional alternatives in the nearshore environment were examined.

### 2.3.1 Mid-Shelf and Continental Slope Alternatives

The Continental Shelf off Sabine Pass extends from the 20-meter isobath to 200-meter isobath and, thus, from roughly 40 to 130 miles offshore (Figure 2-1). A placement site located in the mid-shelf area would be 60 to 70 miles offshore in 90 to 110 feet of water. A straightforward computer analysis of two dredging scenarios, assuming nothing changes except transport distance, will demonstrate that an increase in transport distance from 1 to 10 miles increases the cost of dredging on a per-cubic-yard basis by a factor of 2.5. EPA (1983b) notes an increase of $0.15/cubic yards (cy)/mile of transport distance for disposal at a mid-shelf site off Tampa Bay, Florida. Since fuel costs have skyrocketed since 1983, this value is very low. The value of $0.15/cy/mile, noted above, would be $0.29/cy/mile, if adjusted for inflation (ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt). Using a value of $0.29/cy/mile, the construction material quantities provided in Table 2-1, and the average locations of the proposed Extension ODMDSs, as given in Section 3.2.1 (which would require an average increase in distance offshore of 39.5 miles to get to a mid-shelf site), the incremental increase in the cost for construction dredging would be approximately $215,000,000. This increase would make it impossible to economically justify the SNWW CIP. Additionally, safety risks increase and the feasibility of monitoring and surveillance are decreased with increasing distance offshore.


LOUISIANA
TEXAS
GULF OF MEXICO
Bathymetry Contours
(depth in m)
-40
-100
-150
-200
-300
Existing Channel
Proposed Channel
N
W
E
S
50
25
0
50
Miles
Figure 2-1
GULF OF MEXICO BATHYMETRY
Prepared for: USACE
Job No.: 441206.00
Scale: 1 inch = 50 miles
Prepared by: EMons/RCoop
Date: 03/09/2007
File: 441206/post_HU_projects/Projects/Figure_2_1_vr2.mxd

The Ocean Dumping Regulations (40 CFR 228.5(e)) state that whenever feasible, a site beyond the edge of the Continental Shelf will be chosen. The edge of the Continental Shelf is defined as that area where there is a significant increase in the vertical/horizontal gradient, indicating the beginning of the continental slope. In the western Gulf, the 200-meter isobath is fairly indicative of the shelf/slope break and is plotted on Figure 2-1. Off Sabine Pass, the Continental Shelf/slope break is approximately 130 miles offshore, at the widest segment of the Continental Shelf in the northern Gulf.

Pequegnat et al. (1978) examined the potential impacts of deepwater disposal, e.g., at a site on the slope. They note that the increased depth would provide greater volumes of water for dilution and dispersal before the dredged material impacts the ocean floor. They also note (1) the relative paucity of benthos in deeper water and (2) the fact that the value of organisms from the truly deep ocean floor (greater than 1,000 meters depth) are not important to world fisheries. However, EPA (1983a) cites several sources for the fact that although there may be fewer organisms in the deeper waters of a slope site, the relative impact of burial by dredged material would be much greater than to shallow-water benthic organisms because deep-water organisms are not adapted to survival under conditions where temporary burial by resuspended sediments is common. Additionally, the concerns with cost, safety, and monitoring and surveillance, noted above for a mid-shelf site, would be greater for a continental slope site. There are also no data to indicate that such sites would offer any environmental benefit over a nearshore site. Therefore, because of inordinate cost, increased safety problems, and lack of environmental benefits, the mid-shelf and continental slope sites have been eliminated from further alternative analysis.

## 2.3.2 Nearshore Alternatives

### 2.3.2.1 Beneficial Uses

The use of the dredged material from construction of the 48-Foot Project has been evaluated for marsh restoration and beach nourishment, and, as feasible, construction and maintenance material would be used beneficially. However, it should be noted that while this applies to the nearer-shore portions of the channel, the SNWW Entrance Channel Extension begins at roughly 18 miles from shore so pumping either construction or maintenance material from the offshore channel segment to shore is not feasible. However, the beneficial use of construction or maintenance material from a nearshore channel, the Sabine Pass Jetty Channel, was evaluated. This channel segment was targeted for evaluation because it was close enough to the Gulf shorelines to potentially provide an economical alternative for beach nourishment. However, further evaluation determined that it would require either dredging with a hopper dredge with pumpout capabilities, which would require mooring and connecting to the discharge pipe for each load of dredged material, or the use of a pipeline dredge in a channel segment where the feasibility of its use has not been established. The Jetty Channel has very high waves and unreliable weather conditions, which make using a pipeline dredge uncertain and inefficient. Pipeline dredges are not large enough to remain stable in high-wave conditions and can easily be swamped (the attempted use of a pipeline at another similar ship channel led to the dredge being swamped [USACE, 2005]). These risk factors make the cost

much higher. Therefore, because of high risk to human safety and dredge equipment and cost, the beach nourishment beneficial use alternative has been eliminated from further analysis.

A marsh restoration beneficial use alternative was evaluated for an area of eroding marshes in the Texas Point National Wildlife Refuge (TPNWR). Maintenance material (approximately 370,000 cy) from one dredging cycle of the inward portion of the Sabine Pass Jetty Channel could potentially be excavated using a cutterhead pipeline dredge and pumped into a 196-acre area of open water near the western jetty in the TPNWR. This is material that would normally be dredged using a hopper dredge and placed in one of the existing ODMDSs. The dredge pipe would need to be moved frequently to achieve an average fill depth of 8 inches, as requested by Refuge personnel. The objective would be to restore 70 percent of the open water (137 acres) to an elevation capable of supporting brackish marsh habitat. For this potential alternative, material would be taken from the most-inshore portion of the Sabine Pass Jetty Channel, a reach that is more protected from weather and waves than rest of the Sabine Pass Jetty Channel. This beneficial use alternative was considered to be a one-time demonstration effort—to determine whether wave and weather conditions would make it cost effective and reliable for future efforts. However, further analysis by USACE engineers determined that use of a cutterhead suction dredge in this reach of the channel was neither safe nor engineeringly sound. Therefore, this beneficial use option was dropped from consideration.

A different type of beneficial use alternative, the creation of a topographic high, was evaluated for non-nearshore areas. There is a significant natural topographic high (Sabine Bank) in the vicinity, but the beneficial use of creating another one off the Louisiana coastline was evaluated for the material from the Project. This beneficial use would involve the use of as much construction material as possible from either the deepened Entrance Channel or from the Extension in water depths that can safely be used by a hopper dredge. This site would also need to be located far enough upcurrent to prevent dredged material from being redeposited in the navigation channel. It has been determined (Hands and Bradley, 1990; McLellan and Imsand, 1989; Langan and Rees, 1989; Clarke and Pullen, 1992; Clarke and Kasul, 1994) that a properly designed underwater stable berm can provide reduction in the energy of erosive waves and serve as a refuge and feeding location for fish and shrimp.

Based upon assumptions and criteria established for a similar beneficial use area constructed in conjunction with the Houston-Galveston Navigation Channels Project, dredged material could be placed in an area roughly 11,000 by 14,000 feet, in a series of rows, each roughly 5 feet high at the center parallel to the shore (USACE, 1998a; Figure 2-2) If the edges of the rows are separated by roughly 100 feet and 10:1 side slopes are assumed, roughly thirty-five 14,000-foot rows would be required to fill the Beneficial Use (BU). However, it should be noted that the benefits noted for the topographic high cited in the paragraph above are for a BU site off Mobile Bay, with a much different configuration than that used off Galveston and there was no monitoring of the Galveston topographic high to determine whether any benefits accrued.

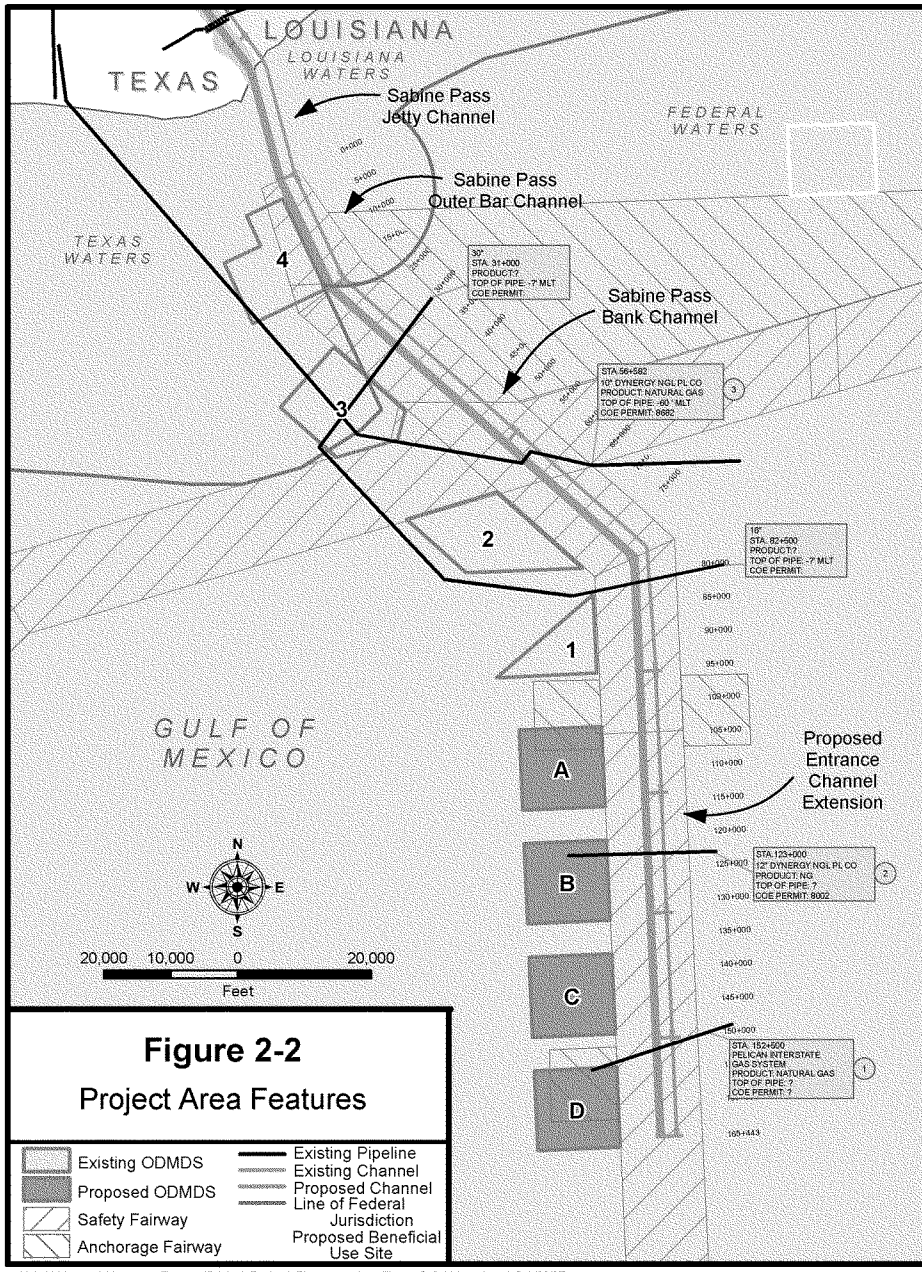



**Figure 2-2**

Project Area Features

N:441206/post_HU_projects/Projects/Original_Revised_Figure_Numbers/Figure_2_2_Vr2.mxd (A.P. 3/08/07)

A configuration such as that described above could use up to 13.6 mcy of construction material, or roughly 56 percent of the expected 24.3 mcy construction material from the deepened Entrance Channel. To avoid the Fairway Anchorage along the Safety Fairway and to achieve the envisioned size of the BU, the BU must be located roughly 9 miles east of the Entrance Channel, just north of the Fairway Anchorage (Figure 2-3) in Federal waters. Thus, the southwest corner of the BU site would be located at 29° 37.6′ N, 93° 35.1′ W. A similar BU (offshore feeder berm) was examined by USACE (1997) and found not to be economically feasible because it was roughly seven times more expensive than standard offshore placement, which would result in an incremental cost of $268,182,000 (calculated based on October 2005 price levels and assuming a fuel cost of $2.05 per gallon). In the case of the BU examined by USACE (1997), the average roundtrip distance to the berm was only around 6 miles. The average roundtrip distance to the BU described above from the Extension is roughly 45 miles, so the cost would be exorbitantly high. Therefore, this BU option is not economically feasible.

#### 2.3.2.2 Regional Sediment Management

As a Regional Sediment Management (RSM) measure, two alternatives were considered potentially viable for utilizing the approximately 9.9 mcy of the coarser-grained sediments to be generated by the new work dredging of sections "B" and "C" of the Extension Channel (or between stations 114+000 to 150+500) to produce regional benefits. The two alternatives included (1) the transport and stockpiling of the coarser-grained dredged sediments at ODMDS 4 (see Figure 2-2) for future beneficial use; and (2) the transport and discharge of the coarser-grained dredged sediments into the littoral zone offshore of Texas Point.

##### *2.3.2.2.1 RSM Stockpiling Alternative*

ODMDS 4 is the nearest existing ODMDS to Texas Point and has been designated by EPA to receive maintenance dredged material from the SNWW Entrance Channel. ODMDS 4 is classified as a dispersive site and is located beyond the depth of closure (approximately –19 feet mean lower low water [MLLW]); therefore, any appreciable accumulation of dredged material placed within the site is typically short term, and the dispersed material would not migrate into the littoral zone to add to the sediment budget. The stockpiling of dredged material within the aquatic environment for future beneficial use is effective only if significant quantities of the stockpiled material remain in place for rehandling as the need arises. Stockpiling assumes that the beneficial use need would not be immediate but may be required beyond the foreseeable future, which may be defined as a period greater than 3 months. It is expected that a substantial amount of material, if stockpiled within ODMDS 4, would have dispersed within a period of 3 months. It was therefore concluded that stockpiling dredged material within ODMDS 4 is not a viable RSM alternative.

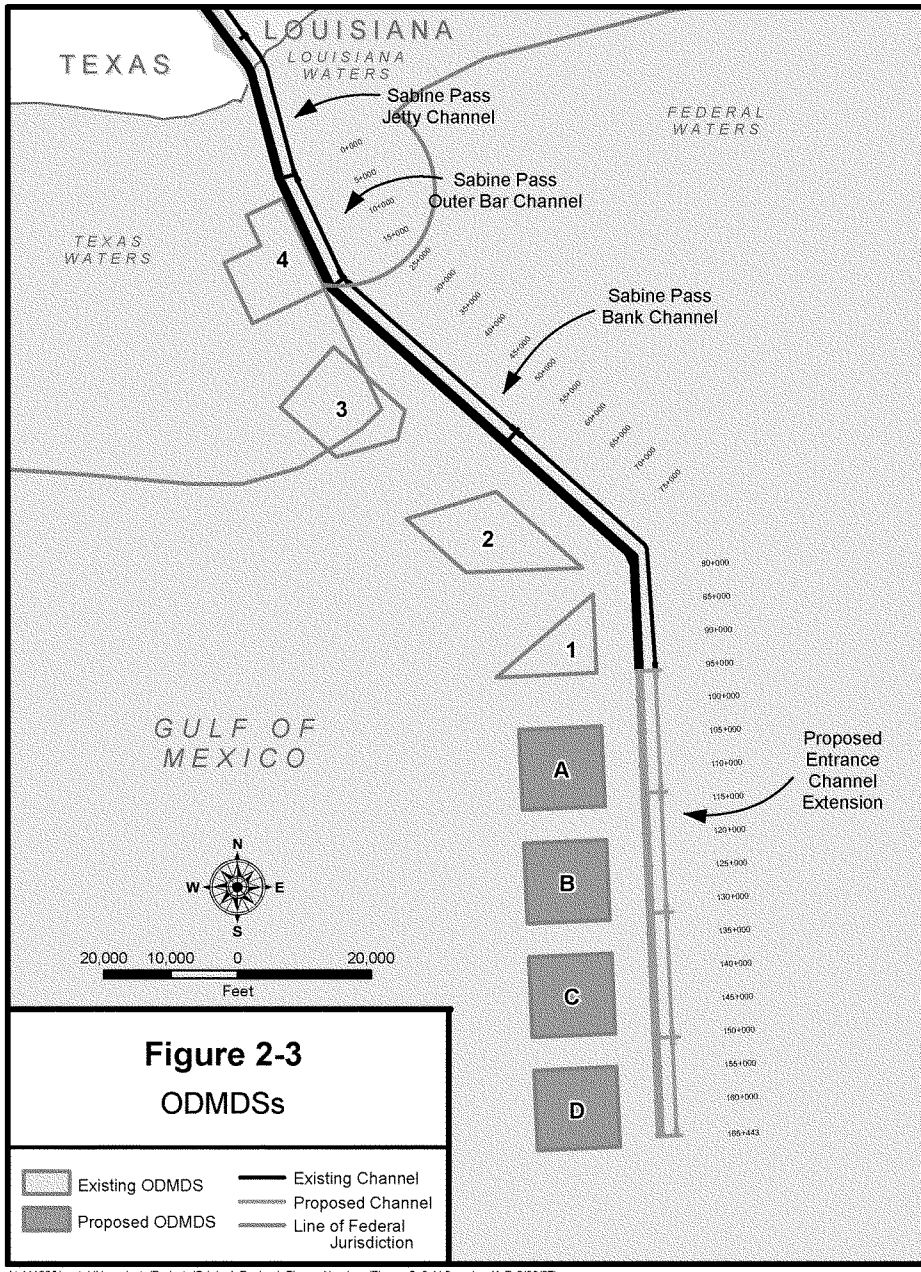



**Figure 2-3**
ODMDSs

N:441206/post_HU_projects/Projects/Original_Revised_Figure_Numbers/Figure_2_3_Vr2.mxd (A.P. 3/08/07)

#### *2.3.2.2.2 RSM Littoral Zone Discharge Alternative*

This alternative entails the transport by hopper dredge of sediments dredged from sections "B" and "C" of the Extension Channel to an upstream point adjacent to ODMDS 4 (approximately at Station 3+000 or roughly ½ mile beyond the outer end of the jetties). The average one-way transport distance from sections "B" and "C" of the Extension Channel to Station 3+000 ranges from 21 to 28 miles. Upon arrival at Station 3+000, the hopper dredge would pump out the dredged material via a connecting pipeline to a discharge point located on, or inshore of, the 14-foot depth contour offshore of the Texas Point shoreline, a pump distance of approximately 3 miles from Station 3+000. Discharging the material at or inshore of the 14-foot depth contour should guarantee the reintroduction of sediments within the littoral zone, where natural processes would beneficially distribute the sediments. The incremental cost to transport and pump approximately 9.9 mcy of dredged material within the littoral zone via a hopper dredge with pump-out capabilities is estimated to be $86.7 million at October 2005 price levels and based on a fuel price assumption of $2.05 per gallon. The incremental cost for this RSM alternative would not be a project cost, and therefore would not be federally cost-shared, if implemented.

### 2.3.2.3 ODMDS

#### *2.3.2.3.1 Existing ODMDSs 1, 2, 3, and 4*

One ODMDS alternative would be to use the existing ODMDSs 1 through 4, designated by EPA (1983a) for placement of all construction and future maintenance material from both the Entrance Channel and the Extension. These ODMDSs are located along the west side of the SNWW Entrance Channel and are the historically used ODMDSs; ODMDS 4 has been used since at least 1931 and the others since 1962 (EPA, 1983a). As noted in Section 2.3.4.2, modeling has shown that the existing ODMDSs are of sufficient size to accommodate all of the material without undue mounding. However, as noted in Section 2.3.4.1.1, the cost of transporting the construction and maintenance material from the Extension to the existing ODMDSs would be prohibitive. Therefore, use of the existing ODMDSs is not considered a viable alternative.

#### *2.3.2.3.2 Additional ODMDSs*

Within the nearshore environment, four sites had been identified by USACE (1982) for the placement of construction and maintenance material for a proposed 50-foot channel, but these sites were never designated. Since these sites were proposed and studied for the 1982 EIS, they were tentatively identified as potential offshore placement sites for the proposed 48-Foot Project. They would be examined here as the preferred alternative (modified slightly, since the 1982 project was a 50-foot project), if they are not excluded in the selection process, described below.

## 2.3.3 Methodology

Historically, the NEPA approach to alternative analysis, and the one used in Designation EISs for the historically used ocean sites, has been to select a preferred alternative and compare it to several other

selected reasonable alternatives, or to a suite of generic alternatives, and to the No-Action Alternative. An alternative approach used in some ODMDS EISs is basically the same, except in the selection of the other sites. The purpose of this process is to "delineate economically feasible sites that are sufficiently far removed from ecologically sensitive or incompatible use areas to eliminate or minimize adverse impacts to these areas. Such so-called 'critical areas or resources' are likely to include geographically limited breeding, spawning, nursery, feeding or passage habitats; navigation lanes; beaches; and other critical areas that are determined to be incompatible with dredged material disposal activities" (EPA/USACE, 1984). Under this approach outlined in Science Applications, Inc. (SAI, 1986), selection of sites is conducted by selecting a Zone of Siting Feasibility (ZSF) and then, on the basis of available information, excluding those areas that would not conform to the 5 general criteria and the 11 specific factors for site selection given in 40 CFR 228.5 and 40 CFR 228.6(a), respectively. This selection process is normally visually displayed by a set of figures, which individually show the areas excluded for a single criterion or set of criteria (e.g., areas of biological sensitivity) and collectively show all excluded, and thus, nonexcluded areas. Therefore, the set of alternative sites is developed on a logical basis for all feasible sites. The process used here is a modification of the latter process because the Extension is so far offshore that some of the items ordinarily of concern are not of concern (i.e., transport of fines to the beach and its effect on aesthetics). Additionally, although not designated, the USACE selected four sites in an earlier EIS (USACE, 1982), as noted above, for a similar project that was never implemented. These sites are included in the ZSF and would be examined in the selection process.

After all necessary information, including that from field surveys (40 CFR 228.13), had been synthesized and nonexcluded areas had been delineated, the alternative sites were analyzed (see Section 4) relative to the 5 general criteria (40 CFR 228.5) and the 11 specific factors (40 CFR 228.6(a)). First application of the criteria and factors would be to the historically used and designated SNWW ODMDSs, if they are in the ZSF. If these sites were to conform to all criteria and factors, one or more of them would be recommended for selection unless another nonexcluded site was determined more amenable to ocean discharge.

#### 2.3.3.1 Literature Search

Several concurrent approaches were taken in the collection of data relative to the proposed project and surrounding area. A computerized literature search for pertinent information was conducted. Forms of materials referenced include monographs, journals, and other serials, conference and symposium proceedings, theses and dissertations, technical reports, government-sponsored research reports, and pamphlets.

Data available from work contracted by the USACE to private corporations and universities, and from USACE EISs, and monitoring data from the existing SNWW project were obtained. The data provided by the USACE also offer (1) information on the characteristics and quantity of the material previously dredged and deposited at the historically used sites, and (2) expected characteristics of future dredged material. This information aided in determining the compatibility of future dredged material with that

already at the existing site and the expected amounts of dredged material. USACE personnel also provided information pertinent to physical and geographical constraints.

Monitoring studies have been conducted at and near the historically used ODMDSs and the proposed Extension. The results of these studies, conducted by the USACE and USACE contractors, along with other studies, provided the necessary site-specific data used to characterize the water and sediments in the ZSF and the grain-size data for the construction and future maintenance material.

All of the information discussed above, plus navigation charts, Minerals Management Service (MMS) charts, EISs, and other documents, were identified and collected.

The collected data were compiled, arranged according to the pertinent topics, and examined. At that time, any data gaps were noted. None were sufficient to disallow completion of the selection process; i.e., sufficient information was available to apply the exclusion process and the 5 general and 11 specific criteria.

#### 2.3.3.2 Identification of Alternative Sites via the Screening Procedure

The procedure classically used to determine which potential site is the preferable site is basically a series of eliminations carried out in sequential order. The order used in the elimination process is as follows:

*Phase I*

1) **Definition of ZSF.** This is an initial screening procedure used to limit the geographic area of consideration and define the ZSF. Reasonable haul distances are a determining factor, as well as cost of monitoring and surveillance, and constraints imposed by political boundaries.

2) **Characterization of expected material and site sizing.** The type, quantity, and behavior of expected construction and maintenance material is identified. This is compared to general sediment characteristics in the ZSF to delineate zones of incompatibility. Then, the requisite size of proposed ODMDSs is determined using a numerical model, which simulates the behavior and disposition of the expected construction and maintenance material.

3) **Establish buffer zones for critical areas and resources.** The numerical model may also be used to define appropriate buffer zones around critical areas and resources. In this document, critical areas and resources are discussed in three general categories — biologically sensitive areas, beaches and recreational areas, and navigation channels.

*Phase II*

In this phase, more site-specific issues are resolved in compliance with the 11 specific factors prescribed in 40 CFR Part 228.6. In this document, factors assessed in identifying further areas to be eliminated from the ZSF are discussed in the following categories.

1) elimination due to oceanographic constraints;
2) elimination due to cultural and historic sites;
3) elimination due to nonliving resources and conditions such as sediment drift, oil and gas platforms and/or pipelines, etc.;
4) elimination due to living resources, including an appropriate buffer zone;
5) elimination due to environmental quality constraints; and
6) elimination due to recreational uses, such as beaches or recreational fishing areas, including appropriate buffer zones.

*Phase III – Final evaluation and site selection*

Based upon the evaluations conducted in phases I and II, final determination of the environmental suitability of each candidate site would be made in accordance with the five general criteria for site selection (40 CFR Part 228.5).

## 2.3.4 Development of Alternative Sites Using the Screening Technique

### 2.3.4.1 Zone of Siting Feasibility

The constraints on a site relative to the ZSF are those related more to its feasibility from a utilitarian as opposed to a regulatory perspective, although there is some overlap. Primary among the geographical and physical constraints are those that would restrict the safe and economical use of the site, such as distance from the dredging area, dangerous structures or currents, interference with or from other vessels, political boundaries, and logistic constraints on monitoring and surveillance.

#### *2.3.4.1.1 Limits Due to Cost of Transport*

The efficiency of the dredging operation, for the purposes of this report, depends only on the placement site location since all other factors would be relatively constant, no matter where the placement site is located. This efficiency can be broken down into several factors: (1) safety to personnel and dredges, (2) cost of dredging per cubic yard, (3) the time required for the dredge to complete the dredging operation and be ready to move to another area, and (4) down-time due to equipment failure. All of these factors are adversely affected by increasing the distance of the placement site from the channel. The last three of these factors can be directly correlated to the distance from dredging area to placement site, while the first is more complicated and site-specific. Certainly, however, the safety of personnel and dredges is related

to some measure of the exposure time to potential hazards (i.e., weather, other vessels/structures, etc.), and increasing exposure time in the offshore area would have an overall adverse impact on safety considerations. As noted in Section 2.3.1, replacing the proposed ODMDSs with a mid-shelf ODMDS(s) would increase construction dredging costs to $275,000,000. Maintenance dredging costs would also increase dramatically, and monitoring costs would also increase. Excess benefits from the SNWW CIP are insufficient to support such an increase; therefore, going to a mid-shelf site would make the project economically infeasible.

This distance factor also applies to ODMDSs that are much nearer the shore. For instance, existing ODMDSs were examined to determine whether all construction and future maintenance material from the Extension could be accommodated in the existing ODMDSs. Computer model runs indicated that this would be possible, without excessive mounding, but all of the existing ODMDSs would have to be used to avoid excessive mounding. Logically (see Figure 2-3), the material that would be expected to be placed in proposed ODMDS D would go to existing ODMDS 1, ODMDS C to ODMDS 2, etc., increasing the travel distance by roughly 26 miles for every load of dredged material since the end of the existing Entrance Channel and the end of the Extension is roughly 13 miles. This would increase construction-dredging costs for the Extension, using the same value of $0.29 cy/mile as in Section 2.3.1, by more than a factor of two, to $141,000,000. This cost would make it impossible to economically justify the SNWW CIP. An increase of this magnitude would obviously make the cost of transport to place material from the Extension into the existing ODMDSs much too expensive to be feasible, and additional ODMDSs in the ZSF are needed.

In the following EISs for the designation of ODMDSs for channels along the Gulf Coast (49 FR 34485 (Friday, August 31, 1984), 52 FR 22352 [Thursday, June 11, 1987]), EPA (1983a, 1983b), it was demonstrated that neither a mid-shelf site nor one beyond the edge of the Continental Shelf was preferable to a nearshore site. The Long Island Sound Dredged Material Disposal EIS (68 FR 53691 [September 12, 2003]) found that sites beyond the edge of the Continental Shelf were "economically unfeasible because of the extended travel time and associated expense." EPA (1986) states that ODMDSs should be located in an area that is within an economically and operationally feasible distance from the dredging site. Pequegnat et al. (1990) also cite operational and transportation costs as a limit on the location of an ODMDS. These factors would also apply to the placement of virgin material. Therefore, since no significant reasons for moving the placement site farther offshore, i.e., to a more nearshore site, mid-shelf site, or to one beyond the edge of the Continental Shelf, have been demonstrated, and since economic and safety reasons discourage it, the ZSF, based on limits due to cost of transport, would be an area parallel to and generally downcurrent from the SNWW Entrance Channel Extension.

#### *2.3.4.1.2 Limits Due to Feasibility of Monitoring and Surveillance*

The geographical constraints on the feasibility of a site for monitoring and surveillance are three: (1) size, (2) configuration, and (3) location. Based on historical practice, size and configuration are not pertinent to the ZSF analysis. The restrictions on location are (1) that the site be near enough to shore to allow safe

and efficient monitoring by vessels reasonably available, and (2) since benthic impacts are of primary concern, that the site be located in water shallow enough to allow efficient benthic sampling by vessels and equipment reasonably available. The first restriction is moot since any distance feasible for hopper dredge use would also be feasible for reasonably available monitoring and surveillance vessels. The efficiency of getting good replication benthic sampling due to anchoring difficulties for vessels reasonably available puts a depth limitation on the site of approximately 100 feet (Pequegnat et al., 1981). Also, any increase in depth increases benthic sampling time due to increased winch time in dropping and retrieving the grab sampler. However, along the shallow Texas coast near the SNWW Entrance Channel (see Figure 2-1), depth limitations are not as restrictive as are the cost factors, although a mid-shelf site would be in 90–110 feet of water. A site well beyond the ZSF would place restrictions on monitoring and surveillance that would reduce the feasibility of such a site.

#### *2.3.4.1.3 Limits Due to Political Boundaries*

As can be seen on Figure 2-3, the state line between Texas and Louisiana extends out down the middle of the Sabine Pass Jetty Channel, extends 9 nautical miles (approximately 10.36 statute miles) beyond the end of the jetties on the Texas side, and 3 Imperial nautical miles (approximately 3.46 statute miles) on the Louisiana side. At those points it intersects the line between Federal and State waters, which is shown on Figure 2-4. These are the Texas and Louisiana State Seaward Boundaries, measured from the MLLW line and that separate State from Federal waters. The State Seaward Boundary determines the jurisdiction over activities that occur in those waters; for instance, the seaward limit of each State's Coastal Zone and the extent of waters from which States receive all revenues from oil and gas exploration. However, these particular political boundaries, while near the SNWW Entrance Channel Extension and influencing the need of determination of CZMP consistency, do not limit the ZSF. There are no Military Warning Areas within roughly 60 miles of Sabine Pass (www.gomr.mms.gov/regulate/environ/MWA_boundries.pdf).

#### *2.3.4.1.4 Conclusion*

Pequegnat (1984) recommends additional criteria for selecting a site and develops criteria such that all U.S. sites would be essentially suitable for all situations, i.e., an ideal site. For example, a minimum water depth of 20 meters is recommended to assure that the material would remain in the disposal area for a relatively long time. Should the dredged material contain pollutants, strong winter waves would not resuspend it. Also a minimum size of 3 square nautical miles is recommended, which would be adequate for 26 to 40 mcy of material annually. However, when site-specific information is available, it is not unreasonable to use that information to determine a site, which is specific for the area of interest. Indeed, Pequegnat (1984) recommends that where existing sites are suitable for their areas, they should not be excluded from consideration just because they do not meet the criteria for an ideal ODMDS.

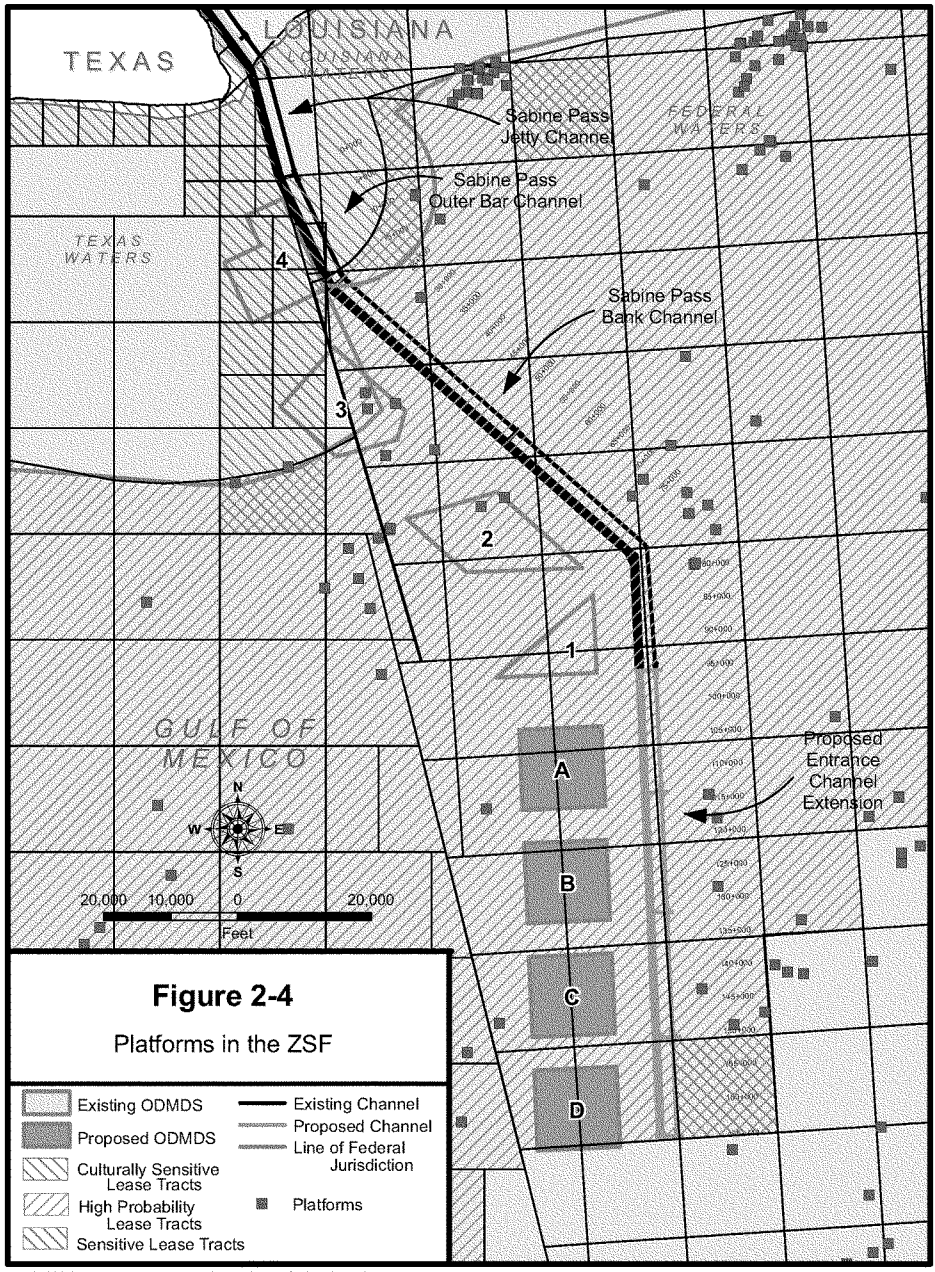



**Figure 2-4**

Platforms in the ZSF

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In this document, the cost and safety issues involved in the transportation of dredged material were the limiting factors in determining the ZSF. Especially, a mid-shelf site (60 to 70 miles offshore) and a site beyond the Continental Shelf would not be feasible because of dredging costs, safety, and limits on monitoring and surveillance. However, the amount and quality of the material to be dredged allowed the selection of the chosen ZSF since deep-water and larger placement sites were not necessary.

Based primarily on the efficiency of the dredging operation in terms of time, money, and safety, and the general uniformity of the area near the Entrance Channel Extension, the ZSF for ODMDSs is an area 13.2 statute miles long, paralleling the Extension Channel and 4 statute miles to the west of the Extension Channel. The ZSF thus encompasses an area of roughly 52 miles. All areas outside this ZSF are excluded, unless some other factor arises that excludes all of the ZSF.

#### 2.3.4.2 Modeling Dredged Material Distribution

The disposition of dredged material was simulated using an updated version (MDFATE; EPA/USACE, 1991) of a 1976 model, Dredged Material Fate (DMF), developed for the USACE through the Dredged Material Research Program by Tetra Tech., Inc. (Brandsma and Divoky, 1976). The modifications to this model were made under the supervision of Dr. Billy H. Johnson of the Waterways Experiment Station of the USACE. The purpose of the modeling was to determine the necessary size of any new ODMDSs and to determine if the existing ODMDSs were of sufficient size to contain the additional construction and future maintenance from the existing Entrance Channel and from the proposed Extension.

This program models the initial behavior and final disposition of dredged material deposited "instantaneously" at the site of interest through the doors of a hopper dredge. The MDFATE model assumes that this procedure may be broken into three phases: (1) convective descent, during which the discharge cloud falls under the influence of gravity; (2) dynamic collapse, occurring when the descending cloud impacts the bottom or arrives at a level of neutral buoyancy at which point the descent is retarded and horizontal spreading dominates; and (3) long-term passive dispersion, commencing when the material transport and spreading are determined more by ambient currents and turbulence than by the dynamics of the disposal operation (Johnson and Holliday, 1978). The model also includes the settling of suspended solids.

The model was run for the sizes of hopper dredge that have been typically used in the SNWW Entrance Channel, the specifications of which are shown in Table 2-1. Additionally, an examination of Table 2-1 would reveal that more construction material is anticipated to go into proposed ODMDS B, while more maintenance material is expected to be placed in ODMDS C. Since all of the proposed ODMDSs are the same size and are roughly at the same depth, the model was run only for ODMDS C, with the amount of new work material expected to be placed in ODMDS B and the amount of maintenance material destined for ODMDS C, as a worst-case scenario. The volumes used in the model were based on preliminary numbers for a 50-foot channel plan and, therefore, are either greater than or equivalent to the current

Table 2-1[1]
Proposed Extension Ocean Dredged Material Disposal Sites
(MFDATE Simulation Volumes)

| | Channel Station | | Length | Width | Area | Area | Depth | New Work Material | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PA | North | South | (feet) | (feet) | (square feet) | (square miles) | (feet) | Quantity (cy)[2] | Sand | Silt | Clay |
| A | 100+000 | 112+000 | 12,000 | 12,359 | 148,308,000 | 5.32 | 44.3 | 4,600,000 | 21.6 | 23.8 | 54.6 |
| B | 117+000 | 129+000 | 12,000 | 12,359 | 148,308,000 | 5.32 | 44.2 | 5,300,000 | 45.8 | 16.5 | 37.8 |
| C | 134+000 | 146+000 | 12,000 | 12,359 | 148,308,000 | 5.32 | 45.8 | 4,640,000 | 40.8 | 19.3 | 40.0 |
| D | 151+000 | 163+000 | 12,000 | 12,359 | 148,308,000 | 5.32 | 44.5 | 4,200,000 | 22.5 | 21.6 | 55.9 |
| | | | | | | | | 18,740,000 Total | | | |

| | Contributing Channel Channel Station | | Channel | | Future Maintenance Material with Proposed Project[4] | | | |
|---|---|---|---|---|---|---|---|---|
| PA | North | South | Length | Frequency (years) | Quantity[3] (cy/cycle) | Sand | Silt | Clay |
| A | 95+734 | 114+000 | 18,266 | 4 | 639,310 | 9.7 | 35.8 | 54.5 |
| B | 114+000 | 132+000 | 18,000 | 4 | 630,000 | 9.7 | 35.8 | 54.5 |
| C | 132+000 | 150+500 | 18,500 | 4 | 647,500 | 9.7 | 35.8 | 54.5 |
| D | 150+500 | 165+000 | 14,500 | 4 | 507,500 | 9.7 | 35.8 | 54.5 |
| | | | | | 2,424,310 per cycle (assumes 4-year cycle) | | | |
| | | | | | 30,303,875 per 50 years | | | |
| | | | | | 606,078 Average annual | | | |

[1]Volume based on an earlier 50-foot channel plan.

[2] from calculations supplied by USACE

[3] from table from Galveston District

[4] Based on historic data for maintenance material going into PA1, the farthest offshore of existing ODMDSs. Bottom current velocity = 0.4 feet per second to south-southwest (EPA, 1983).

Model is MDFATE found at: http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=drgmat
Hopper dredge statistics: Capacity in cy, time in minutes, velocity in knots, all others in feet.

| Size | Small | Medium | Large |
|---|---|---|---|
| Capacity | 3600 | 6400 | 9180 |
| Type | Split Hull | Split Hull | Bottom Door |
| Hopper | | | |
| Length | 150 | 137 | 153 |
| Width | 41 | 40 | 40 |
| Time to empty | 4 | sand 6<br>mud 2 | 3 |
| Loaded Draft | 19.4 | 22.4 | 29 |
| Unloaded draft | 12 | 15 | 20.5 |
| Velocity at discharge | 4 | 4 | 2 |

volumes of the proposed 48-foot channel plan, with the exception of the future maintenance material volumes for proposed channel extension. Following subsequent shoaling analyses, it was concluded that the future maintenance volume for the proposed 48-foot plan channel extension is actually 25 percent greater than the extension channel maintenance volumes used for the MDFATE simulation. However, when combining ODMDS B new work material with ODMDS C future maintenance material, the combined volume for the simulation increased by only 2.5 percent. The model was also run on each existing ODMDS, using the quantity of construction and future maintenance material that is projected to go into those ODMDSs. Model runs were made for all existing PAs since there is great variation in the sizes and quantities of materials expected to be placed in them. A run was also made to determine if the existing ODMDSs could accommodate all of the construction and future maintenance material from both the existing Entrance Channel and the proposed Extension. For the 50-foot channel plan, the combination of new work and maintenance material from ODMDS B and PA3 going into PA3 appeared to be the worst case and was used for the combination model run.

#### *2.3.4.2.1 New Work Material*

The percentage of the various soil particle types anticipated in the new work sediment to be dredged was estimated (see tables 2-1 and 2-2) using information (gravel, sand, and fines) from cores collected by the USACE in 1977, in preparation for the EIS for the 50-foot channel proposed in USACE (1982), supplemented by grain-size data for the fines fraction from Pearson et al. (1986). The proposed channel extension for the 48-foot project is located within the general footprint of the channel extension proposed in the 1982 EIS. The USACE took 26 cores from the end of the jetties to beyond the Extension. Of these, eight were in the proper location and of sufficient depth to provide information on the grain-size distribution in the ZSF. However, the cores taken by the USACE did not break the fines into the silt and clay fractions needed for the modeling. Therefore, data in which fines were broken into silts and clays were taken from Pearson et al. (1986) for cores in roughly the same location, at the same depths, and from the same sediment type. The relative percentages of silts and clays in the reference cores were applied to the fines fractions of the USACE cores to provide complete grain-size distribution. These data for the entire column of the construction material that was expected to be placed in each proposed or existing ODMDS (sand content is higher at the surface) at the time of MDFATE simulations are presented in tables 2-1 and 2-2, along with the quantity of material from Extension construction or existing Entrance Channel improvement that was anticipated to be placed in each proposed ODMDS for the MDFATE simulations. Updated new work and future maintenance material volumes are previously reported in Table 1-1 of this document.

Output from the MDFATE model simulates the results of depositing the entire amount of dredged material on the ocean floor at predetermined grid points. In the models, the mounds of new work material were slightly skewed in the current and vessel-heading directions and would form rounded diamond-shapes, slightly elongated in the downcurrent and vessel-travel directions, although this is difficult to see at the scale of the figures in Attachment A. At its thickest, the mound elevation for the largest mound of

Table 2-2
Existing Entrance Channel Ocean Dredged Material Disposal Sites
(MDFATE Simulation Volumes)

Contributing Channel

| PA | Channel Station North | Channel Station South | Area (acres) | Area (square yards) | Area (square miles) | Depth (feet) | New Work Material Quantity (cy)[1] | Gravel (%) | Sand (%) | Silt (%) | Clay (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 2+500 | 18+000 | 3,444 | 16,668,960 | 5.38 | 34 to 43 | 4,669,000 | 0 | 4.3 | 24.4 | 71.3 |
| 3 | 24+000 | 41+000 | 3,939 | 19,064,760 | 6.15 | 30 to43 | 5,923,000 | 0 | 15.4 | 21.6 | 63.0 |
| 2 | 61+000 | 80+000 | 4,738 | 22,931,920 | 7.40 | 33 to41 | 8,275,000 | 0 | 18.7 | 20.7 | 60.6 |
| 1 | 84+000 | 95+734 | 2,020 | 9,776,800 | 3.16 | 34 to43 | 9,983,000 | 0 | 3.2 | 24.7 | 72.1 |
| | | | | | | | 28,850,000 | Total | | | |

Contributing Channel

| PA | Channel Station North | Channel Station South | Channel Length | Frequency (years) | Quantity per year[2] (cy) | Future Maintenance Material with Proposed Project Quantity per cycle (cy) | Gravel (%) | Sand (%) | Silt (%) | Clay (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 0+000 | -215+29 | 21,529 | 5 | 327,241 | 1,636,204 | 0 | 9.6 | 57.5 | 32.9 |
| 3 | 0+00 | 18+000 | 18,000 | 1 | 4,590,000 | 4,590,000 | 0 | 9.6 | 57.5 | 32.9 |
| 2 | 18+000 | 53+000 | 35,000 | 2 | 1,855,000 | 3,710,000 | 0 | 11.8 | 51.3 | 36.9 |
| 1 | 53+000 | 95+734 | 42,734 | 4 | 373,923 | 1,495,690 | 0 | 5.0 | 51.6 | 43.4 |
| | | | | | 7,146,163 | 11,431,894 | per cycle | | | |
| | | | | | | 357,308,165 | per 50 years | | | |

[1] From USACE Construction Estimate Table

[2] Information from Nancy Young (Frqncy Tbl 20051)

new work material in the proposed ODMDSs would be 4.14 feet and 5.25 in the existing ODMDSs (Table 2-3). The lateral extent from the peak of the mounds at the edge of the mounding to the point where the model indicates mound thickness is reduced such that ambient water depth is reached is 705 feet upcurrent of the discharge point and 1,081 feet in the with-current direction (see Table 2-3). Cross-current mounding extended 539 feet from the release point in the direction from which the vessel was traveling and 690 feet from the release point in the direction of vessel travel. Therefore, these are the distances that would be used in the determination of the sizes of the buffer zones and the proposed ODMDSs.

For the existing ODMDSs, the locations of the discharge points, a grid within each ODMDS, were controlled so that no dredged material mound extended beyond the boundaries of the site and then the mounding height was determined. This method was chosen to ensure that the existing ODMDSs are of sufficient size without excessive mounding. For some runs, not all of the potential discharge points were needed (e.g., compare Attachment A, pages A-10 with A-11 or A-14 with A-15). As an examination of Table 2-3 and Attachment A would reveal, the sizes of the existing ODMDSs are sufficient to contain the material from the proposed channel deepening and widening.

#### *2.3.4.2.2 Maintenance Material*

The MDFATE model program was also run on the maintenance material. The percentage of the grain sizes anticipated in the maintenance material to be dredged from the Entrance Channel Extension and existing Entrance Channel was estimated (see tables 2-1 and 2-2) using historical information from analyses of maintenance material from the existing channel dating from 1993 through 2004 (USACE Galveston District Dredging Histories Data Base) and the models were conducted, again on proposed ODMDS C and each existing ODMDS (Attachment A). At its thickest, the mound elevation for the largest mound of material would be 2.79 feet for the proposed ODMDSs and 7.46 feet for the existing ODMDSs (see Table 2-3). The lateral extent from the peak of the mounds at the edge of the mounding to the point where the model indicates mound thickness is reduced such that ambient water depth is reached is 679 feet upcurrent of the discharge point and 1,078 feet in the with-current direction (see Table 2-2). Cross-current mounding extended 399 feet from the release point in the direction from which the vessel was traveling and 389 feet from the release point in the direction of vessel travel. These distances would also be used in the determination of the sizes of the buffer zones and the proposed ODMDSs. Since no long-term mounding has occurred over the history of use of the existing ODMDSs, which includes several channel deepenings (EPA, 1983a) and continuing maintenance dredging events, and since the construction dredging would include advance maintenance, the mounding for the maintenance material was not added to that for the construction dredging.

As a result of that analysis, it was found that the size of the existing SNWW ODMDSs (EPA, 1983a) was sufficient for 50 years of routine maintenance from the 48-Foot Project for the area of the existing Entrance Channel. Since all other facets of the maintenance material are the same for the 48-Foot Project

Table 2-3
MDFATE Results

| Material | Dredge Size | Maximum Mound Height (feet) | Spacing (feet) | Downcurrent Maximum Distance (SW) (feet) | Upcurrent Maximum Distance (NE) (feet) | With Dredge Direction (South) (feet) | Against Dredge Direction (North) (feet) | Typical Duration of Dredging (days) |
|---|---|---|---|---|---|---|---|---|
| Entrance Channel Extension | | | | | | | | |
| ODMDS C | | | | | | | | |
| New Work | Large | 4.14 | 500 | 798 | 615 | 690 | 539 | 321 |
| | Small | 2.23 | 500 | 1,081 | 703 | 346 | 378 | |
| Maintenance | Large | 2.79 | 900 | 649 | 541 | 389 | 357 | 52 |
| | Small | 1.90 | 500 | 1,078 | 679 | 388 | 399 | |
| Entrance Channel Only | | | | | | | | |
| ODMDS 4 | | | | | | | | |
| New Work | Large | 4.90 | 500 | 992 | 562 | 612 | 661 | 411 |
| | Small | 3.47 | 500 | 1,537 | 760 | 661 | 413 | |
| Maintenance | Large | 7.46 | 500 | 876 | 793 | 744 | 992 | 185 |
| | Small | 5.67 | 500 | 1,207 | 826 | 760 | 661 | |
| ODMDS 3 | | | | | | | | |
| New Work | Large | 4.21 | 500 | 1,019 | 438 | 438 | 723 | 410 |
| | Small | 2.81 | 500 | 1,384 | 757 | 303 | 649 | |
| Maintenance | Large | 4.44 | 500 | 1,351 | 465 | 1,200 | 508 | 113 |
| | Small | 3.59 | 500 | 1,509 | 863 | 593 | 539 | |
| ODMDS 2 | | | | | | | | |
| New Work | Large | 4.62 | 500 | 895 | 658 | 608 | 574 | 415 |
| | Small | 3.08 | 500 | 1,467 | 900 | 1,017 | 550 | |
| Maintenance | Large | 4.35 | 500 | 877 | 548 | 636 | 723 | 67 |
| | Small | 3.76 | 500 | 1,266 | 844 | 641 | 895 | |
| ODMDS 1 | | | | | | | | |
| New Work | Large | 4.90 | 500 | 973 | 432 | 616 | 162 | 235 |
| | Small | 5.25 | 500 | 1,732 | 910 | 1,293 | 373 | |
| Maintenance | Large | 4.17 | 500 | 973 | 649 | 800 | 551 | 38 |
| | Small | 3.14 | 500 | 1,458 | 800 | 877 | 307 | |
| Entrance Channel and Entrance Channel Extension | | | | | | | | |
| ODMDS 3 | | | | | | | | |
| New Work | Large | 3.66 | 500 | 1,102 | 518 | 848 | 298 | 693 |
| | Small | 3.27 | 500 | 1,536 | 762 | 1,006 | 331 | |
| Maintenance | Large | 3.71 | 500 | 1,384 | 649 | 1,049 | 1,405 | 163 |
| | Small | 3.12 | 500 | 1,514 | 832 | 995 | 649 | |

as currently exist, the analysis conducted for EPA's site designation (EPA, 1983a) is considered sufficient, and no additional analyses were conducted for maintenance material for the 48-Foot Project to the end of the existing Entrance Channel. The existing designated maintenance material ODMDSs are the selected alternative for routine maintenance material associated with the 48-Foot Project to the end of the existing Entrance Channel. Accordingly, no further discussion of maintenance material from this portion of the 48-Foot Project is included in this EIS.

#### 2.3.4.3 Buffer Zone Assignment

The computer model (results displayed in Attachment A) for short-term sediment mounding was used to determine the expected distribution of the construction and maintenance material on the ocean floor immediately after placement. The information gained from the model runs, by consistently using conservative scenarios, allowed the determination of (1) the buffer zones discussed below, and (2) the appropriate size for the ODMDS.

##### *2.3.4.3.1 Biologically Sensitive Areas*

The only biologically sensitive area near the existing or candidate ODMDSs is the Sabine Bank, a sand bank located approximately 17 miles south of the mouth of Sabine Pass in water depths of – 39 feet (Blum et al., 2002). The main body of the bank (Sabine West Bank) is 20.5 miles long, running roughly parallel to the Texas coast. The existing SNWW navigation channel is located approximately 0.75 mile to the east of its eastern extent. A smaller body of Sabine Bank (Sabine East Bank), approximately 10.5 miles long, is located east-northeast of the SNWW channel. Existing ODMDSs PAs 1 and 2 are located north and south of the eastern end of the Sabine West Bank, and none of the Sabine Bank is located within the ZSF. Sabine Bank, as a topographic high that provides relief in an otherwise relatively flat area, likely provides ecologically and economically important essential fish habitat (EFH) for fish species (Brooks et al., 2003). It also "may provide a special microhabitat with a different benthic community residing within on-bank, off-bank, and ecotone areas based on a combination of sediment grain size and energy regime (Neuman and Able, 1998; Wright et al., 2000; Bergen et al., 2001)" (Brooks et al., 2003). However, since Sabine Bank (East or West) would not be affected if the material does not flow out of the proposed ODMDSs, as shown by the modeling, no buffer zones were utilized for biologically sensitive areas.

##### *2.3.4.3.2 Beaches and Recreational Areas*

Since the nearest beach is roughly 12 miles away from the most-inshore of the candidate sites, and since other ODMDSs for the Texas coast (EPA, 1982, 1989, 1990a, 1990b, 1990c, 1990d) indicate needed buffer zones ranging from 0.8 to 1.9 miles, a buffer zone for beaches was not determined. The only recreational pastime that could be affected would be fishing (all others would be onshore and at least 12 miles away), most of which would occur at Sabine Bank or at drilling rigs in the vicinity. Since both of these would be avoided, no buffer zones were required for recreational areas.

#### *2.3.4.3.3 Navigation Channel*

The upcurrent edge of detectable mounding for virgin material is roughly 705 feet upcurrent of the discharge point, as noted in Section 2.3.4.2.1. Since the location of the disposal site would inevitably be downcurrent of the channel (see Section 2.3.4.4), doubling of the 705 feet, should provide an adequate buffer zone to prevent significant material from being carried back into the channel. This buffer zone also keeps the dredge well out of the navigation channel when it is discharging. Thus, the navigation channel buffer zone is 1,410 feet. The proposed ODMDSs are roughly 3,000 feet downcurrent from the Extension, so application of a Navigation Channel Buffer Zone is easily met.

### 2.3.4.4 Oceanographic Constraints

With time, the mounding from the construction material would erode and be carried downcurrent. Since the longshore drift is predominantly east to west along the Gulf Coast at Sabine Pass (EPA, 1983a; Kumpf et al., 1999), placing the disposal area to the east of the channel would ensure that the dredged material would be carried right back into the channel. Therefore, all areas east of the channel are excluded from consideration for the ODMDSs.

### 2.3.4.5 Cultural and/or Historical Resources Constraints

No buffer zone for buried sites of archeological or historic interest is recommended. Shipwrecks are the only cultural/historic resources that could be expected in the ZSF, and existing databases indicate no known shipwrecks are located within the ZSF. However, Figure 2-4 does show Texas lease tracts that are designated as Culturally Sensitive Lease Tracts by the THC; Federal lease tracts that are listed by MMS as High Probability Lease Tracts because of the probability of a shipwreck, based solely on location; and Federal and State lease tracts that are designated by MMS as Sensitive Lease Tracts because they are believed to contain specific shipwrecks that are more than 50-years old. Ancient river levees along the buried valley walls of the relict Sabine River channel are the only offshore locations where archeological sites could reasonably be found. None of this relict river valley is located in the ZSF (Figure 2-5). Figure 2.5 was taken *in toto* from Pearson et al. 1986, since it so excellently showed the relic valley. To it was added the SNWW Entrance Channel and Extension. As Figure 2-5 demonstrates, the SNWW Entrance channel splits off from the relic valley at about the offshore end of the Outer Bar Channel. The proposed ODMDSs are hidden by the inset map in the bottom right hand corner of Figure 2-5. Therefore, the proposed ODMDSs are well away from the higher probability areas along the relic riverbank. Furthermore, there is no long-term accumulation of material in the ODMDSs and the short-term accumulation outside of the sites is expected to be minimal, similar to that at the historically used ODMDS. There should be no significant impact should unknown wrecks be present within the ODMDS sites.

**Figure 1-1. The study area (after Nelson and Bray 1970).**

Figure 2-5

#### 2.3.4.6 Nonliving Resources Constraints

There is only one natural obstruction in the proposed ODMDSs and it is only a slight shoal to 40-foot MLLW in proposed ODMDS A. The Extension, the navigation channel buffer zone, and the Navigation Safety Fairways, for safety reasons, are excluded from the area available for the proposed ODMDSs (see Figure 2-2). There are no active oil or gas platforms reported in the proposed ODMDSs (see Figure 2-4; MMS, 2004; NOAA Chart 11341), although there may be a platform located at the northwest corner of proposed ODMDS B (USACE, 2004). However, it does not appear to be associated with a pipeline and, therefore, is likely the location of a shut-in and abandoned well. If it is indeed in the boundaries of the proposed ODMDS, the USACE has a 1,000-foot safety precaution built into all dredging contracts, such that dredges must not discharge within 1,000 feet of any platform. Offshore platforms from the University of Texas Bureau of Economic Geology (BEG) database, through 2001, are included on Figure 2-4.

MMS typically has a 1,300-foot clearance restriction on dredged material placed nearby drilling rigs or production platforms because of the possibility of "mudslides" that could damage oil/gas rigs. USACE typically imposes a 1,000-foot buffer zone around rigs/platforms in its dredging contracts. Dredged material does flow, thus the diminution of mound height from the placement point, as seen in Attachment A. However, from the data in Table 2-3, it can be determined that the maximum mound height in the proposed ODMDSs is only about 4 feet, with side slopes of an average of 116 horizontal to 1 vertical for construction material and 155:1 for maintenance material. Accumulations of this height and slope obviously pose no threat to oil/gas rigs. Furthermore, there are no active oil or gas platforms in the proposed ODMDSs.

There is one pipeline that just touches the northern edge of proposed ODMDS D (see Figure 2-3), and another that can be found under the northeast portion of proposed ODMDS B, but their presence should not preclude the use of these sites since (1) they are buried and should not be an obstruction for dredge operations; (2) the existing ODMDSs are crossed by pipelines with no reported problems; (3) the mounding would be evenly distributed all over the ODMDSs, therefore causing no overburden stress on the pipelines; (4) the material would winnow away with time; and (5) active pipelines would have to be deepened or relocated because they cut across the proposed Extension. Proposed ODMDSs A and D overlap with portions of Fairway Anchorage Areas but should not preclude the designation of these proposed ODMDSs since (1) the dredged material placement would cause no more than 5 feet of shoaling and the average water depth in the anchorages is 46 feet (see Figure 2-3 and Figure 2-6); (2) the ODMDSs would be located on Navigation Charts and Notices to Mariners; and (3) part of the Anchorages do not overlap with the ODMDSs and the use of the sites is one time for construction material and intermittent for future maintenance material.

#### 2.3.4.7 Living Resources Constraints

Sabine Bank, at its nearest, is located roughly 1.7 miles northwest of the northwest corner of proposed ODMDS A. There are no nearby fish havens, and the jetties, which provide excellent fish habitat, are more than 16 miles away and the nearest artificial reef (see Figure 2-7) is 6.6 miles from proposed

ODMDS B. Both of these jetties and the artificial reefs are too distant to warrant generation of buffer zones. EFH is discussed in great detail in the SNWW CIP EIS. From a review of that discussion, most of the areas of concern are estuarine, which would not be affected by ocean placement. For the marine aspects of the fish covered by EFH, they are either concentrated near reefs, offshore platforms, or other hard substrate or they are widely scattered over the Gulf bottom, and no single area, excepting Sabine Bank, is likely to be more important than any other. Therefore, there are no EFH issues that influence the selection of the ODMDS locations. The only marine fish with Critical Habitat near the ZSF is the Gulf sturgeon, which has a present range of Lake Pontchartrain and the Pearl River system in Louisiana east to the Suwannee River in Florida (68 FR 13370). The nearest portion of the Critical Habitat is Lake Pontchartrain east of the Lake Pontchartrain Causeway and is, therefore, not a factor in ODMDS site selection.

#### 2.3.4.8 Environmental Quality Constraints

As noted (1) in sections 3.2, 3.3.4, and 4.2.1, which are concerned with characterization of the material to be dredged, with water quality in the ZSF, with the quality and characteristics of sediment in the ZSF, and the environmental impacts of ocean placement in the preferred sites, and (2) sections 3.4.2 and 4.2.2.2, which are concerned with the benthos, no environmental quality constraints on the new work or maintenance material site selection exist except for those included in the buffer zone development, since as noted in Section 2.3.6, there are no grain-size considerations.

#### 2.3.4.9 Recreational Uses Constraints

As noted above, the only recreational use would be from fishing, and since Sabine Bank is at least 1.7 miles from any proposed ODMDS and there are no offshore platforms in any of the proposed ODMDS, no recreation use buffer zone is needed.

#### 2.3.4.10 Areas Available for an ODMDS

Based on the information provided above, all of the areas in the proposed ZSF are available for designation.

### 2.3.5 ODMDS Size Determination

The same oceanographic considerations that applied to the development of the buffer zones apply to the determination of necessary size of a disposal site. That is, the site must be designed so that any mounding that occurs would not endanger shipping (i.e., mounding of no more than 5 feet), and so that sediment and water column parameters would be at background levels outside of the disposal site. As noted above, the modified ODMDSs proposed by USACE (1982) were examined and are sufficiently large to accommodate both the construction material and anticipated future maintenance material without undue mounding if placement of all loads occurs at least 980 feet from the boundaries of the ODMDSs, and the

loads are placed in a grid pattern with drop points at 500-foot intervals. If there are more loads than drop points, the pattern would be repeated until all dredged material has been discharged.

### 2.3.6 Preferred Sites

As noted previously, the virgin material is predominantly silt and clay (average of 32 percent sand), and the maintenance material is even finer (roughly 9 percent sand), which would make a predominantly silt/clay regime the preferable bottom type upon which to dispose of the material. However, there are no such regions in the ZSF. In fact, all of the surface areas in the ZSF and up to 16 miles to the west are dominated by sandy sediments. Therefore, there is no reason, based on grain size and the information provided above, to locate the proposed ODMDSs anywhere other than at the sites selected by USACE (1982). It should be noted that the same situation exists at the existing ODMDSs, but studies have shown no significant change in diversity and only a slight decrease in benthic abundance with continual use of these ODMDSs (USACE, 1975; EPA, 1983a). In a study for EPA (1983a; Appendix A), where dredging occurred between two benthos investigations, the only change found that could potentially be related to dredged material placement was a slight decrease in the percentage of deposit feeders. Therefore, the apparent incompatibility of grain size appears, based on empirical data, to have little impact on the benthic community. Additional factors are that dredged material does not appear to accumulate at the ODMDSs, and the benthos on the inner shelf is disturbed so frequently that it never reaches a climax stage and, thus, is dominated by opportunistic, adaptable species. According to EPA (1983a), dredged material is likely to erode completely within a year or two because of tropical storms or hurricanes. Every 3 years or so a hurricane or tropical storm would come sufficiently close (within 30 miles) to cause bottom currents near 200 centimeters per second (cm/sec) and every year, on average, close enough (within 250 miles) to cause bottom currents of 50 cm/sec. Both of these currents are sufficient to cause significant sediment movement, and the former would cause massive movement of bottom sediments (EPA, 1983a).

Therefore, the preferred sites for the SNWW 48-Foot Project new work and maintenance material ODMDSs for the Entrance Channel Extension are bounded by (Coordinates in NAD 83):

| | |
|---|---|
| ODMDS A | 29° 24′ 47″ N, 93° 43′ 29″ W; 29° 24′ 47″ N, 93° 41′ 08″ W |
| | 29° 22′ 48″ N, 93° 41′ 09″ W; 29° 22′ 49″ N, 93° 43′ 29″ W |
| ODMDS B | 29° 21′ 59″ N, 93° 43′ 29″ W; 29° 21′ 59″ N, 93° 41′ 08″ W |
| | 29° 20′ 00″ N, 93° 41′ 09″ W; 29° 20′ 00″ N, 93° 43′ 29″ W |
| ODMDS C | 29° 19′ 11″ N, 93° 43′ 29″ W; 29° 19′ 11″ N, 93° 41′ 09″ W |
| | 29° 17′ 12″ N, 93° 41′ 09″ W; 29° 17′ 12″ N, 93° 43′ 29″ W |

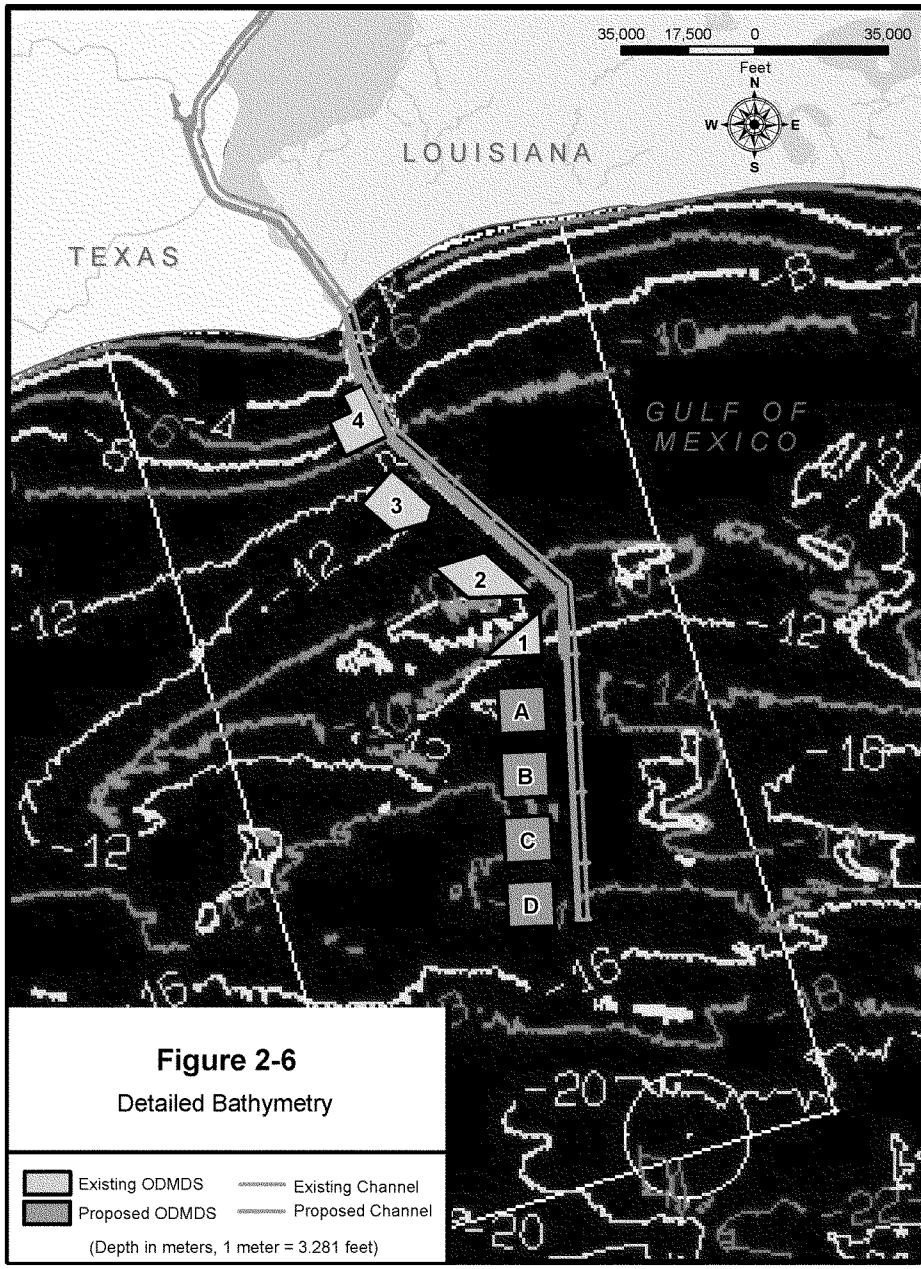


**Figure 2-6**

Detailed Bathymetry

N:/441206/post_HU_projects/Projects/Figure_2_6_vr2.mxd

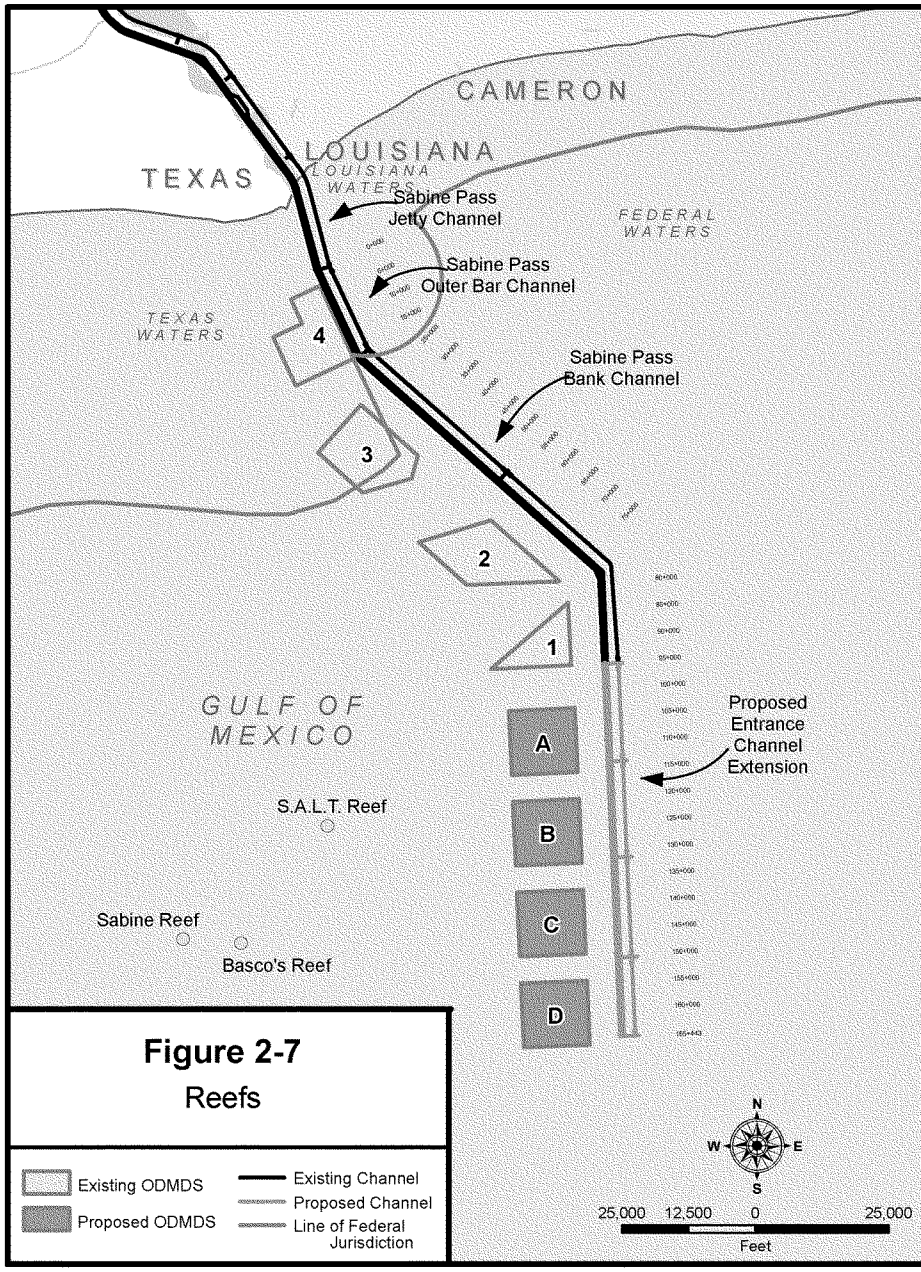


**Figure 2-7**
Reefs

N:441206/post_HU_projects/Projects/Original_Revised_Figure_Numbers/Figure_2_7_Vr2.mxd (A.P. 3/08/07)

ODMDS D 29° 16′ 22″ N, 93° 43′ 29″ W; 29° 16′ 22″ N, 93° 41′ 10″ W
29° 14′ 24″ N, 93° 44′ 10″ W; 29° 14′ 24″ N, 93° 43′ 29″ W

Each is 12,000 feet long in the north-south direction, 12,360 feet in the east-west direction, and has an area of 5.32 square miles, or 4.02 square nautical miles.

## 2.4 PREFERRED ALTERNATIVE – DESIGNATION OF FOUR ADDITIONAL WEST-OF-CHANNEL ODMDSs

### 2.4.1 Description

Alternatives examined were the No-Action Alternative, upland placement, and ocean placement, including Nearshore, Mid-Shelf, and Continental Slope Alternatives. The No-Action Alternative would result in the cancellation of the 48-Foot Project and, previously in this document, was determined to be not viable. The Mid-Shelf and Continental Slope Alternatives were not considered viable because of safety and economic considerations and because of limits on monitoring and surveillance. While the existing ODMDSs appear to have sufficient capacity to contain all construction and maintenance material from the 48-Foot Project, they are not considered viable because of greatly higher transport costs. The preferred nearshore sites, as opposed to mid-shelf or continental slope sites, were developed by excluding those areas that would not be appropriate for ocean disposal of dredged material, and then selecting apparent environmentally acceptable, suitably sized disposal sites. Since the sites selected by USACE (1982) were found to be of sufficient size, had essentially the same grain size as all other areas in the ZSF, and are environmentally acceptable and operationally efficient, they were selected as the preferred alternative. EPA's Preferred Alternative is the final designation of the preferred sites as the ODMDSs for the one-time placement of virgin material and the placement of future maintenance material from the dredging of the Entrance Channel Extension of the 48-Foot Project.

### 2.4.2 Site Monitoring and Surveillance

One of the ODMDS management responsibilities cited in 40 CFR 228.3 is "developing and maintaining effective ambient monitoring programs," although this is tempered somewhat by 40 CFR 228.9 (a), which states, "The monitoring program, if deemed necessary by the Regional Administrator or the District Engineer, as appropriate, may include baseline or trend assessment surveys. . . ." Since 40 CFR 229 (c) states that "EPA will require the full participation of permittees . . . in the development and implementation of disposal monitoring programs," a monitoring program and Site Monitoring and Management Plan (Attachment C) are included in this EIS.

There are two approaches that may be applied to determining unfavorable trends. One is to conduct monitoring surveys on the ecosystem at and near the ODMDSs at regular intervals. The other approach is to determine the quality of the material to be discharged at the site, from a chemical and biological perspective, and thereby, to determine expected impacts. The testing requirements specified in 40 CFR

227.13, as applied by the USACE, Galveston District, satisfy parts of both of the above-mentioned approaches.

The Site Management and Monitoring Plan included as Attachment C addresses the details of monitoring and surveillance for both construction and maintenance material.

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# 3.0 AFFECTED ENVIRONMENT

This section provides a brief description of the area comprising the land and ocean areas near Sabine Pass, the Entrance Channel, and offshore for roughly 30 miles. This is the ODMDS Study Area as the term is used in this EIS. Thus, this section provides more information than that pertaining to the existing site or even the ZSF. More-specific information, as the Ocean Dumping Regulations apply to the preferred alternative, is presented in Section 4.1.

## 3.1 CHARACTERISTICS OF HISTORICALLY USED ODMDSs

### 3.1.1 Site Locations

The characteristics of the four ODMDSs that have been historically used (see Figure 2-4) and were designated in 1987 (52 FR 34218) are listed below (based on data from EPA [1983a] and USACE data [Coordinates are in NAD 27; all dredged material quantities include advance maintenance, allowable overdepth, and nonpay dredging]).

| Site | Corner Coordinates | Distance from Shore (miles) | Area (miles/ nautical miles) | Depth (feet) | Existing Maintenance Material (mcy) | Estimated 48-Foot Project Construction Material (mcy) | Estimated 48-Foot Project Maintenance Material (mcy)* |
|---|---|---|---|---|---|---|---|
| ODMDS 1 | 29° 28′ 03″ N, 93° 41′ 14″ W | 18.4 | 3.2/ | 34–43 | 2.56 | 8.31 | 1.51 |
| | 29° 26′ 11″ N, 93° 41′ 14″ W | | 2.4 | | | | |
| | 29° 26′ 11″ N, 93° 44′ 11″ W | | | | | | |
| ODMDS 2 | 29° 30′ 41″ N, 93° 43′ 49″ W | 14.6 | 7.4/ | 30–43 | 1.70 | 7.05 | 3.13 |
| | 29° 28′ 42″ N, 93° 41′ 33″ W | | 5.6 | | | | |
| | 29° 28′ 42″ N, 93° 44′ 49″ W | | | | | | |
| | 29° 30′ 08″ N, 93° 46′ 27″ W | | | | | | |
| ODMDS 3 | 29° 34′ 24″ N, 93° 48′ 13″ W | 7.8 | 6.2/ | 33–41 | 1.99 | 5.92 | 4.47 |
| | 29° 32′ 47″ N, 93° 46′ 16″ W | | 4.6 | | | | |
| | 29° 32′ 06″ N, 93° 46′ 29″ W | | | | | | |
| | 29° 31′ 42″ N, 93° 48′ 16″ W | | | | | | |
| | 29° 32′ 59″ N, 93° 49′ 48″ W | | | | | | |
| ODMDS 4 | 29° 38′ 09″ N, 93° 49′ 23″ W | 4.8 | 5.4/ | 16–30 | 1.14 | 2.98 | 1.35 |
| | 29° 35′ 53″ N, 93° 48′ 18″ W | | 4.1 | | | | |
| | 29° 35′ 06″ N, 93° 50′ 24″ W | | | | | | |
| | 29° 36′ 37″ N, 93° 51′ 09″ W | | | | | | |
| | 29° 37′ 00″ N, 93° 50′ 06″ W | | | | | | |
| | 29° 37′ 46″ N, 93° 50′ 26″ W | | | | | | |
| | Total per dredging cycle | | | | | N/A | 10.46 |
| | Project Total | | | | 7.38 | 24.26 | 334.30 |

*Per dredging cycle.

### 3.1.2 Characterization of the Materials Expected to be Dredged

#### 3.1.2.1 Virgin Material

The SNWW was last deepened before the MPRSA was enacted, so no Section 103 evaluations have been conducted on the construction materials, per se. However, the construction material should be the same as the material examined in PBS&J (2004), which was found acceptable under a Section 103 evaluation. The material expected to be dredged during deepening of the Jetty Channel, Outer Bar Channel, and Sabine Bank Channel should be essentially the same as the sediments to be dredged from the Extension Channel (discussed in Section 3.2.4.1). Therefore, there are no concerns relative to the sediment quality.

#### 3.1.2.2 Maintenance Material

As noted in Section 1.1, the designation of the existing ODMDSs for the maintenance material was presented in EPA (1983a). EPA (1983a) included information about sediment and elutriate chemistry and bioassays and bioaccumulation studies on maintenance material and that information indicated no concerns relative to the maintenance material. However, additional information is provided in sections 3.2 and 3.3 of the SNWW CIP FEIS, to which this document is appended. SNWW CIP FEIS Section 3.3, Water Quality, and Section 3.4, Sediment Quality, discuss USACE chemistry and bioassay data on maintenance material samples from the existing Entrance Channel, collected in 1993, 1995, 1996, 1998, and 2004. Samples were subjected to chemical analyses in all years and bioassays and bioaccumulation studies in 1998 (PBS&J, 1999) and 2004 (PBS&J, 2004). These sections conclude that there are no concerns with the maintenance material relative to water-quality or ocean-floor impacts.

## 3.2 CHARACTERISTICS OF PROPOSED ODMDSs

### 3.2.1 ODMDS Locations

The characteristics of the four proposed ODMDS (see Figure 2-4) are listed below (based on information provided by the USACE [Coordinates are in NAD 83; all dredged material quantities include advance maintenance, allowable overdepth, and nonpay dredging]):

| Site | Corner Coordinates | Distance from Shore (miles) | Area (miles/ nautical miles) | Depth (feet) | Estimated 48-Foot Project Construction Material (mcy) | Estimated 48-Foot Project Maintenance Material (mcy)* |
|---|---|---|---|---|---|---|
| ODMDS A | 29° 24′ 47″ N, 93° 43′ 29″ W<br>29° 24′ 47″ N, 93° 41′ 08″ W<br>29° 22′ 48″ N, 93° 41′ 09″ W<br>29° 22′ 49″ N, 93° 43′ 29″ W | 21 | 5.3/<br>4.0 | 44 | 4.59 | 0.79 |
| ODMDS B | 29° 21′ 59″ N, 93° 43′ 29″ W<br>29° 21′ 59″ N, 93° 41′ 08″ W<br>29° 20′ 00″ N, 93° 41′ 09″ W | 24 | 5.3/<br>4.0 | 44 | 5.30 | 0.78 |

| Site | Corner Coordinates | Distance from Shore (miles) | Area (miles/ nautical miles) | Depth (feet) | Estimated 48-Foot Project Construction Material (mcy) | Estimated 48-Foot Project Maintenance Material (mcy)* |
|---|---|---|---|---|---|---|
| | 29° 20′ 00″ N, 93° 43′ 29″ W | | | | | |
| ODMDS C | 29° 19′ 11″ N, 93° 43′ 29″ W<br>29° 19′ 11″ N, 93° 41′ 09″ W<br>29° 17′ 12″ N, 93° 41′ 09″ W<br>29° 17′ 12″ N, 93° 43′ 29″ W | 27 | 5.3/<br>4.0 | 46 | 4.65 | 0.80 |
| ODMDS D | 29° 16′ 22″ N, 93° 43′ 29″ W<br>29° 16′ 22″ N, 93° 41′ 10″ W<br>29° 14′ 24″ N, 93° 44′ 10″ W<br>29° 14′ 24″ N, 93° 43′ 29″ W | 30 | 5.3/<br>4.0 | 45 | 4.20 | 0.65 |
| | Total per dredging cycle | | | | N/A | 3.02 |
| | Project Total | | | | 18.74 | 37.73 |

*Per dredging cycle.

### 3.2.2 Characterization of the Disposal Area

In 2004, the USACE contracted for the collection of samples for water, surface sediments (grab samples), and elutriate chemistry; grain-size analysis; suspended particulate phase (SPP) and solid phase (SP) bioassays and bioaccumulations studies; and macrobenthic invertebrate analysis on material from the proposed ODMDSs and the centerline of the proposed Extension Channel (PBS&J, 2004).

Samples were collected at nine channel sites and three ZSF sites for water, sediment, and elutriate chemistry; grain size; suspended particulate and SP bioassays; and bioaccumulation studies (Figure 3-1). Additionally, samples were collected at 56 stations in the ZSF for grain-size analysis and at 14 stations for benthos. The chemical analysis and grain-size data are presented in Attachment C, which is appended to this ODMDS EIS.

The ZSF-Ref elutriate exceeded the EPA Acute and Chronic Water Quality Criteria (WQC) for copper, as did the water sample, and the Chronic WQC for nickel and zinc, but not the Acute WQC. There were no concerns with contaminants in the sediments as determined by the analyses described below. There were no tests in which survival of test organisms in the SPP and SP bioassays was at least 10 percent less than Reference Control survival (20 percent for the amphipods), requiring statistical analysis of the data (Attachment C). Therefore, these data yield no indication of toxicity to sensitive marine organisms during dredging or placement. Also, there was no bioaccumulation of trace metals or organic compounds in *Mercenaria mercenaria* or *Nereis virens* exposed to sediments from stations in the proposed Entrance Channel extension or from the reference stations. There was some statistically significant accumulation of cyanide in *N. virens* exposed to SN-CH-100 sediments (Attachment C). The significance of this is not

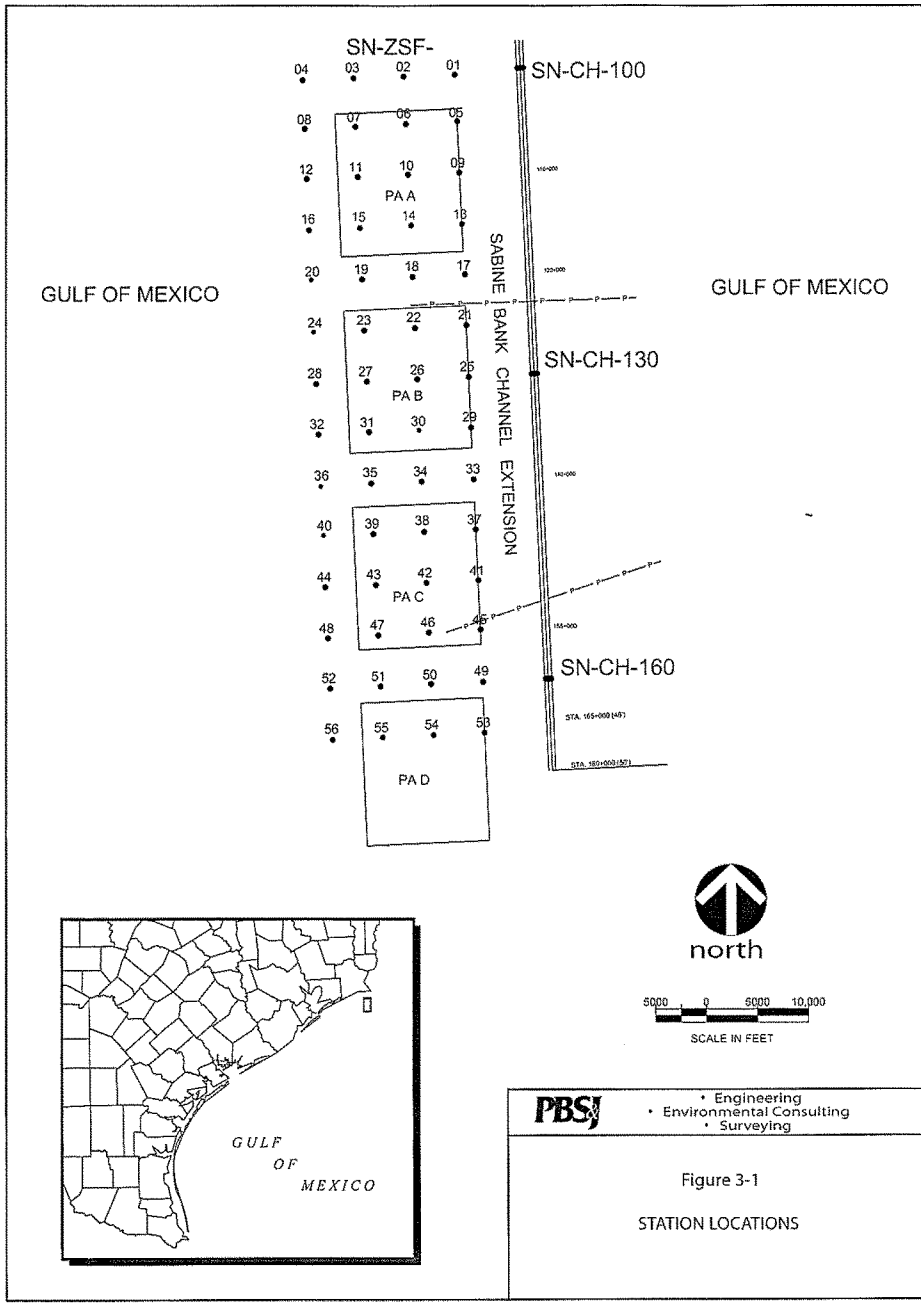


Figure 3-1

STATION LOCATIONS

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clear but for the reasons that follow, should not be of concern. There is no U.S. Food and Drug Administration (FDA) Action level for cyanide and cyanide was not detected in any water, elutriate, or sediment sample. Cyanide was not detected in all replicates of *N. virens* exposed to SN-CH-100 sediments; was found in some replicates of *N. virens* exposed to SN-CH-160 sediments, although not at concentrations significantly greater than Reference Control tissues; and was found in some replicates of *M. mercenaria* exposed to Reference, SN-CH-130, and SN-CH-160 sediments, but not SN-CH-100 sediments. Additionally, there should be no difference in the channel station sediments, relative to the reference sediments since there is no channel in place at this time.

The sediments in the area (PBS&J, 2004) are predominantly sand: 26 percent of the samples contained >90 percent sand, 41 percent contained >80 percent sand, and only two samples had a sand content less than 50 percent. The maximum sand content was 99.1 percent sand at Station ZSF-55.

Additional data from the Rice University Coastal Research Group (2008), as noted in Anderson and Wellner (2002), White et al. (1987), and Pearson et al. (1986), were examined to determine if the data were useful for comparison to the PBS&J (2004) data and to determine whether grain size changed markedly outside the ZSF. Only the Rice University data for surface sediments from core samples were useful because Pearson et al. (1986) did not provide complete grain-size analysis for the core data by depth and White et al. (1987) only provided nearshore data. The Rice University data are summarized in Table 3-1. The data were organized so that they provide a series of roughly north-south lines, with the lines moving from east of the SNWW channel to roughly 46 miles west of the channel. The line within 93°44′ W to 93°49′ W most closely aligns with the ZSF, even though it is slightly to the west. The Rice University data confirm what was found in the ZSF (PBS&J, 2004), that surface sediments in the region surrounding the ZSF are predominantly sand.

### 3.2.3 Characterization of the Material Expected to be Dredged

#### 3.2.3.1 New Work Material

The information provided above for the ZSF is also a description of the surface material from the area to be dredged for the proposed Extension. Therefore, there is no concern for placement of the surface material. No chemical analyses or bioassays have been conducted on cores from the proposed Extension, but such testing is excluded by the Ocean Dumping Regulations (40 CFR §§200–228; 42 FR 2468, January 11, 1977), which state at 40 CFR § 227.13(b)(3) that dredged material is excluded from testing:

> (3) When:
>
> (i) The material proposed for dumping is substantially the same as the substrate at the proposed disposal site; and

Table 3-1
Rice University Coastal Research Group Core Data

| Station | Longitude Degrees | Longitude Minutes | Latitude Degrees | Latitude Minutes | Sand (%) | Silt (%) | Clay (%) |
|---|---|---|---|---|---|---|---|
| Longitude 93° 36' - 37' | | | | | | | |
| 93-1 | 93 | 37 | 29 | 31 | 31 | 66 | 3 |
| 93-2 | 93 | 37 | 29 | 31 | 100 | 0 | 0 |
| 93-3 | 93 | 37 | 29 | 30 | 75 | 25 | 0 |
| 93-4 | 93 | 36 | 29 | 29 | 62 | 36 | 2 |
| 93-5 | 93 | 36 | 29 | 28 | 65 | 33 | 2 |
| Longitude 93° 44' - 49' | | | | | | | |
| 96-2B | 93 | 49 | 29 | 28 | 65 | 33 | 2 |
| 96-2C | 93 | 49 | 29 | 28 | 65 | 33 | 2 |
| 96-1 | 93 | 46 | 29 | 27 | 75 | 25 | 0 |
| 96-3 | 93 | 47 | 29 | 26 | 100 | 0 | 0 |
| 96-4 | 93 | 46 | 29 | 24 | 100 | 0 | 0 |
| 96-5 | 93 | 44 | 29 | 21 | 100 | 0 | 0 |
| Longitude 93° 49' - 53' | | | | | | | |
| GY-134A | 93 | 51 | 29 | 29 | 100 | 0 | 0 |
| 93-13 | 93 | 53 | 29 | 28 | 36 | 63 | 1 |
| GY-135A | 93 | 50 | 29 | 27 | 100 | 0 | 0 |
| GY-136A | 93 | 49 | 29 | 26 | 100 | 0 | 0 |
| 93-12 | 93 | 52 | 29 | 26 | 60 | 39 | 1 |
| 93-11 | 93 | 51 | 29 | 26 | 92 | 8 | 0 |
| 93-10 | 93 | 51 | 29 | 25 | 87 | 13 | 0 |
| 93-14 | 93 | 55 | 29 | 25 | 87 | 12 | 1 |
| 93-9 | 93 | 50 | 29 | 24 | 91 | 8 | 1 |
| 93-8 | 93 | 50 | 29 | 23 | 15 | 83 | 2 |
| 93-7 | 93 | 49 | 29 | 22 | 87 | 13 | 0 |
| 93-6 | 93 | 49 | 29 | 22 | 81 | 18 | 1 |
| Longitude 93° 57' - 59' | | | | | | | |
| 93-16B | 93 | 58 | 29 | 23 | 87 | 12 | 1 |
| 93-16A | 93 | 58 | 29 | 23 | 94 | 5 | 1 |
| 93-17 | 93 | 57 | 29 | 22 | 84 | 15 | 1 |
| 93-15 | 93 | 59 | 29 | 21 | 68 | 31 | 1 |
| Longitude 94° 02' - 04' | | | | | | | |
| 93-21 | 94 | 4 | 29 | 22 | 96 | 4 | 0 |
| 93-20 | 94 | 4 | 29 | 21 | 95 | 5 | 0 |
| 93-19 | 94 | 3 | 29 | 20 | 37 | 58 | 5 |
| 93-18 | 94 | 2 | 29 | 19 | 94 | 6 | 0 |

Source: Rice University Coastal Research Group (2008).

(ii) The site from which the material proposed for dumping is to be taken is far removed from known existing and historical sources of pollution so as to provide reasonable assurance that such material has not been contaminated by such pollution.

#### 3.2.3.2 Maintenance Material

Future maintenance material in the Extension should be essentially the same as the maintenance material routinely dredged from the existing Entrance Channel (sections 3.1.2.2, 4.1.2.4, and 4.2.1.2), which has not shown a cause for concern in past testing and is even further removed from sources of pollution.

## 3.3 PHYSICAL ENVIRONMENT

The historically used ODMDSs have received SNWW Entrance Channel maintenance material (USACE records) since at least 1971, although the channel was obviously maintained before that date. The sizes of the ODMDSs and their coordinates are provided in Section 3.1.1. They are south-southeast of Sabine Pass between the –20-foot and –40-foot contour lines. The historically used ODMDSs were designated by EPA for the continued placement of dredged material removed from the SNWW Entrance Channel (FR Vol. 52, No. 175, September 10, 1987, page 34218; FEIS, 1983 [EPA, 1983a]).

The SNWW Entrance Channel provides access for vessels of up to 40-foot draft to the ports of Port Arthur and Beaumont and nearby areas. The Sabine Pass area is atypical in that, unlike 90 percent of the Texas shoreline, it is not separated from the Gulf by barrier islands. The Gulf Intracoastal Waterway (GIWW) runs northwest-southeast through the area, running from Galveston, Texas, to Port Arthur, to near Orange, and on toward Lake Charles, Louisiana.

### 3.3.1 Climate and Meteorology

While the study area for this EIS is entirely within the contiguous waters of the Gulf, the climate is still the same as that described in Section 3.2.4 of the 48-Channel EIS and are not repeated here. Of the material here that is not included in Section 3.2.4 of the SNWW Channel Improvement Project EIS, much is drawn from Ward (1977). The Sabine Pass area is in a marine environment dominated by the Gulf. The dominating influence of the Gulf arises chiefly from (1) the large area of the Gulf and long residence time of overlying air that enables the Gulf to function as an airmass source region, and (2) the persistent onshore flow that transports Gulf air deep into the state. The onshore flow is interrupted by weather disturbances carried in the belt of prevailing westerlies, but these interruptions occur primarily in winter, when the belt of westerlies is displaced southward to the middle latitudes of the U.S., the Bermuda High weakens considerably, and frontal passages over the project area become much more frequent.

In late summer, when the westerlies have retreated into Canada, the Texas Gulf coast area falls under the influence of the tropical easterlies, which, like the westerlies, carry disturbances. These tropical systems, easterly waves, depressions, and sometimes hurricanes, enter the state from the east and southeast and move westward. The peak month of this tropical activity is September. According to Henry and

McCormack (1975), annually there is a 32 percent, 18 percent, or 6 percent chance of a tropical storm, hurricane, or extreme hurricane, respectively, striking a 100-mile strip of the Gulf coast centered a little east of Sabine Pass.

The average temperatures in the Sabine Pass area for winter (January) and summer (July) are 52 degrees Fahrenheit (°F) and 83°F, respectively, for the period 1957 to 2004. These average temperatures are, of course, the statistical expression of a complex of meteorological systems within the respective months over 48 years. Average monthly rainfalls in the Sabine Pass area for months representative of the four seasons are as follows: 4.9 inches (January), 5.3 inches (May), 5.5 inches (July), and 5.6 inches (September), for a yearly average of 56.8 inches (www.waterbase.com).

Two principal wind regimes occur along the Texas coast: prevailing south to southeasterly winds, and short-lived but strong northerly winds, generally associated with winter "northers." Wind velocities in the area are generally constant throughout the year, ranging from a monthly average of 7.4 miles per hour (mph) in July to 11.4 mph in March.

From the hydrographic point of view, the most significant climatological effects are due to seasonal precipitation distributions and to the forcing of circulations and wave motions by wind systems. With respect to the latter, the phenomenon of the frontal passage is of particular importance. Bays along the Texas coast, including Sabine Lake, are extremely responsive to meteorological forcing, as are the inner reaches of the shelf (Crout et al., 1984). Although the characteristics and morphology of frontal systems are highly variable, a general scenario may be sketched as follows. As a polar outbreak enters Texas, low-level convergence in the frontal zone enhances the normal southerly flow. The resultant onshore winds elevate water levels in the upper parts of the bays and along the northwest Gulf coast, forcing a volume of water through the passes. With the passage of the front, pressure increases inland and the wind turns to the north, depressing water levels in the upper bays and in the northwest Gulf, thus discharging volumes of water through the passes into the Gulf.

## 3.3.2 Oceanographic

### 3.3.2.1 Bathymetry

The neritic zone potentially affected by dredged material disposal activities includes the shoreface, defined as the area from shore to about 30 feet depth and the inner reaches of the Gulf Continental Shelf, which extends from a depth of about 30 feet to the 65,000 feet contour (Fisher et al., 1973). Shallow waters, less than 45 feet deep, comprise approximately 25 percent of the entire shelf.

Transition from shoreface to shelf occurs between 1 to 10 miles from shore and is marked by a decrease in bottom slope. In the Sabine Pass area, the bottom slope averages 6 feet per mile until roughly 1 mile offshore, after which it steadily decreases to an average 1 foot per mile roughly 10 miles offshore (White et al., 1987). Thus, for most of its extent, the shelf is gradually sloping and, except for Sabine Bank, it is relatively featureless. The shelf merges seaward with the slightly more precipitous continental slope at

about –650 feet with the transition area known as the shelf break. The Continental Shelf is at its widest south of the Sabine Pass area (100 miles wide; MMS, 1997). No coral reefs, banks, or other major physiographic features characterize the shelf in the Sabine Pass area, except for Sabine Bank. As can be seen from Figure 2-6, the water depth in the area ranges to approximately 65 feet.

#### 3.3.2.2 Circulation and Mixing

The hydrodynamic regime of the northwestern Gulf is the result of the complex interaction of tides, meteorological driving forces (i.e., wind and atmospheric pressure gradients), freshwater inflows, Coriolis acceleration, etc. Both local conditions and the overall Gulf circulation pattern affect the hydrodynamics of the study area. In addition, major meteorological events such as hurricanes and tropical storms can have profound influence on waves, tides, and currents. However, these events are relatively rare and of short duration. For example, EPA (1982) states that within approximately 40 miles of the Gulf coast of northeastern Texas, bottom currents would reach a maximum velocity of around 3.92 knots every 3 years and sustain velocities of 1 knot or greater for several days once a year.

Astronomical tides are generally small in the Gulf. They vary from diurnal to semidiurnal as a function of the moon's declination, with a typical diurnal range of 2 to 4 feet along the coast. Spring tides are generally higher, but since the range is so small, meteorological effects (i.e., wind or storms) can completely obscure tidal fluctuations (Buchman, 1979). A more-detailed discussion of tides in the Gulf can be found in Marmer (1954).

A major feature that dominates circulation in the eastern Gulf is the Loop Current, a continuation of the Yucatan Current, which enters the Gulf through the Yucatan Straits. There are two important semipermanent currents that diverge from the Loop Current: one circulating clockwise in the southwestern Gulf, the other circulating counterclockwise in the northwestern Gulf (Curray, 1960; Cochrane and Kelly, 1986), although in summer, winds that can cause upwelling can also cause a reversal of the counterclockwise flow. The general surface circulation in the Gulf is depicted on Figure 3-2.

Roughly one-third of the discharge from the Mississippi River system flows to the Mississippi-Alabama shelf, and the Texas-Louisiana shelf receives the other two-thirds, which produces one of the most productive coastal fisheries in the U.S. The Mississippi and Atchafalaya rivers, along with the other rivers in Texas and Louisiana, produce a freshwater flow equal to approximately 10 percent of the shelf volume (Dinnel, 1984).

For the purposes of this EIS, the most critical currents are those associated with strong, episodic events, e.g., northers, tropical storms, and hurricanes. Brooks (1984) has measured the effects of hurricanes, which may increase current speeds at the water surface over the Continental Shelf to 3 to 5 feet per second (MMS, 2002), down to 700 feet. Off the Texas-Louisiana coast in 100 meters of water, Halper and

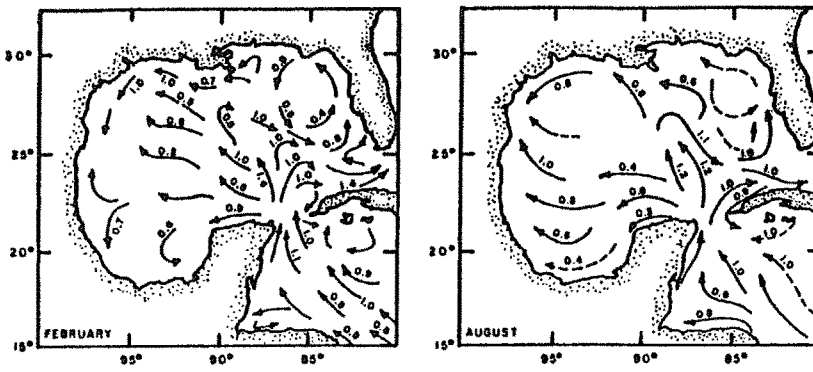


Figure 3-2

Surface Currents in the Gulf of Mexico (after Nowlin, 1971).

Schroeder (1990) found that currents at a current meter moored at 60 meters depth rapidly shifted from westerly at 5 to 10 cm/sec to north-northwesterly at 25 to 30 cm/sec and reached a maximum of 55–60 cm/sec. At 315-foot depth, the currents went from southerly at 5 cm/sec to north-northeasterly at 15 cm/sec. The current shift was also accompanied by a 34°F decrease in temperature, attributed to storm-caused upwelling of cold bottom water over the shelf break (Halper and Schroeder, 1990).

### 3.3.3 Water Quality

The results of chemical analyses for compounds detected in water and elutriate samples are presented in PBS&J (2004). Elutriates were prepared from test sediment and channel water for chemical analysis, which provides information on those constituents that are dissolved into the water column during dredging and open-water placement. A comparison of the elutriate results with the channel water results indicated minor increases in nickel, upon elutriate preparation at most channel stations, and more-dramatic increases for several metals at the Reference station. The water and elutriate samples at the ZSF-REF exceeded both the acute and chronic copper WQC, and the elutriate sample also exceeded the chronic nickel and zinc WQC but not the acute WQC. The acute WQC are more appropriate for these analyses since these are grab samples, and thus are a snapshot in time, not from a series of samples taken over time or a 4-day average like the chronic WQC. This station is not in the channel extension, no material would be dredged from it, and sediment was only collected there to use as a reference.

SPP bioassays were also conducted on composite proposed Extension Channel samples and a True and Reference Control (PBS&J, 2004). There were no tests in the SPP bioassays in which survival in the True Control was greater than survival in the treatments and the difference exceeded 10 percent (EPA/USACE, 2003). Therefore, these data yielded no indication of toxicity to sensitive marine organisms during dredging or placement of virgin material.

### 3.3.4 Sediments

#### 3.3.4.1 Sediment Quality and Characteristics

Sediment concentrations of detected compounds are also presented in PBS&J (2004). There were no trends evident in the sediment chemistry data, not surprising since all of these stations are virgin Gulf bottom and the only distinction to the channel extension stations being that they are in line with the existing SNWW Entrance Channel. Copper and nickel concentrations in CH-130 sediments seemed to be higher, relative to the other stations, but this was not true for the duplicate of CH-130. The concentrations of all organics, except total organic carbon (TOC) were below detection limits.

There are no sediment quality criteria with which to compare concentrations in the sediment. However, there are several different guidelines that are used to look for a cause for concern in sediment samples, one of which is the Effects Range Low, or ERL (Buchman, 1999), used as a potential trigger to identity a cause for concern. ERLs were developed by a technique that demonstrates no cause and effect from the chemicals in the data set, and when ERLs derived from sets of data from different areas are compared, the

results are inconsistent (USACE, 1998b). Since the ERLs are not based on cause and effect data, they are used only to determine a possible "cause of concern."

No ERLS were exceeded by the sediment concentrations from the ZSF, so these data indicate no cause for concern. Even so, SP bioassays and bioaccumulation studies were conducted on composite proposed Extension Channel samples and a True and Reference Control (PBS&J, 2004). As with the SPP data, there were no tests in the SP bioassays in which survival in the Reference Control was greater than survival in the treatments and the difference exceeded 10 percent (20 percent for the amphipods). Therefore, the survival data from the SP bioassay indicate no potential for environmentally unacceptable toxic impacts to benthic organisms from the placement of sediments from SNWW Entrance Channel Extension stations onto nearby bottom sediments.

No organic chemicals were found above detection limits in test organism tissues from the bioaccumulation studies. Of the metals, arsenic, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc, plus cyanide, were found in tissue samples above detection limits. The concentrations of none of the metals in tissues of *N. virens* or *M. mercenaria* exposed to test sediments were significantly higher than the respective concentrations in Reference Control organisms. However, cyanide concentrations in tissues of *N. virens* exposed to SN-CH-100 sediments were significantly greater than in the Reference polychaetes. Therefore, there is some indication of bioaccumulation from exposure to these sediments. The significance of this is not clear. There is no FDA Action level for cyanide, and cyanide was not detected in any water, elutriate, or sediment sample. Cyanide was not detected in all replicates of *N. virens* exposed to SN-CH-100 sediments; was found in some replicates of *N. virens* exposed to SN-CH-160 sediments, although not at concentrations significantly greater than Reference Control tissues; and was found in some replicates of *M. mercenaria* exposed to Reference, SN-CH-130, and SN-CH-160 sediments, but not SN-CH-100 sediments. Additionally, there should be no difference in the proposed Extension Channel station sediments, relative to the reference sediments since there is no channel in place at this time.

The surface sediments in the area are predominantly sand: 26 percent of the samples contained >90 percent sand, 41 percent contained >80 percent sand, and only two samples had a sand content less than 50 percent. The maximum sand content was 99.1 percent sand at Station ZSF-55.

#### 3.3.4.2 Sediment Transport

The Texas shoreline is an ever-changing interface of land and the waters of the Gulf. Sedimentation processes result from the interaction between the winds, waves, currents, tides, and other active agents in the littoral zone. Shores erode, accrete, or remain stable, depending on the rates at which sediment is supplied to and removed from the shore.

Energy for sediment dispersal on the Texas shelf is attributed primarily to meteorological events (prevailing winds and storms) and secondarily to astronomic tidal events (Shideler, 1978). The most effective normal winds are the persistent southeasterly winds and the short-lived, intense northers. The

predominant southeasterly winds, combined with the current regime in the northwestern Gulf (Section 3.3.2.2), generate a net longshore drift in a westerly direction off Sabine Pass. Sediments supplied by this longshore drift are derived primarily from the Mississippi River. Some sediment is also carried to the shoreface by tropical storms and hurricanes. The northers create strong waves and complicated circulation patterns (resulting in resuspension of sediments), strong ebb currents, and the neutralization of flood currents.

Moherek (1978) studied four different sediment types containing different quantities of sand, silt, and clay found near Galveston Bay. The study was conducted to determine the bottom water velocity necessary to cause rapid erosion of the bottom sediments, i.e., to cause movement of both the suspended load and the bed load. He found a critical erosion velocity of 0.47 knot, with little variation among the sediment types. As noted in Section 3.3.2.2, on an annual basis, the bottom ocean currents near Sabine Pass should have sustained bottom velocities of at least twice the critical erosion velocity for several consecutive days. This would cause significant sediment movement. At a bottom water speed of around 4 knots, which can be expected every 3 years (Section 3.3.2.2), massive bed load erosion can be expected.

The astronomic tidal components of the hydraulic regime are most influential in the sedimentation processes by providing suspended sediment through coastal tidal inlets. Wind-drift currents are the dominant sediment transport mechanism compared to the residual wave-drift components. Minimal wave-drift sediment is transported along the Texas coast under normal wave conditions; however, storm waves, which possess longer periods, have substantial influence. In a few hours, hurricanes and severe tropical storms can produce erosion and deposition equal to the effect of normal conditions over months or even years. Storm tides are also important as dispersal agents by intensifying the discharge of sediments from coastal inlets. Also, rip currents and littoral currents along the coastal zone, in addition to tidal currents, are important to regional sediment dispersal.

Motion of sediment in the littoral zone is initiated by wind-induced waves that then drive current systems that transport the sediment. Breaker height is significant in determining the quantity and size of sand to be set in motion, and breaker angle with the coast is a major factor in determining the direction and rate of longshore transport. Onshore-offshore transport in the littoral zone is dictated by sediment size, wave steepness, and beach slope. In general, high, steep waves transport material offshore, while low waves move sediment onshore. Waves may break and reform three or four times across the shoreface, producing an associated line of breakers and breaker bars. These shell and sand breaker bars change size and shift position as determined by the variable wave height. Variations in the wind direction and wave approach can mean that longshore transport direction can vary hourly, daily, or seasonally with the wind.

## 3.4 BIOLOGICAL ENVIRONMENT

### 3.4.1 Plankton

The plankton community comprises phytoplankton, zooplankton, and ichthyoplankton. The phytoplankton are primary producers and form the basis of the food chain, along with bacteria in the

offshore environment. Phytoplankters are not free-swimming organisms but move with currents and tides. Because of the more-stable environment offshore, relative to salinity, nutrient concentration, vertical mixing, and predation, the phytoplankton community in the Gulf is more stable than in estuarine waters (MMS, 2002). The water feeding into the Gulf from the Caribbean is low in nutrients. However, in the winter, with the overturning of the surface waters, nutrient-rich bottom water is brought to the surface to supply nutrients. In late spring, nutrient-rich river discharge reaches its maximum, and the phytoplankton also reaches its maximum. During late summer and fall, with the decline in riverine discharge and the concomitant decrease in nutrients, the phytoplankton decline (Institute for Marine Remote Sensing, 2008). In the Gulf near Sabine Pass, the phytoplankton are dominated by diatoms, which make up more than 90 percent of phytoplankters (MMS, 2002). The dominant diatoms are *Nitschia*, *Thalassiothrix*, *Thalassionema*, *Skeletonema*, *Chaetoceros*, and *Asterionella* (SEADOCK, 1976; Simmons and Thomas, 1962). The diatom domination of the phytoplankton changes to a coccolithophorid-dominated phytoplankton in deeper waters (Baalen, 1976).

Zooplankton, the faunal portion of the plankton, are mostly free-swimming organisms, as opposed to the phytoplankton, and comprise the organisms that spend all of their life stages in the water column (holoplankton) and the organisms that spend only larval stages in the water column (meroplankton). Holoplankton in the project include protozoans, gelatinous zooplankton, copepods, chaetognaths, polychaetes, and euphausids, whereas the meroplankton include also polychaetes plus echinoderms, gastropods, bivalves, and fish larvae and eggs (MMS, 2002). These latter two comprise the ichthyoplankton. Meroplankton constitute 3 to 5 percent of the total zooplankton (Harper, 1977).

Among the ichthyoplankton, Sherman et al. (1983) determined that the five most abundant families in the northwestern quadrant of the Gulf were Myctophidae (lanternfishes), Gonostomatidae (bristlemouths), Bregmacerotidae (codlets), Gobiidae (gobies), and Clupeidae (herrings). MMS (2002) adapted the data from Ditty et al. (1988) and determined that the species that were found in shallower water (less than 82 feet) north of the 26th parallel in the Gulf were primarily inshore demersal species; e.g., Atlantic bumper (*Caranx ruber*), spotted seatrout (*Cynoscion nebulosus*), pigfish (*Orthopristis chrysoptera*), and black drum (*Pogonias cromis*).

### 3.4.2 Benthos

Macroinfaunal communities along the Texas shelf are related to distributions of sediment texture and to water depth (Flint and Rabalais, 1981). The number of species, number of individuals, and diversity were highest in shallow waters and declined with increasing depth.

Benthos were included in the USACE study of the ZSF (PBS&J, 2004). Fourteen stations were sampled for benthic macroinvertebrate characterization analysis (see Figure 3-1). The detailed methodology and results of these analyses are included in the report provided by Barry A. Vittor & Associates (BV&A) and included in Appendix E of PBS&J (2004). The following is taken from the BV&A report.

A total of 1,199 organisms, representing 75 taxa, were identified. Polychaetes were the most numerous organisms present representing 57.7 percent of the total assemblage, followed in abundance by malacostracans (18.3 percent) and bivalves (7.7 percent). Polychaetes represented 44.6 percent of the total number of taxa followed by malacostracans (21.1 percent) and bivalves (13.7 percent). A mixed assemblage of annelids, mollusks, and arthropods was found at stations 1, 3, 10, 12, 42, 49, and 51, and annelids dominated the assemblage at the remaining stations.

The dominant taxa collected from the Sabine Pass stations were the polychaetes *Spiophanes bombyx*, *Mediomastus* (LPIL), *Magelona* sp. H, and *Prionospio* (LPIL), representing 6.2 percent, 5.4 percent, 5.0 percent, and 4.9 percent of the assemblage, respectively. The most widely distributed taxon was the polychaete family, Onuphidae (LPIL), which was found at 79 percent of the stations.

The mean number of taxa per station ranged from 4.7 at Station 10 to 27.0 at Station 26. Mean density per station ranged from 4,055 organisms/square foot at Station 3 to 30,265 organisms/square foot at Station 26. Taxa diversity ranged from 1.69 at Station 10 to 3.61 at Station 35. Taxa evenness was uniformly high and ranged from 0.77 at Station 10 to 0.97 at Stations 1 and 12.

Wet-weight biomass was highly variable among stations; 11 of the 14 stations had an average biomass of <0.35 gram/square meter ($g/m^2$). The highest biomass was found at Station 42 (0.92 $g/m^2$).

The stations formed four distinct clusters: Stations 10 and 42 (high sand content, 89 to 95 percent sand); stations 26, 28, 33 and, 35 (68 to 75 percent sand); stations 17, 19, 44, 49, and 51 (77 to 91 percent sand, except for Station 49); and stations 1, 3, and 12 (lowest sand content, less than 60 percent sand, except for Station 12). The cluster of stations 26, 28, 33, and 35 had the highest station densities, and the assemblages were dominated by amphipods in the genus *Ampelisca* and the polychaetes, *Magelona* and *Mediomastus*. The cluster of stations 17, 19, 44, 49, and 51 had densities lower than stations 26, 28, 33, and 35, but higher than the remaining stations. The remaining two clusters of stations had the lowest taxa richness, and densities and were not dominated by the amphipod/polychaete assemblage seen at the other stations. Only stations 12 and 49 were not in clusters strongly based on sand content.

### 3.4.3 Nekton

Offshore nekton of the project area include a combination of species utilizing both the bay and Gulf, species found exclusively on the shelf at varying depths year-round, and species that migrate into the area from southern latitudes in response to the warming of shelf waters. Additionally, since 46 percent (Mager and Ruebsamen, 1988) of all wetlands and estuaries of the southeastern U.S. that are important to fishes found offshore are located in the Gulf, finfish of the north-central Gulf are dominated by estuary-dependent fish and shellfish. As can be seen by the landings data in Section 3.5.1.1, these include menhaden, shrimps, crabs, and sciaenids. Common species in the surf zone include Gulf whiting (*Menticirrhus littoralis*) and Atlantic threadfin (*Polydactylus octonemus*) (Hoese and Moore, 1998). Studies by McFarland (1963) and Gunter (1958) on the inshore fish fauna of the central coast of Texas indicated Florida pompano (*Trachinotus carolinus*), southern kingfish (*Menticirrhus americanus*), striped

mullet (*Mugil cephalus*), scaled sardine (*Harengula jaguana*), and Atlantic threadfin as dominants. Other dominant fish, according to Gunter (1958), include Atlantic croaker (*Micropogonias undulatus*), tidewater silverside (*Menidia beryllina*), longnose killifish (*Fundulus similis*), and striped anchovy (*Anchoa hepsetus*). Based on a comparison of data from 1945 and 1947 to 1949, Gunter noted that dominant species were likely to vary from year to year.

According to MMS (2002), the inshore shelf area (depth from 20 to 50 feet) is dominated by Atlantic croaker, spot (*Leiostomus xanthurus*), black drum, silver seatrout (*Cynoscion nothus*), southern kingfish, and Atlantic threadfin; the middle shelf zone (depth from 90 to 150 feet) by longspine porgies (*Stenotomus caprinus*), although sciaenids are included; and the outer shelf zone (depth from 210 to 360 feet) by blackwing searobin (*Prionotus rubio*), Mexican searobin (*Prionotus paralatus*), and shoal flounder (*Syacium gunteri*). Darnell et al. (1983) and Darnell and Kleypas (1987) found that the abundance of fish resources was highest between Galveston and the Mississippi delta for all seasons of the year.

A phenomenon that impacts the nekton and the benthos results from the heavy nutrient input of the large amount of fresh water encroaching on the shelf, as noted in Section 3.3.2.2 above, and a well-developed pycnocline (Cochrane and Kelly, 1986; Dinnel and Wiseman, 1986). A large area of the deeper waters of the Texas/Louisiana shelf from Galveston, Texas, to the Mississippi River Delta becomes anoxic or hypoxic from the combination of these two events (Rabalais et al., 1991), beginning in the late spring, reaching a maximum in midsummer, and disappearing in the fall. The low wind speeds of the summer months and the strong pycnocline do not allow sufficient mixing to bring higher-oxygen-content surface water to the deeper, hypoxic layer (Rabalais et al., 1996). This hypoxic layer has insufficient oxygen (less than 2 milligrams per liter [mg/L] oxygen) for most nekton or epifauna (http://www.nos.noaa.gov/ products/pubs_ hypox.html).

### 3.4.4 Threatened and Endangered Species

Based on correspondence with the National Marine Fisheries Service (NMFS), 11 species of aquatic vertebrates that are considered endangered or threatened may be present in the study area marine environment. These are the blue whale (*Balaenoptera musculus*), the fin whale (*Balaenoptera physalus*), the humpback whale (*Megaptera novaeangliae*), the sei whale (*Balaenoptera borealis*), the sperm whale *Physeter catodon* (=*P. macrocephalus*), the green sea turtle (*Chelonia mydas*), the hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempi*), the leatherback sea turtle (*Dermochelys coriacea*), the loggerhead sea turtle (*Caretta caretta*), and the Gulf sturgeon (*Acipenser oxyrinchus desotoi*).

The U.S. Fish and Wildlife Service (USFWS) added one species of aquatic vertebrate to the threatened or endangered list provided above by the NMFS, the West Indian manatee (*Trichechus manatus*) and one bird, the piping plover (*Charadrius melodus*). All of the species, with the exception of the bald eagle, are discussed in detail in the SNWW CIP FEIS, to which this ODMDS FEIS is appended, and the Biological

Assessment, also appended to the SNWW CIP FEIS as Appendix G1, and that discussion are not duplicated here, although any impacts from site designation to these species is discussed in Section 4.2.2.5. The bald eagle and brown pelican (*Pelecanus occidentalis*) were delisted while this FEIS was in preparation

### 3.4.5 Marine Sanctuaries and Special Biological Resource Areas

There are several biological resource areas within the project area. For instance, the McFaddin and Texas Point National Wildlife Refuges (NWR), located on the upper Texas Coast, supply important feeding and resting habitat for migrating and wintering populations of waterfowl. The 55,000-acre McFaddin NWR consists of the largest remaining freshwater marsh on the Texas Coast and thousands of acres of intermediate to brackish marsh, while neighboring Texas Point NWR encompasses 8,900 acres of fresh to salt marsh with some wooded uplands and prairie ridges (USFWS, 2005). Sea Rim State Park, 4,141 acres of marshland with 5.2 miles of Gulf beach shoreline, is located in Jefferson County, south of Port Arthur. A unique environment, Sea Rim State Park provides a valuable habitat for many wetland species. Finally, the Flower Gardens Banks National Marine Sanctuary is located about 105 miles directly south of the Texas/Louisiana border. This sanctuary is comprised of the northernmost coral reefs in the U.S.

There are three artificial reefs that are part of the Texas Parks and Wildlife Department's (TPWD) Texas Artificial Reef Program, which are relatively near the proposed ODMDSs: Basco's Reef, S.A.L.T. Reef, and Sabine Reef (see Figure 2-7). Basco's Reef (HI-117) is located 23 nautical miles from Sabine Pass in 50 feet of water and has received numerous donations. S.A.L.T. Reef (HI-85, 18 nautical miles from Sabine Pass, 43 feet of water) and Sabine Reef (HI-117, 22 nautical miles from Sabine Pass, 36 feet of water) have not yet received donations but are formally part of the Artificial Reef Program. S.A.L.T. Reef, which is closest to the proposed ODMDSs, is 6.6 miles from ODMDS B.

## 3.5 SOCIOECONOMIC ENVIRONMENT

### 3.5.1 Employment

Direct employment within the three study area ports, the Port of Beaumont, the Port of Port Arthur, and the Port of Orange, makes up a very small fraction of the overall employment that is indirectly tied to port activities. A detailed description of the population, employment, and other socioeconomic features of the SNWW counties, parishes, and states is available in the FEIS. However, conservative estimates of all port, manufacturing, and industrial-related employment, based on information from the three area ports and from local chambers of commerce, indicates approximately 30,000 jobs existed in the study area in 2002 (Beaumont Chamber of Commerce, 2002; Greater Orange Chamber of Commerce, 2002; Nederland Economic Development Corporation, 2002; Port Arthur Economic Development Corporation, 2002; Southwest Louisiana – The Chamber, 2002). The particular "industrial mix" of the study area is heavily concentrated in manufacturing, port-related services, construction, transportation, and public utilities.

#### 3.5.1.1 Commercial and Recreational Fisheries

Commercial fishing within the Sabine Lake system is covered in the SNWW CIP FEIS and is not repeated here. Table 3-2 provides the annual commercial fishery statistics for Louisiana and Texas for 2002 and 2003 and, for the Grand Totals, for the whole Gulf. As can be seen the commercial catch and the value of that catch for Louisiana was 1.3 billion pounds ($307 million) and 1.2 billion pounds ($294 million) for 2002 and 2003, respectively. For Texas, the numbers were 93 million pounds ($173 million) and 96 million pounds ($168 million) for 2002 and 2003, respectively. Menhaden clearly dominated the poundage for Louisiana, whereas shrimp accounted for most of the weight in Texas. Shrimp dominated both states in terms of value. Commercial finfish catches in the Gulf result from beach seines (under certain circumstances), longlines, and incidental catches in shrimp trawls.

Adult brown shrimp (*Farfantepenaeus aztecus*) and white shrimp (*Litopenaeus setiferus*) are members of the offshore benthic epi community in two depth zones. Chittenden and McEachron (1976) have determined that white shrimp dominate from 12 to 72 feet and brown shrimp dominate from 72 to 360 feet. White shrimp spawn in waters up to 164 feet deep, however (Chittenden and McEachron, 1976), while brown shrimp may spawn at any depth greater than 45 feet (Monaco et al., 1989). Buchman (1976) found Penaeid shrimp larvae from April to October in depths of 24 to 45 feet. Peak abundances occurred in spring and fall, coinciding with the spawning of white shrimp. Farther offshore, from 72 feet to 269 feet depth, Penaeid shrimp larvae occurred throughout the year, with peaks in the spring and late fall/early winter. Greatest abundance occurred during the later peak and were assumed to be brown shrimp. Greatest concentrations of all Penaeid shrimp larvae were consistently found in 148 feet of water over a 4-year period.

The blue crab (*Callinectes sapidus*) fishery is located in the bays as well as the Gulf. From 1982 to 1986 an average of 7.1 million pounds of blue crabs was landed in Texas at an average value of $2.8 million.

The depth zone occupied by the white shrimp community (12 to 72 feet) is dominated by the Atlantic bumper (*Chloroscombrus chrysurus*), the Atlantic croaker, silver seatrout, star drum (*Stellifer lanceolatus*), sand seatrout (*Cynoscion arenarius*), bay anchovy (*Anchoa mitchilli*), Gulf butterfish (*Peprilus burti*), and hardhead catfish (*Arius felis*) (Chittenden et al., 1980).

Ilg et al. (1983), working at 33 feet off of Cameron, Louisiana, caught primarily Atlantic bumper, star drum, Atlantic croaker, white shrimp, blue crab, penaeid shrimp (*Trachypenaeus similis*), swimming crab (*Portunus gibbesii*), and Atlantic brief squid (*Lolliguncula brevis*). Some small variations may occur in the nekton along the northwestern Gulf coast, but the eight most abundant finfish caught by Ilg et al. (1983) in Louisiana were the same eight species caught by Chittenden et al. (1980) along the middle Gulf coast of Texas. Farther offshore, in the depth zone occupied by the brown shrimp community (72 to 360 feet), Buchman (1976) found that the demersal finfish were dominated by longspine porgy (*Stenotomus caprinus*), shoal flounder (*Syacium gunteri*), inshore lizard fish (*Synodus foetens*), rock sea bass

Table 3-2
Gulf of Mexico Annual Commercial Landing Statistics

| Year | State | Species | Metric Tons | Pounds | $ |
|---|---|---|---|---|---|
| 2002 | Louisiana | Amberjack, Greater | 118 | 260,872 | 266,761 |
| 2002 | Louisiana | Buffalofishes | 1,431 | 3,154,516 | 493,352 |
| 2002 | Louisiana | Catfish, Blue | 1,422 | 3,133,775 | 1,412,088 |
| 2002 | Louisiana | Catfish, Channel | 688 | 1,517,686 | 760,298 |
| 2002 | Louisiana | Catfish, Flathead | 126 | 278,502 | 118,776 |
| 2002 | Louisiana | Crab, Blue | 22,567 | 49,751,400 | 29,762,629 |
| 2002 | Louisiana | Crab, Blue, peeler | 148 | 327,262 | 699,311 |
| 2002 | Louisiana | Crayfishes or Crawfishes | 7,077 | 15,601,729 | 8,073,793 |
| 2002 | Louisiana | Drum, Black | 1,415 | 3,118,298 | 1,616,828 |
| 2002 | Louisiana | Drum, Freshwater | 356 | 783,813 | 116,088 |
| 2002 | Louisiana | Gars | 312 | 688,360 | 485,912 |
| 2002 | Louisiana | Herrings | 369 | 814,023 | 99,615 |
| 2002 | Louisiana | Mackerel, King | 393 | 866,295 | 1,045,861 |
| 2002 | Louisiana | Menhaden, Atlantic | 493,406 | 1,087,761,750 | 66,419,446 |
| 2002 | Louisiana | Mullet, Striped | 1,159 | 2,554,652 | 1,690,825 |
| 2002 | Louisiana | Oyster, Eastern | 6,333 | 13,961,579 | 30,318,456 |
| 2002 | Louisiana | Shad, Gizzard | 836 | 1,842,046 | 211,161 |
| 2002 | Louisiana | Shark, Blacktip | 361 | 794,894 | 182,574 |
| 2002 | Louisiana | Sheepshead | 718 | 1,583,357 | 325,344 |
| 2002 | Louisiana | Shrimp, Brown | 24,231 | 53,420,402 | 61,280,654 |
| 2002 | Louisiana | Shrimp, Seabob | 3,176 | 7,000,965 | 2,563,628 |
| 2002 | Louisiana | Shrimp, White | 21,431 | 47,245,582 | 77,272,332 |
| 2002 | Louisiana | Snapper, Red | 993 | 2,189,209 | 4,702,302 |
| 2002 | Louisiana | Snapper, Vermillion | 343 | 755,593 | 1,307,519 |
| 2002 | Louisiana | Swordfish | 318 | 700,105 | 1,463,338 |
| 2002 | Louisiana | Tuna, Yellowfin | 1,547 | 3,411,077 | 10,345,941 |
| | | Subtotal | 592,362 | 1,305,921,816 | 306,726,051 |
| 2002 | Texas | Crab, Blue | 3,192 | 7,037,012 | 4,522,532 |
| 2002 | Texas | Drum, Black | 1,057 | 2,330,675 | 1,819,594 |
| 2002 | Texas | Oyster, Eastern | 2,136 | 4,707,968 | 11,276,101 |
| 2002 | Texas | Shrimp, Brown | 20,757 | 45,760,756 | 86,204,570 |
| 2002 | Texas | Shrimp, Marine, Other | 638 | 1,407,107 | 3,898,592 |
| 2002 | Texas | Shrimp, Pink | 232 | 510,261 | 989,078 |
| 2002 | Texas | Shrimp, Rock | 170 | 373,649 | 421,349 |
| 2002 | Texas | Shrimp, Seabob | 342 | 753,721 | 297,821 |
| 2002 | Texas | Shrimp, White | 11,765 | 25,936,919 | 55,717,768 |
| 2002 | Texas | Shrimp, Atlantic and Gulf, Roughneck | 181 | 398,531 | 143,992 |
| 2002 | Texas | Snapper, Red | 671 | 1,478,471 | 3,362,801 |
| 2002 | Texas | Tuna, Yellowfin | 193 | 425,645 | 1,179,740 |
| | | Subtotal | 42,211 | 93,059,148 | 173,340,477 |

Table 3-2 (Concluded)
Gulf of Mexico Annual Commercial Landing Statistics

| Year | State | Species | Metric Tons | Pounds | $ |
|---|---|---|---|---|---|
| 2003 | Louisiana | Amberjack, Greater | 145 | 320,082 | 267,486 |
| 2003 | Louisiana | Buffalofishes | 1,510 | 3,329,825 | 525,239 |
| 2003 | Louisiana | Catfish, Blue | 1,246 | 2,745,843 | 1,229,752 |
| 2003 | Louisiana | Catfish, Channel | 398 | 877,240 | 443,273 |
| 2003 | Louisiana | Catfish, Flathead | 104 | 229,119 | 109,481 |
| 2003 | Louisiana | Crab, Blue | 21,634 | 47,693,720 | 32,591,174 |
| 2003 | Louisiana | Crab, Blue, peeler | 153 | 337,585 | 767,493 |
| 2003 | Louisiana | Crayfishes or Crawfishes | 3,754 | 8,275,643 | 4,814,307 |
| 2003 | Louisiana | Drum, Black | 1,595 | 3,516,737 | 1,937,831 |
| 2003 | Louisiana | Drum, Freshwater | 285 | 627,183 | 89,262 |
| 2003 | Louisiana | Gars | 351 | 773,474 | 516,098 |
| 2003 | Louisiana | Herrings | 314 | 693,146 | 95,695 |
| 2003 | Louisiana | Mackerel, King | 413 | 910,550 | 990,113 |
| 2003 | Louisiana | Menhaden, Atlantic | 436,449 | 962,196,400 | 58,443,314 |
| 2003 | Louisiana | Mullet, Striped | 2,051 | 4,522,040 | 2,590,590 |
| 2003 | Louisiana | Oyster, Eastern | 6,172 | 13,606,883 | 33,368,831 |
| 2003 | Louisiana | Shad, Gizzard | 658 | 1,449,694 | 182,434 |
| 2003 | Louisiana | Shark, Blacktip | 556 | 1,225,461 | 198,236 |
| 2003 | Louisiana | Sheepshead | 743 | 1,637,948 | 413,031 |
| 2003 | Louisiana | Shellfish | 287 | 632,057 | 50,604 |
| 2003 | Louisiana | Shrimp, Brown | 26,583 | 58,605,029 | 51,964,591 |
| 2003 | Louisiana | Shrimp, Seabob | 1,412 | 3,112,376 | 908,691 |
| 2003 | Louisiana | Shrimp, White | 28,991 | 63,912,851 | 82,069,068 |
| 2003 | Louisiana | Snapper, Red | 782 | 1,723,357 | 3,955,593 |
| 2003 | Louisiana | Snapper, Vermillion | 478 | 1,052,991 | 1,895,816 |
| 2003 | Louisiana | Tuna, Yellowfin | 1,367 | 3,012,875 | 8,950,213 |
| | | Subtotal | 539,777 | 1,189,991,546 | 294,352,001 |
| 2003 | Texas | Catfish, Blue | 2,182 | 4,811,275 | 3,157,047 |
| 2003 | Texas | Drum, Black | 761 | 1,676,687 | 1,365,092 |
| 2003 | Texas | Grouper, Yellowedge | 128 | 282,536 | 752,655 |
| 2003 | Texas | Oyster, Eastern | 3,091 | 6,813,469 | 16,493,273 |
| 2003 | Texas | Shrimp, Brown | 24,300 | 53,571,724 | 90,043,487 |
| 2003 | Texas | Shrimp, Marine, Other | 567 | 1,250,309 | 3,658,940 |
| 2003 | Texas | Shrimp, Pink | 251 | 554,132 | 1,247,880 |
| 2003 | Texas | Shrimp, Rock | 737 | 1,624,802 | 1,851,721 |
| 2003 | Texas | Shrimp, Seabob | 288 | 634,676 | 210,362 |
| 2003 | Texas | Shrimp, White | 9,761 | 21,519,276 | 42,456,408 |
| 2003 | Texas | Snapper, Red | 729 | 1,606,782 | 3,756,617 |
| 2003 | Texas | Tuna, Yellowfin | 125 | 274,768 | 719,638 |
| | | Subtotal | 43,601 | 96,122,318 | 168,316,508 |
| **Grand Total** | | | **1,509,149** | **3,327,070,559** | **1,394,508,722** |

Source: NMFS (2005)

(*Centropristis philadelphica*), and goatfish (*Upeneus parvus*). Farther south, in the study area, the longspine porgy was replaced by blackear bass (*Serranus atrobranchus*) and wenchman (*Pristipomoides aquilonaris*).

There is no commercial oyster harvesting in Sabine Lake or Sabine Pass because the areas are closed and under prohibited status, according to Texas Department of State Health Services, Seafood and Aquatic Life Group, on December 5, 2005. Due to a Memorandum of Understanding between the States of Texas and Louisiana, the Texas Department of State Health Services can also speak for oyster harvesting in Louisiana waters in Sabine Lake and Sabine Pass.

Charter boat and party boat fishing is important in both sport and commercial fishing. According to the USFWS, recreational saltwater fishing increased by 22 percent between 1991 and 2001 (USFWS, 2002). Party boats are large vessels that accommodate numerous fishermen and usually restrict their trips to a few distinct areas. Charter boats generally have a specific goal of catching particular game fish and usually accommodate only one to several customers. Charter boat operators work both bay and Gulf waters, depending on the target species, generally use smaller, more-mobile boats, and range over a larger area. During the warmer months, offshore waters produce king and Spanish mackerel, tarpon and billfish. However, most of these fish are caught in water depths greater than 70 feet (USFWS, 2002).

Within northeastern Texas and southwestern Louisiana, recreational anglers contributed more than $400 million to the local economy in 1996, with more than half a million people involved in this leisure-time activity (Davis, 1996).

### 3.5.2 Shipping

Import and export data through the ports served by the SNWW are presented in the SNWW CIP FEIS. In 2007, the SNWW ranked 5th in the U.S. in tonnage volume. As individual ports, Beaumont ranked 4th in the nation and Port Arthur ranked 28th with 29.3 million short tons. Sixty percent of the tonnage consisted of deep-draft ocean-going movements, with the remaining 40 percent consisted of shallow-draft GIWW traffic. SNWW's 2002 to 2006 crude petroleum waterborne imports comprised 12 percent of the U.S. and 18 percent of the western Gulf region. Beaumont's 2005 to 2007 wheat exports are 5 percent of the U.S. total, and approximately 10 percent of U.S. fertilizer exports.

### 3.5.3 Beaches and Recreational Areas

Wildlife-watching, particularly birding, is an extremely popular activity within the study area and in the nearby vicinity. Among almost 1.6 million people who participated in wildlife-related recreation in the State of Louisiana in 2001, 60 percent were involved in wildlife-watching. In addition, among the 5.0 million people who participated in wildlife-related recreation in the State of Texas in 2001, 65 percent were involved in wildlife-watching (USFWS, 2002). There are several sections of the Great Texas Coastal Birding Trail that are located in or near the project study area as well as several wildlife

management areas, parks, and wildlife preserves and refuges (a detailed list is available in the SNWW CIP FEIS, Section 3.14.3.5).

Two USFWS NWRs occur near Sabine Pass, both on the Texas side (Sabine NWR does not front the Gulf Coast). Texas Point NWR is located just west of Sabine Pass at the Gulf coast. The area is a modern Chenier Plain. The linear features that reflect the ridge and swale topography are fanned out at Sabine Pass and converge to the west. The ridge supports transitional areas that support communities that are intermediate between upland and wetland. Gulf cordgrass (*Spartina spartinae*) is the common dominant species in these grassland/shrublands. The intervening swales support salt and brackish marshes (USFWS, 1998; White et al., 1987). McFaddin NWR is located in the southwest part of the study area between the GIWW and the Gulf shoreline. The predominant habitats include extensive high and low brackish marsh. The refuge also includes the beach and dune complex and scattered transitional areas. Sea Rim State Park is located adjacent to and east of McFaddin NWR and is also between the GIWW and the Gulf shoreline. The predominant habitats include extensive high and low brackish marsh. The park also includes the beach and dune complex and scattered transitional areas. Red drum (*Sciaenops ocellatus*), flounder (*Paralichthys* spp.), alligator gar (*Atractosteus spatula*), blue catfish (*Ictalurus furcatus*), and blue crab are some of the species caught by fishermen at McFaddin and Texas Point NWRs. Waterfowl hunting opportunities are available seasonally on both McFaddin and Texas Point NWRs. Blue and green-winged teal (*Anas discors* and *A. crecca*), mottled ducks, gadwall (*A. strepera*), scaup (*Athya* spp.), and shoveler (*Anas* spp.) are hunted among the 32 different hunt units. A mile-long cattle walk and primitive trail on Texas Point NWR provide foot access to the marsh for bird-watching and wildlife photography. There are 8 miles of interior roads on the McFaddin NWR that provide wildlife viewing opportunities and access to various boat ramps. There is also a ¼-mile birding trail at the entrance of Texas Point NWR.

Additionally, on the Texas side (on the west side) of the Sabine Pass, is the Sabine Pass Battleground State Historical Park. Farther west along the Gulf coastline is the Sea Rim State Park. This area, like McFaddin NWR, is characterized by (mostly) undeveloped marshland and beaches, with numerous small lakes and wetland areas. The eastern side of Sabine Pass consists almost entirely of undeveloped marshland and beaches. State Highway (SH) 82 parallels the Gulf coastline and connects with Johnson's Bayou, Holly Beach, Cameron, and the Calcasieu Lake area to the east.

The Chenier coastline has been severely eroding in Texas. For example, the Gulf beach is heavily eroded and virtually nonexistent at Texas Point where saline marshes can occur on the coastline. The shoreline in Louisiana is accreting near the jetties but is eroding nearer to Holly Beach.

### 3.5.4 Mineral Extraction and Transport

The only aspects of mineral extraction in the Sabine Pass area that would impact the siting of an ODMDS are offshore platforms and pipelines. These are important both as obstructions and fishery resource areas. As shown on Figure 2-2, and discussed in Section 2.3.4.6, there are only two pipelines and possibly one platform in the ZSF.

### 3.5.5 Cultural and Historic Sites

The cultural resources of the area are discussed in detail in the SNWW CIP FEIS and are not repeated here. However, much of that discussion does not include the ZSF. It does indicate that there are no sites of concern in the existing PAs as does EPA (1983a). An examination of Section 2.3.4.5 and Figure 2-4 confirms that observation. Figure 2-4 also includes areas of Texas Water Culturally Sensitive areas, Offshore Sensitive Areas, and High Probability Areas, based on MMS information (Section 2.3.4.5). These are not areas with known cultural or historic sites but are areas that, because of their location, are considered to have a high probably of occurrence of a cultural or historic site. As can be seen, the proposed ODMDSs are not in any "sensitive" leases. This information indicates that impacts to historic properties is unlikely. All of the proposed ODMDSs are located in Federal waters, and the Texas State Historic Preservation Officer (SHPO) declines to comment on matters outside State waters.

### 3.5.6 Military Restrictions

No military restrictions would apply to the SNWW CIP ODMDS selection process. There are no Military Warning Areas within roughly 60 miles of Sabine Pass (www.gomr.mms.gov/regulate/environ/MWA_boundries.pdf).

### 3.5.7 Political Boundaries

The border between Texas and Louisiana runs through the center of the Sabine Pass Channel and Sabine Lake, and north along the Sabine River. The offshore boundary between State and Federal waters, shown on Figure 2-3, runs 9 nautical miles offshore of Texas, and 3 nautical miles offshore of Louisiana. There are no other significant political boundaries in the area of interest to this ODMDS FEIS.

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# 4.0 ENVIRONMENTAL CONSEQUENCES

The environmental consequences of the site designation are discussed from two perspectives, even though some of the information may be repetitive. First, the preferred site is examined relative to the 5 general criteria and the 11 specific factors (40 CFR 228.5 and 40 CFR 228.6(a), respectively). Then the classic NEPA approach is undertaken that examines the environmental consequences of the action on the different aspects of the affected environment.

## 4.1 REGULATORY CHARACTERIZATION

### 4.1.1 Five General Criteria

#### 4.1.1.1 40 CFR 228.5(a)

*The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.*

The preferred ODMDSs were selected, including appropriate buffer zones, to avoid sport and commercial fishing activities, as well as other areas of biological sensitivity. As noted in sections 2.3.4.3.1 and 2.3.4.7, Sabine Bank is an important commercial fishing area as well as a special, sensitive biological habitat that differs from the basically flat area surrounding the proposed ODMDSs. Therefore, the only excluded area was Sabine Banks, since it was the only sensitive area in the vicinity. The buffer zone was sized on the basis of the physical movement of the placement material, since sediment analysis concluded that the quality of the material proposed for discharge met the criteria of 40 CFR 227. Based on the use of the buffer zone, there should be no impacts to Sabine Bank. S.A.L.T. Reef, which is closest to the proposed ODMDSs, is 6.6 miles from ODMDS B (Figure 2-7). As noted in Section 2.3.4.3.1, there is no buffer zone for biologically sensitive areas since modeling did not indicate that material would flow out of the ODMDSs after placement. Therefore, no impacts would be expected to these artificial reefs. The preferred ODMDSs are outside the channel, including the navigation channel buffer zone, and safety fairways, and they avoid known navigational obstructions, although they do infringe on two Fairway Anchorage areas.

#### 4.1.1.2 40 CFR 228.5(b)

*Locations and boundaries of disposal sites will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.*

Complete testing was conducted on the virgin surface sediments proposed for dredging, including toxicity tests. Testing has been conducted on existing maintenance material for years, and that material was examined. There is no evidence that either the virgin or maintenance material would not meet the criteria of 40 CFR 227. The appropriate sizes for the buffer zones and for the preferred sites are based on sediment transport modeling and the physical oceanographic characterization of the Sabine Pass area. These, combined with the information on the expected quality of the material to be dredged, ensure that perturbations caused by placement would be reduced to ambient conditions at the boundaries of the site.

#### 4.1.1.3 40 CFR 228.5(c)

*If, at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in 228.5–228.6, the use of such sites will be terminated as soon as suitable alternative disposal sites can be designated.*

This criterion does not apply to the preferred sites because they are not existing sites approved on an interim basis. However, extensive monitoring programs including bathymetric scans; water, sediment and elutriate chemistry; and benthic infaunal analyses during construction should provide warning of potential problems. Extensive monitoring programs, including water, sediment and elutriate chemistry; bioassays; and bioaccumulation studies are routinely conducted under the Regional Implementation Agreement among the EPA, Region 6, and the USACE, Galveston and New Orleans districts (EPA/USACE, 2003) on all maintenance material. The results of that monitoring, plus studies conducted prior to designation of the existing ODMDSs (EPA, 1983a), indicated no problems at the existing ODMDSs in the past. There is no reason to expect problems with future maintenance material from the Extension. However, the alternatives analysis indicates that should the preferred sites be found in the future to be nonsuitable and de-designation of the preferred sites proves desirable, other areas are available and suitable for use as an ODMDS.

#### 4.1.1.4 40 CFR 228.5(d)

*The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and to permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.*

The sizes of the sites are as small as possible to reasonably meet the criteria stated in 40 CFR 228.5 and 228.6(a). The determined size of each proposed ODMDS is 5.32 square statute miles (4.02 square nautical miles). The monitoring program should provide adequate surveillance to prevent adverse long-range impacts.

#### 4.1.1.5 40 CFR 228.5(e)

*EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the Continental Shelf and other such sites that have been historically used.*

Cost, safety, and time factors plus difficulties with monitoring and surveillance dictate that the distance to the edge of the Continental Shelf off Sabine Pass precludes the use of any ODMDS off the shelf. Additionally, the lack of resilience of the deep-ocean benthic community indicates that an off-shelf placement site would cause severe impacts to the off-shelf benthic community. No environmental advantage to an off-shelf site was noted, whereas impacts to the human environment were less with a nearshore site for safety reasons. The historically used ODMDSs, while large enough to accommodate future maintenance material, are cost prohibitive.

### 4.1.2 Eleven Specific Factors

40 CFR 228.6(a) states that the factors included below as sections 4.1.2.1 through 4.1.2.11 would be considered in the selection process for site designation.

#### 4.1.2.1 40 CFR 228.6(a)(1)

*Geographical position, depth of water, bottom topography, and distance from coast.*

The preferred sites, as determined in Chapter 2, are bounded by the following coordinates noted in sections 2.3.6 and 3.2.1 (see also Figure 2-3):

| | | |
|---|---|---|
| A | ODMDS | 29° 24′ 47″ N, 93° 43′ 29″ W; 29° 24′ 47″ N, 93° 41′ 08″ W<br>29° 22′ 48″ N, 93° 41′ 09″ W; 29° 22′ 49″ N, 93° 43′ 29″ W |
| B | ODMDS | 29° 21′ 59″ N, 93° 43′ 29″ W; 29° 21′ 59″ N, 93° 41′ 08″ W<br>29° 20′ 00″ N, 93° 41′ 09″ W; 29° 20′ 00″ N, 93° 43′ 29″ W |
| C | ODMDS | 29° 19′ 11″ N, 93° 43′ 29″ W; 29° 19′ 11″ N, 93° 41′ 09″ W<br>29° 17′ 12″ N, 93° 41′ 09″ W; 29° 17′ 12″ N, 93° 43′ 29″ W |
| D | ODMDS | 29° 16′ 22″ N, 93° 43′ 29″ W; 29° 16′ 22″ N, 93° 41′ 10″ W<br>29° 14′ 24″ N, 93° 44′ 10″ W; 29° 14′ 24″ N, 93° 43′ 29″ W |

The water depth at the preferred sites ranges from 39 to 46 feet (see Figure 2-6), the bottom topography is flat, and proposed ODMDS A, the most-inshore proposed ODMDS, is approximately 19 miles from the coast at its closest point.

#### 4.1.2.2 40 CFR 228.6(a)(2)

*Location in relation to breeding, spawning, nursery, feeding or passage areas of living resources in adult or juvenile phases.*

Nekton of the nearshore Gulf can be grouped in three categories: estuarine-dependent species; seasonal-migrant species; and permanent-resident species. The most abundant nearshore species are the estuarine-dependent species, which spawn offshore, move into the estuarine nursery areas as larvae to develop and mature, and return to the ocean as juveniles or adults. The seasonal migrants may also pass through the nearshore ocean waters in transit. The proposed ODMDSs can be described as being between the principal spawning areas and the estuarine nursery areas. The passage of organisms to and from the spawning-nursery areas is not expected to be adversely affected by the water column and benthic effects associated with ocean disposal of dredged material at the proposed ODMDSs. The migration route is not limited geographically to the ODMDSs. Therefore, migration and spawning are not expected to be adversely affected by dredged material disposal. The proposed ODMDSs are not expected to adversely affect surf zone or estuarine nursery areas. These areas are beyond the area potentially affected by ocean disposal operations. The migration paths of sea turtles and large marine mammals near the alternative sites are poorly known. It is unlikely that localized and intermittent dredged material disposal operations would adversely affect migration, feeding, or nesting of marine mammals and sea turtles. Endangered and threatened species are discussed in other sections of this EIS.

Sabine Bank is excluded, as are the jetties, but the jetties are so far from the proposed ODMDSs that no buffer zones were assigned. The jetties provide a migratory passage for brown and white shrimp, blue crab, drum, sheepshead, and southern flounder. Sabine Bank, as noted in Section 4.1.2.3 is at a safe distance from any proposed ODMDS. There are no partially submerged shipwrecks, which improve fishing, in any of the proposed ODMDSs.

#### 4.1.2.3 40 CFR 228.6(a)(3)

*Location in relation to beaches or other amenity areas.*

The preferred sites are over 19 miles from any beach and Sabine Bank is at least 1.7 miles from any of the proposed ODMDSs. According to the modeling (Section 2.3.4.2), the maximum distance for the mounded dredged material to reach ambient depth was 1,081 feet (see Table 2-3). Doubling this would provide a buffer of 0.4 mile, only a fraction of the 1.7 miles to Sabine Bank.

#### 4.1.2.4 40 CFR 228.6(a)(4)

*Types and quantities of wastes proposed to be disposed of and proposed methods of release, including methods of packaging the waste, if any.*

Table 2-1 provides the quantities of virgin and maintenance material expected to be dredged, by hopper dredge, from the proposed Extension that are proposed for placement in ODMDSs A–D. Table 2-2

provides the quantities of virgin and maintenance material expected to be dredged from the existing Entrance Channel and placed in existing ODMDSs 1–4. As was concluded in Section 2.3.4.8, there are no environmental quality constraints on the material to be dredged so no special location or precautions would be necessary for the placement of the approximately 18.7 mcy of new work material to be dredged during construction of the Extension, the approximately 24.3 mcy of new work material to be dredged during deepening of the existing Entrance Channel, the approximately 3.0 mcy of maintenance material per cycle expected to be dredged during Extension maintenance, and the approximately 10.5 mcy of maintenance material per cycle expected to be dredged during the existing Entrance Channel maintenance. The proposed ODMDSs were located in a sediment regime as near to that of the expected placement material as is possible in the general vicinity (Section 2.3.6).

#### 4.1.2.5 40 CFR 228.6(a)(5)

*Feasibility of surveillance and monitoring.*

The preferred site is amenable to surveillance and monitoring. The proposed monitoring and surveillance program consists of (1) a method for recording the location of each discharge; (2) bathymetric surveys; and, (3) grain-size analysis, sediment chemistry characterization, and benthic infaunal analysis at selected stations.

#### 4.1.2.6 40 CFR 228.6(a)(6)

*Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current velocity, if any.*

These physical oceanographic parameters were used to develop the necessary buffer zones for the exclusion analysis and to determine if the size of the preferred sites was adequate. Predominant longshore currents, and thus predominant longshore transport, are to the west. Long-term mounding has not historically occurred in the existing ODMDSs. Therefore, steady longshore transport and occasional storms, including hurricanes, remove the placed material from the sites.

#### 4.1.2.7 40 CFR 228.6(a)(7)

*Existence and effects of current and previous discharges and dumping in the area (including cumulative effects).*

The discussion of the results of chemical and bioassay testing of samples from the proposed Extension and surrounds concluded that there were no indications of water or sediment quality problems in the ZSF, including the preferred sites. Testing of past maintenance material indicates that it was acceptable for ocean placement under 40 CFR 227. Based on current direction and modeling of the virgin and maintenance material, the preferred sites were situated to prevent discharged material from reentering the channel and to ensure that any mounding poses no obstruction to navigation. No cumulative mounding

has been detected at the existing ODMDSs and there is no reason to expect any at the proposed ODMDSs.

#### 4.1.2.8 40 CFR 228.6(a)(8)

*Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of the ocean.*

The items from the above list that are pertinent to the present situation are shipping, mineral extraction, commercial and recreational fishing, and recreational areas. The preferred site would not interfere with these or other legitimate uses of the ocean because the exclusion process was designed to prevent the selection of sites that would interfere. Placement operations in the past have not interfered with other uses.

#### 4.1.2.9 40 CFR 228.6(a)(9)

*Existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys.*

As noted briefly above in Section 4.1.1.2 and in detail in Sections 3.3.3 and 3.3.4, a baseline study was conducted on samples from the proposed Extension and the ZSF. No water or sediment quality concerns were indicated. Benthos of the area was characterized. In general, the water and sediment quality is good throughout the ZSF (PBS&J, 2004) and in the historically used ODMDSs (EPA, 1983a). This latter indicates that there have been no long-term impacts on water and sediment quality. As noted in EPA (1983a), there also appear to be no long-term impacts on the benthos at the historically used ODMDS, and none is expected with use of the proposed sites. The available data were used to determine the locations and sizes of the preferred sites.

#### 4.1.2.10 40 CFR 228.6(a)(10)

*Potentiality for the development or recruitment of nuisance species in the disposal site.*

With a disturbance to any benthic community, initial recolonization would be by opportunistic species. However, these species are not nuisance species in the sense that they would interfere with other legitimate uses of the ocean, that they are human pathogens, or that they are nonindigenous, nuisance species. The placement of maintenance material in the past has not attracted or promoted, and the placement of the virgin material and future maintenance material should not attract or promote, the development or recruitment of nuisance species.

#### 4.1.2.11 40 CFR 228.6(a)(11)

*Existence of or in close proximity to the site of significant natural or cultural features of historical importance.*

MMS records indicate that no historic shipwrecks are mapped within the limits of the proposed ODMDSs. However, no remote-sensing surveys have been conducted. Placement activities are not expected to adversely impact unrecorded wrecks given the depth of water through which the material would settle, the expected depth of burial at the time of placement, and the dispersive nature of the seabed environment in this portion of the Gulf. The distribution, depth, and dispersion of dredged material within these ODMDSs have been evaluated by numerical modeling (PBS&J, 2006). Dredged material would be dropped by hopper dredge onto these ODMDSs, forming mound fields with individual mounds totaling no more than 5 feet in height. The effects of the deposition of material on any undiscovered resource would be cushioned by settling through water depths ranging from 30 to 45 feet. Previous monitoring of existing PAs and studies of bottom ocean currents has determined that the material would disperse between maintenance cycles and not accumulate. The proposed ODMDSs are located in Federal waters; the Texas SHPO chooses not to comment on projects located outside of state waters.

## 4.2 ENVIRONMENTAL CHARACTERIZATION

### 4.2.1 Physical Environment

Of the areas discussed in the Physical Environment section (Section 3.3), there would be no impacts from designation of the preferred site on climatology or meteorology.

#### 4.2.1.1 Oceanography

##### *4.2.1.1.1 Bathymetry*

There would always be localized and temporary changes in bathymetry caused by dredged material placement. However, studies of the existing ODMDSs indicate that, over the long term, there is little or no buildup of materials. The preferred sites were selected so that the temporary reduction in water depth and long-term transport of material from the sites would cause no adverse impacts.

##### *4.2.1.1.2 Circulation and Mixing*

The determined area of the preferred sites is small compared to the shelf area off Sabine Pass. As noted above, changes in bathymetry are small and temporary. Therefore, the placement of dredged material anywhere in the nonexcluded part of the ZSF would have negligible impact on the circulation and mixing of shelf waters.

#### 4.2.1.2 Water Quality

Possible effects on water quality relative to dissolved oxygen (DO), oxygen demand, turbidity, heavy metals, pesticides, and nutrients are discussed below.

The DO concentration in the water column at a dredged material placement site may temporarily decrease (Brown and Clark, 1968; Hopkins, 1972; Pearce, 1972), not change (May, 1973), or increase (Wakeman,

1974; Windom, 1972). May (1973) found that although the water column DO did not change, a temporary decrease was found at the water/sediment interface in the areas of mud flow. He found little apparent difference in the immediate oxygen demand between recently deposited sediments from dredged material placement and other sediments. May (1973), Jones and Lee (1978), Peddicord (1979), and Lee (1976) agree that even with sediments that have a high total oxygen demand, as measured in the laboratory, oxygen depletion upon placement is not likely to cause adverse environmental impacts because only a small part of the oxygen demand is exerted at placement.

The most obvious result of dredged material placement to the water column is turbidity which has been shown to reduce primary production in laboratory studies (Sherk, 1971). Field studies, however, have shown essentially no biological impacts from turbidity (Odum and Wilson, 1962; May, 1973). May (1973) found that on a still day, the turbidity plume was detectable from an aircraft, more than a mile downcurrent. On days when winds caused natural turbidity in an estuarine system, the plume was not detectable more than a few hundred yards downcurrent from an active dredge. He also noted that because the small size of the particles, responsible for an extended turbidity, causes them to behave differently than most of the disposed material, the turbidity plume has little relationship to dredged sediment distribution, except near the dredge. Impacts from increased turbidity would be less nearshore, where higher turbidity is common, than they would be farther offshore in more-pristine water.

Wildish and Power (1985) found that smelt avoid water containing suspended sediments at concentrations above a certain threshold level, which was about 20 mg/L under their test conditions. Allen and Hardy (1980) note that direct destruction of nekton from suspended solids associated with dredging and placement is of little consequence because of their ability to avoid the turbid water.

May (1973) found that total suspended solids was reduced by 92 percent within 100 feet of the discharge point, by 98 percent at 200 feet, and that concentrations above 100 mg/L were seldom found beyond 400 feet from the placement point. Therefore, unless contaminants are released from the discharged sediments, more than short-term, local impacts could not be expected from the total suspended solids (TSS) resulting from discharge.

Chemical analyses of elutriates made with past maintenance material and samples from the proposed extension and surrounding area indicate that no significant release of constituents from the sediment can be expected during dredging and placement (sections 3.3.3 and 3.3.4). Additionally, examination of water at the existing ODMDSs yields no indications of water quality problems and past studies at the existing ODMDSs (EPA, 1983a) show no water problems caused by placement activities.

In summary, water quality impacts from dredged material placement anywhere in the nonexcluded part of the ZSF would be temporary, localized, and nonsignificant.

#### 4.2.1.3 Sediment Quality and Characteristics

There are no sediment quality problems at the historically used or proposed ODMDSs or surrounding areas, as determined by past testing (Section 3.3.4) and monitoring (EPA, 1983a). The only expected detrimental impacts on bottom sediments caused by the placement of virgin material from the 48-Foot Project and future maintenance material would result from grain-size distribution, not sediment quality. The sediment regime offshore of Sabine Pass matches neither that of the construction material nor the maintenance material, but there is no area near Sabine Pass that is a better match. Additionally, monitoring of the existing ODMDSs, where the same situation exists, indicated no long-term impacts to the local benthos (EPA, 1983a).

### 4.2.2 Biological Environment

The biological impacts that are discussed in this document are the result of dredged material placement, not site designation *per se*. Site designation provides an acceptable ocean location for the placement of dredged materials.

#### 4.2.2.1 Plankton

The impact of placement at the preferred sites on phytoplankton would probably be greater than that associated with placement at more-offshore sites, slope sites, or abyss sites since Kamykowski et al. (1977) and MMS (2002) found a larger standing crop at near-shore stations. Both negative and positive impacts would occur. A localized increase in turbidity would occur, which has been found to decrease phytoplankton production in laboratory studies (Sherk, 1971), and Kamykowski et al. (1977) found total zooplankton abundance to be inversely related to turbidity. Conversely, the decrease in phytoplankton production, presumably from decreased available light, has been found to be offset by increased nutrient content (Kamykowski et al., 1977; Morton, 1977). In past studies of the impacts of dredged material placement from turbidity and nutrient release, the effects are both localized and temporary (Odum and Wilson, 1962; May, 1973; Brannon et. al., 1978; Kraus, 1991; Dragos and Peven, 1994). Thus, due to the small area represented by the proposed ODMDSs, relative to the Gulf shelf near Sabine Pass, and the reproductive capacity and natural variation in plankton populations, the impacts of dredged material placement anywhere within the ZSF are not expected to be significant, and, therefore, impacts at the preferred sites are not expected to be significantly different from those at any other part of the ZSF.

#### 4.2.2.2 Benthos

No constituents were found in the virgin sediment that would lead to an expectation that toxic impacts to benthos would occur. At the existing ODMDSs, when dredging occurred between two benthos investigations, the only change found by EPA (1983a) that could potentially be related to dredged material placement was a slight decrease in the percentage of deposit feeders. The only major expected impact to the benthos, i.e., burial, would also be expected to be slightly less at a nearshore site since the

nearshore area is naturally more turbulent than the deeper areas of the ZSF, and therefore is inhabited by a more-resilient, opportunistic community.

#### 4.2.2.3 Nekton

Wright (1978) indicates that nekton is not directly affected by dredged material placement since they can avoid areas of high turbidity. Some flatfish might be buried and would die, but as discussed in Rhoads and Carey (1997), some near the periphery of the mound would dig up through the material and survive. The benthos at the site, which would have been used as a food source, would be lost, but the area of the site is as small as is feasible and is small compared to the offshore area near Sabine Pass. The elutriate analyses and bioassessments with undisturbed virgin sediment yielded no expectation of short-term water column or benthic toxicity from dredging or placement operations, except from increased turbidity. Therefore, no significant impacts to the nekton of the area from the proposed dredging and placement operations are expected.

#### 4.2.2.4 Essential Fish Habitat

Section 3.10.2.3 of the SNWW CIP FEIS lists the organisms for which the study area has been designated as EFH. As a review of that section would demonstrate, the organisms listed there are either (1) mostly dependent on estuaries or hard-bottom areas (reefs, rigs, etc.) for spawning, breeding, feeding, or growth to maturity, (2) spawn at depths beyond the range of the proposed ODMDSs, or (3) they are so widely distributed in the offshore study area that any impacts from use of the proposed ODMDSs would be negligible.

#### 4.2.2.5 Threatened and Endangered Species

Of the Threatened or Endangered Species Act noted in Section 3.12 of the SNWW CIP FEIS and the biological assessment for the SNWW CIP, only sea turtles and whales would be found as far offshore as the propose ODMDSs. While rare off Texas, the listed species of sea turtles may be present in the project area during certain portions of the year. From 1995 through 2005, the total take of sea turtles from dredging in the Sabine Pass Entrance Channel by hopper dredges (cutterhead suction dredges move too slowly to capture sea turtles) was only one Kemp's ridley sea turtle and one loggerhead sea turtle (NOAA, 2003). In 2006, maintenance dredging in the Sabine Bank Channel resulted in the lethal take of one Kemp's ridley sea turtle, but there were no lethal takes in the 2008 dredging of the Sabine Pass Outer Bar Channel (USACE, 2009). The effects of placing dredged material at the proposed sites include (1) a collision potential from the vessel; (2) the deposition of dredged material on sea turtles and forage areas, and (3) the possibility of trash and debris from the dredge operation. Regarding the deposition of dredged material, modeling indicates that most of the dredged material is confined to a relatively small area. Since this is a short-term effect, and considering the mobility of the sea turtle species and the lack of limestone ledges in the proposed ODMDSs, the sea turtles should easily be able to avoid a descending plume, and available food sources should not be seriously reduced (NOAA, 2003). Regarding the vessel and debris possibility, it is the combined effect of many marine activities (e.g., oil spills, oil and gas operations,

commercial fishing, marine transportation, etc.) that constitute the hazard and not a single activity such as a dredge operation. These activities, combined with natural predation and development on land, result in a cumulative adverse impact on sea turtles (MMS, 1997). As noted in Section 4.13.2 of the SNWW CIP FEIS to which this document is appended, it has been determined that the proposed site designation does not constitute an adverse impact on listed sea turtles. EPA concurs that the proposed site designation does not constitute an adverse impact on the listed sea turtles.

In contrast to the sea turtles, the listed whales are found in deep oceanic waters off the continental slope. Based on the shallow-water location of the placement site, EPA has determined that no adverse impact would result from site designation on the listed whale species.

#### 4.2.2.6 Marine Sanctuaries and Special Biological Resource Areas

The jetties are too far from the proposed ODMDSs to be impacted. The only other fishing area of special concern, Sabine Bank, is at least 1.7 miles from any proposed ODMDS and would not be impacted by use of any proposed ODMDS, based on the modeling studies. Therefore, no impacts are expected to any special biological resource areas. There are no marine sanctuaries in the ZSF.

### 4.2.3 Socioeconomic Environment

The selection process used to generate the excluded and nonexcluded areas of the ZSF was conducted to exclude other features and amenities. Beaches are at least 12 miles from the most-inshore proposed ODMDS. There are no known cultural or historic sites in any of the proposed ODMDSs. Therefore, there should be no impacts to other features and amenities from dredged material placement anywhere within the proposed ODMDSs. There are no oil and gas production facilities in the proposed ODMDSs, and, therefore, there should be no impacts on mineral extraction.

#### 4.2.3.1 Commercial and Recreational Fisheries

Wright (1978) indicates that nekton, including commercial and recreational species, are not directly affected by dredged material placement since they can avoid areas of high turbidity. Additionally, the elutriate analyses and bioassessments give no indication of short-term toxicity from placement operations. The jetties are too far away to be impacted and the one fish haven, Sabine Bank, is at least 1.7 miles from any of the proposed ODMDSs. As noted in Section 4.1.2.3, this is much farther than any buffer zones that could be developed from the modeling that was conducted. Therefore, no significant impacts to commercial and recreational fisheries are expected should the proposed ODMDSs be selected for designation.

#### 4.2.3.2 Shipping

Impacts to shipping are not expected since the navigation channel buffer zone is exceeded by the location of the preferred sites. More importantly, the navigation safety fairway was excluded from the ZSF, thus removing the hopper dredge during placement from possible ship traffic.

#### 4.2.3.3 Environmental Justice

The proposed ODMDSs are all submerged areas at least 21 miles from shore. The Texas Point BU Feature is onshore but it is part of an NWR. Therefore, designation of the proposed ODMDSs for placement of construction and future maintenance material from the Entrance Channel Extension portion of the proposed 48-foot channel would have no disproportionate adverse human health or environmental impacts on minority and low-income populations.

## 4.3 CUMULATIVE IMPACTS

Cumulative impact has been defined by the President's Council on Environmental Quality as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such action." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Impacts include both direct effects, which are caused by an action and occur at the same time and place as the action, and indirect effects, which are also caused by the action and occur later in time and are farther removed in distance, but which are still reasonably foreseeable. Ecological effects refer to effects on natural resources and on the components, structures, and functioning of affected ecosystems, whether direct, indirect, or cumulative.

No individual projects were determined as pertinent to the cumulative impacts from site designation but types of activities can be addressed. Cumulative impacts could occur at the proposed ODMDSs if the impacts of other activities in the area (shipping, recreational, and commercial fishing, and oil and gas exploration and production) compounded the impacts of designation and, thus, placement of dredged material in the proposed ODMDSs. To assess this, one must determine if the impacts that are likely with these activities would affect the ecosystems impacted by dredged material placement in the ocean. A review of Section 4.2 indicates that the only expected impacts from dredged material placement are short-term, temporary impacts to the water column and longer-term but still temporary impacts to the benthos. Shipping and recreational and commercial fishing would impact neither of these resources unless there was a spill of fuels or cargo. There is no way to quantify these events, but they are not common and would have to co-occur with placement, which is expected to occur on 1- to 5-year intervals, before cumulative impacts would occur. There are no oil and/or gas wells in the proposed ODMDSs so cumulative impacts from drilling and dredged material placement cannot be expected. There are platforms in the vicinity, and the pipelines that connect them to shore, that could potentially result in an oil spill but the occurrence of oil spills in the Gulf from platforms accidents and pipeline leaks is very rare, and cumulative impacts from platform operations and dredged material placement cannot be expected. Additional environmental stressors such as hypoxia could add to impacts from site designation. While the placement of dredged material could temporarily reduce the DO content of the water column at the ODMDSs during placement, as discussed in Section 3.4.3, the area of hypoxia in the Gulf is quite large, ranging from Galveston to the Mississippi delta, relative to the area of the proposed ODMDSs, and

monitoring of the water near the existing ODMDSs showed no indication of anoxia (EPA, 1983a). Thus, the dredged material component of any cumulative impacts from anoxia is expected to be insignificant.

Dredging and placement of construction and maintenance material, as well as these other types of activities and stressors, have been ongoing for decades off Sabine Pass with no indication of significant cumulative environmental deterioration. Placement of additional material at the existing ODMDSs and placement of material in the proposed ODMDSs, which should be very similar to that placed at the existing ODMDSs in the past, should not change the situation.

## 4.4 ADVERSE ENVIRONMENTAL IMPACTS THAT CANNOT BE AVOIDED

Ocean placement cannot legally occur without site designation, and therefore, there are a number of unavoidable environmental impacts that result from the placement of dredged material, e.g., increase in turbidity and suspended solids; potential release of minor quantities of heavy metals, oil and grease, and nutrients; a change in DO content; and smothering of the benthos. However, these impacts would result from the placement of dredged material no matter where the ocean placement site is located. The preferred sites minimize impacts to the extent possible. However, certain impacts would occur, most notably the temporary loss of most of the benthic infauna in the actual discharge areas. Based on EPA (1983a), essentially complete recovery can be expected between dredging cycles.

## 4.5 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Ocean disposal of dredged material within the proposed site would not affect the long-term productivity of the site or the adjoining area. Long-term impacts of dredged materials at the preferred disposal sites would be minimized as described in sections 4.1 and 4.2.

## 4.6 ANY IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

The designation of the proposed ODMDSs for dredged material disposal may result in the following irreversible or irretrievable commitments of resources:

1. Fuel, labor, and equipment rental expenses would be incurred by the dredge during transport of the dredged material to the ODMDSs and during return transits (the total of these expenses would increase as the distance to the disposal site increases).

2. Temporary loss of benthic organisms at the site due to smothering by the dredged material, temporary disruption of the biotic community.

3. Loss of the dredged materials for other uses such as beach nourishment.

Final designation of the preferred site would commit the benthic infauna in the proposed ODMDSs during construction. The resources associated with the monitoring program, e.g., manpower, diesel fuel, sampling gear, and boat time, would be committed during monitoring.

## 4.7 ENERGY AND NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL OF VARIOUS ALTERNATIVES AND MITIGATION MEASURES

The No-Action Alternative was not considered viable and is, therefore, not pertinent. Within the bounds of the guidelines for site designation, the distance traveled by the dredges, which accounts for the time required for dredging and the fuel requirements, are kept to a minimum with the use of the proposed ODMDSs. Sites farther offshore and nearer to shore would require more time for the dredging/placement process and increased travel distance and more fuel. Therefore, use of the proposed sites requires the minimum energy requirements of any viable alternative.

## 4.8 COMPLIANCE WITH COASTAL ZONE MANAGEMENT PLANS

Since the proposed ODMDSs are well outside Texas and Louisiana State Waters and thus outside the respective State Coastal Zones and since the modeling indicates no impacts to the respective State Coastal Zones, compliance with the Texas and Louisiana CZMPs is not required for designation of the proposed ODMDSs. However, the SNWW CIP, as a whole, has been determined to be consistent with the Texas and Louisiana CZMPs (Appendix I to the SNWW CIP FEIS).

# 5.0 SELECTED PLAN

## 5.1 EXISTING ENTRANCE CHANNEL

Since the modeling has shown that the existing ODMDSs have sufficient capacity to hold both future construction and maintenance material from the existing Entrance Channel, the Selected Plan for this portion of the 48-foot channel is the continued use of designated ODMDSs 1–4. Pertinent information for these ODMDSs is included in the tables in Section 3.1.1 and on Figure 2-4.

## 5.2 ENTRANCE CHANNEL EXTENSION

The selected plan for the Entrance Channel Extension is the designation of proposed ODMDSs A–D, as shown on Figure 2-4, for the placement of the construction and maintenance material from the extended portion of the Entrance Channel that would be part of the proposed 48-foot channel. Pertinent information on these proposed ODMDSs is provided in the table in Section 3.2.1. A monitoring program, as described in Section 2.4.2, is also included in the Selected Plan for the Entrance Channel Extension.

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# 6.0 LIST OF PREPARERS

| Name/Title | Experience | EIS Area of Responsibility |
|---|---|---|
| **U.S. Environmental Protection Agency** | | |
| Barbara Keeler | 30 years, Coastal Environmental Science and NEPA | SNWW Interagency Coordination Team and Habitat Workgroup |
| Stephen Bainter, Ocean Dumping Coordinator | 30 years, Environmental Related Activities | ODMDS EIS Technical and Policy Review |
| Renee Bellew, Ocean Dumping Coordinator | 9 years, Environmental Related Activities | ODMDS EIS Technical and Policy Review |
| **U.S. Army Corps of Engineers, Galveston District** | | |
| Janelle Stokes, Regional Environmental Specialist | 24 years, Environmental Impact Assessment and Impact Analysis, Cultural Resource Coordination, Archaeological Research and Surveys | Project Coordination and review |
| Rob Hauch, Physical Scientist | 26 years, Environmental Impact Assessment and Impact Analysis; Dredged Material, Water, and Sediment Quality Analyses | Project Review |
| **PBS&J** | | |
| Martin Arhelger, Vice President, Project Director | 28 years, Environmental Assessment and Impact Analysis | Project Manager, water and sediment quality |
| Anthony Risko, PE, Senior Project Manager | 20 years, Coastal Resources Studies | Project Manager, Regional Sediment Management |
| Derek Green, Biologist, Wildlife Specialist | 21 years, Environmental Assessment and Analysis | Wildlife and habitat, endangered and threatened species |
| Bob Gearhart, Archaeologist, Magnetometer and Side-Scan Sonar Specialist | 19 years, Marine Archaeology | Marine archaeology |
| Tricia LaRue, Environmental Planner | 3 years, Planning and Socioeconomics | Socioeconomics |
| Ka Leung Lee, Ph.D., PE, Senior Water Resources Engineer | 12 years, Water Quality Modeling | MDFATE Modeling |
| Lisa Vitale, Marine/Aquatic Biologist | 14 years, Marine/Aquatic Biology | Marine Fisheries/EFH |
| Michael Hettenhausen, Environmental Planner | 2 years, Planning and document review | General ecology, document review |
| Eric Monshaugen, GIS Specialist | 2 years, GIS | GIS data/figures |
| Chris Vidrick, Lead Word Processor | 30 years, Word Processing | Word Processing, document review |
| Linda Nance, Technical Editor | 35 years, Technical Editing | Technical document editing |

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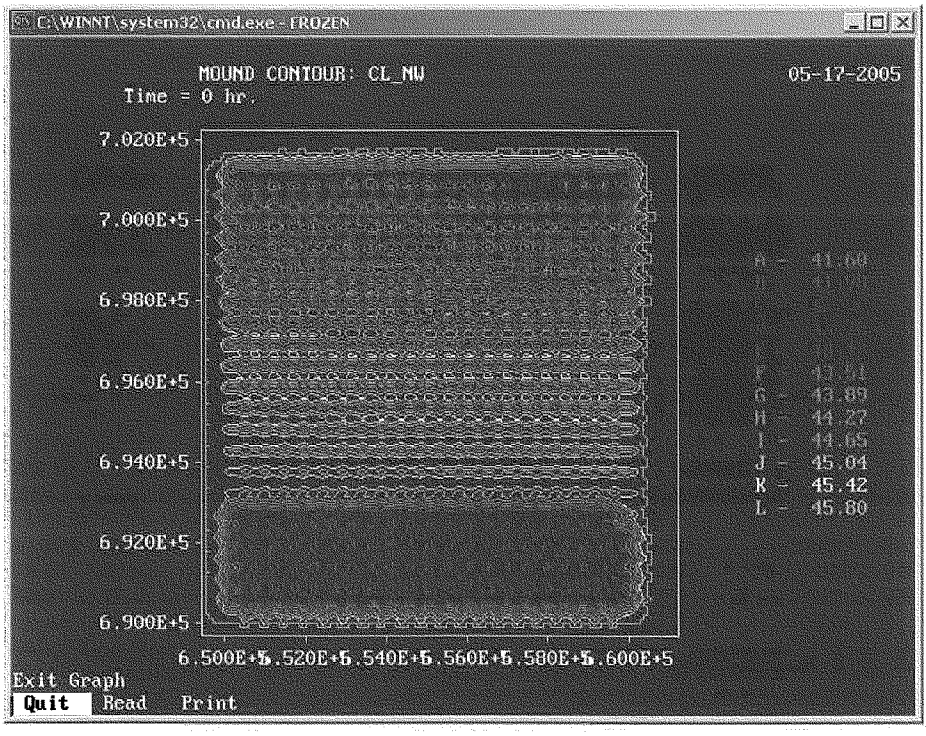
# Attachment A

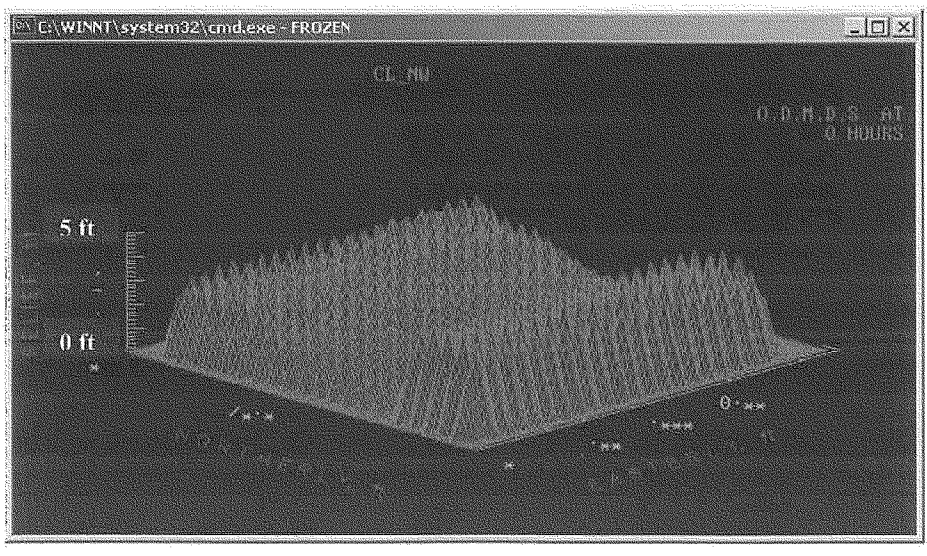
# MDFATE Modeling Results

Note for Attachment A:

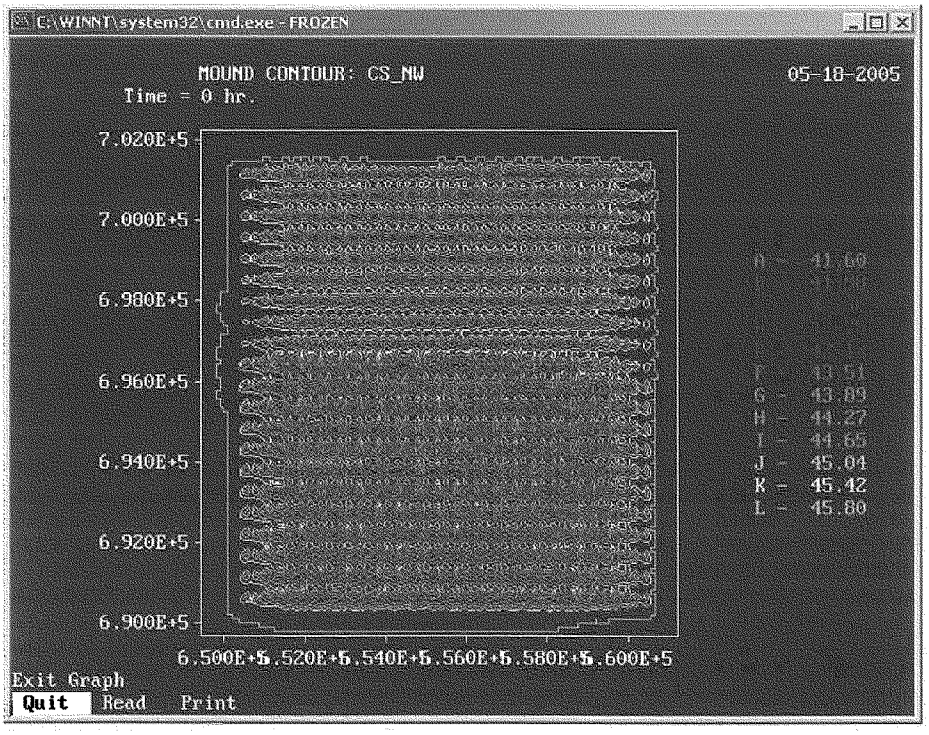
All profiles, except for one set (ODMDS 1), are depicted both as a top-view contour map and as an oblique view showing vertical relief, albeit on a greatly exaggerated vertical-to-horizontal scale. However, for some reason that could not be determined, MDFATE would not generate all files for ODMDS 1, such that the oblique view could not be captured and presented in this attachment.

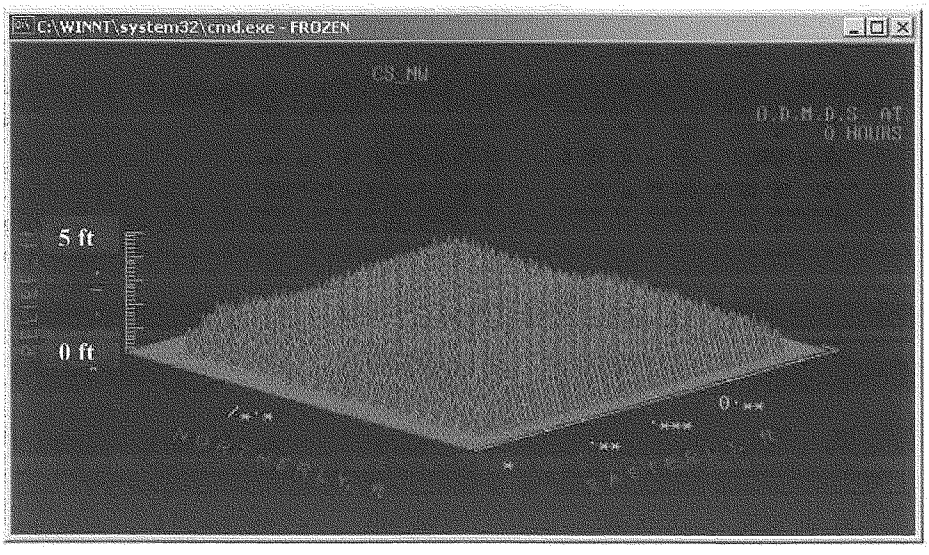
Placement Area C, New Work Material, Large hopper. Max mound height = 4.14 ft.
Dump grid: 21x21 at 500 ft spacing.



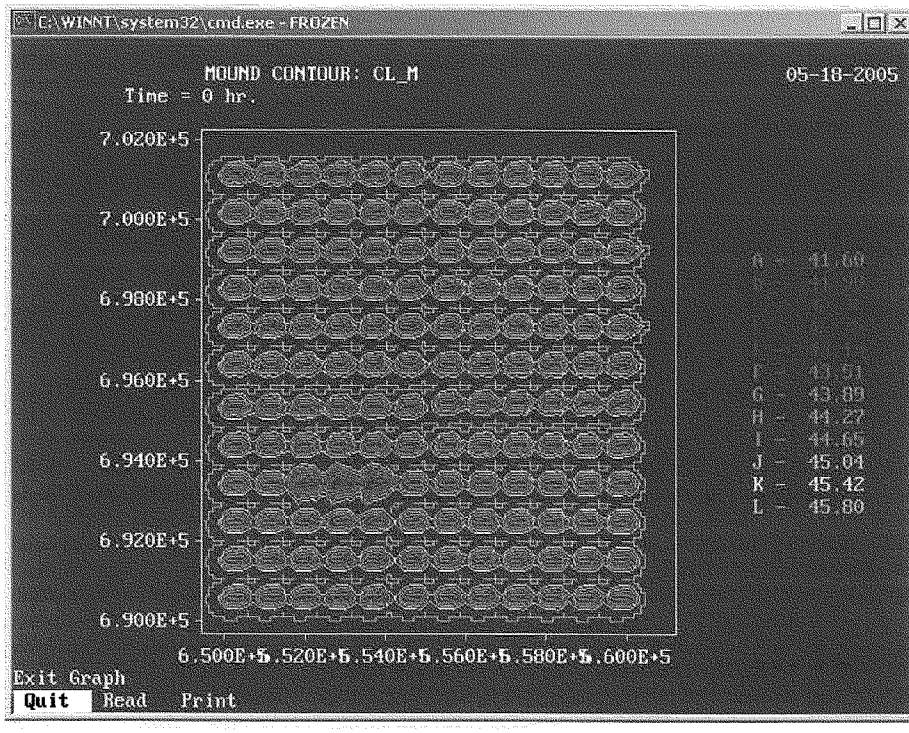



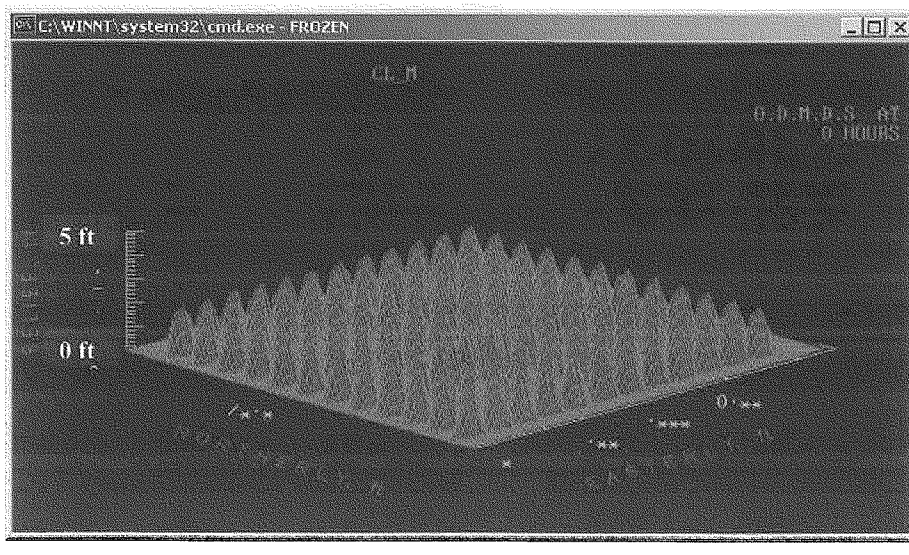
Placement Area C, New Work Material, Small hopper. Max mound height = 2.23 ft.
Dump grid: 19x21 at 500 ft spacing.



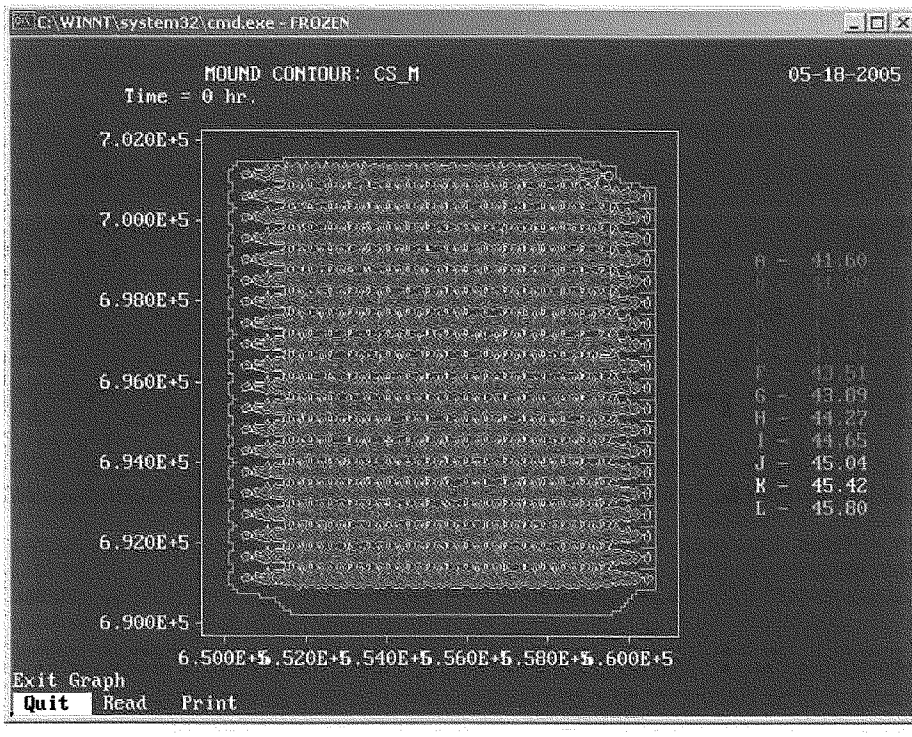



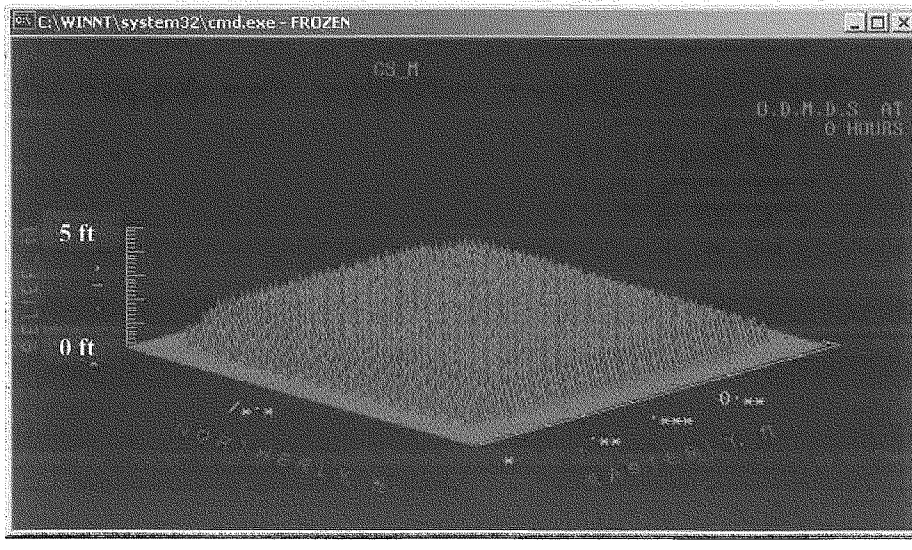
Placement Area C, Maintenance Material, Large hopper. Max mound height = 2.79 ft.
Dump grid: 12x12 at 909 ft spacing.



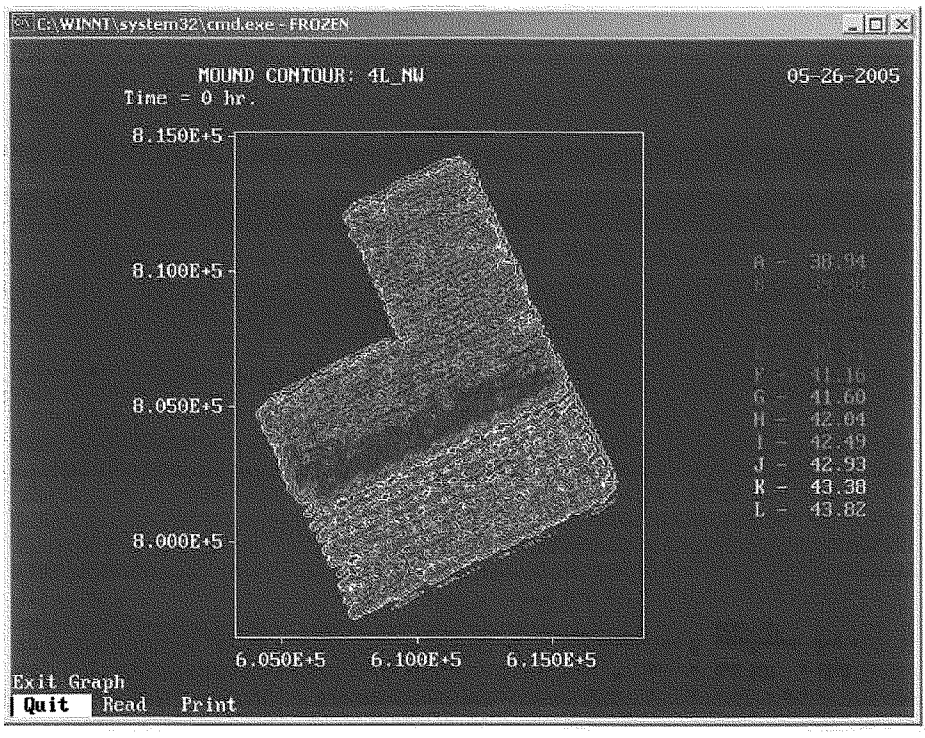



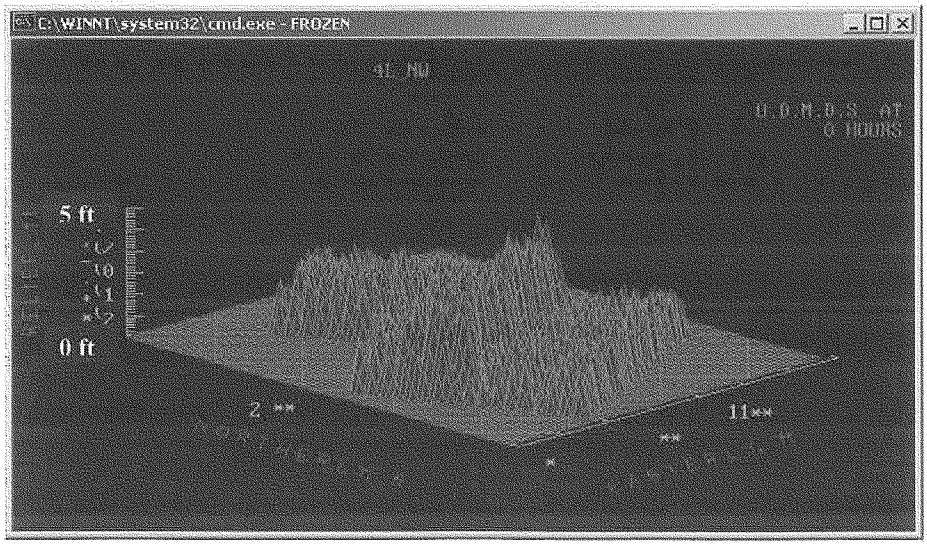
Placement Area C, Maintenance Material, Small hopper. Max mound height = 1.90 ft.
Dump grid: 19x20 at 500 ft spacing.



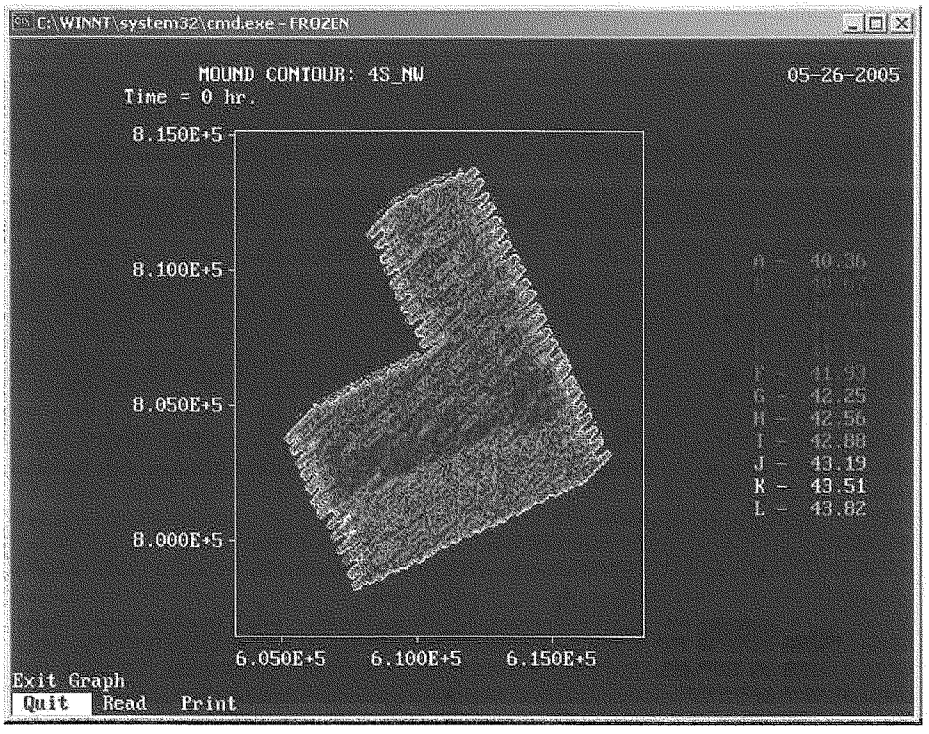



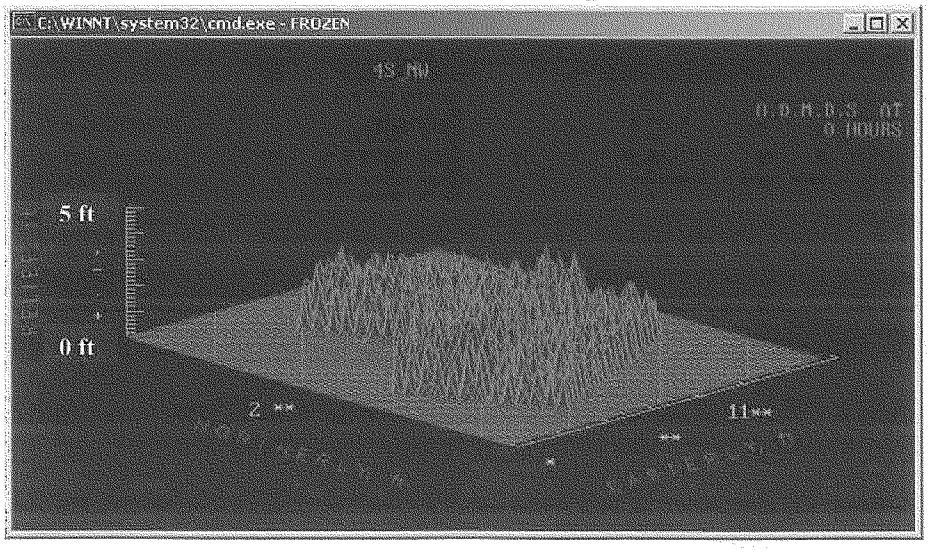
Placement Area 4, New Work Material, Large hopper. Max mound height = 5.36 ft (4.90 ft).
447 dump points at 500 ft spacing.



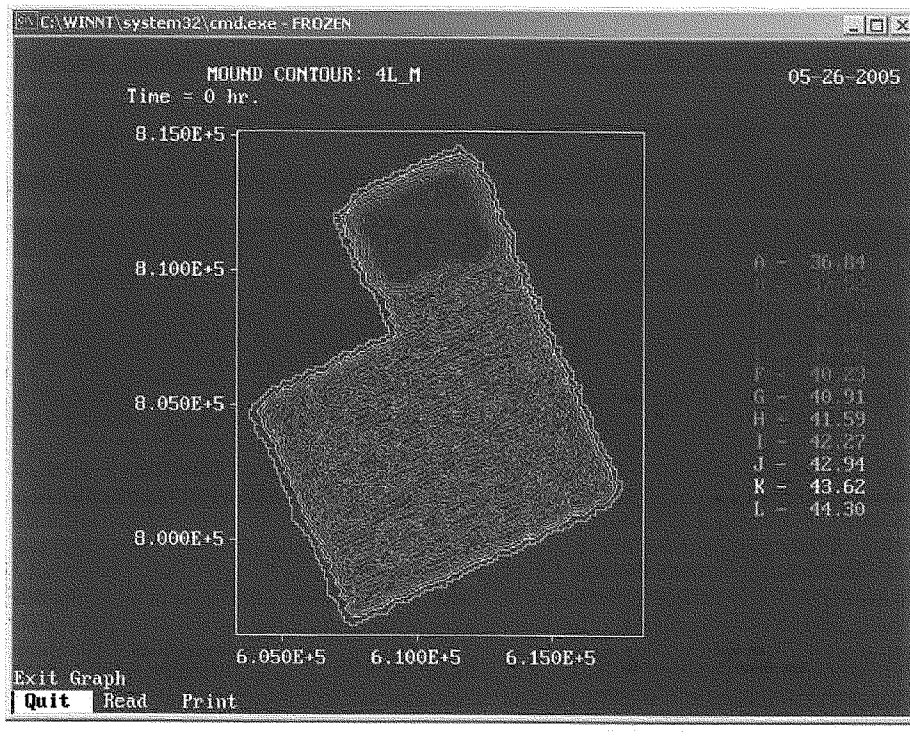



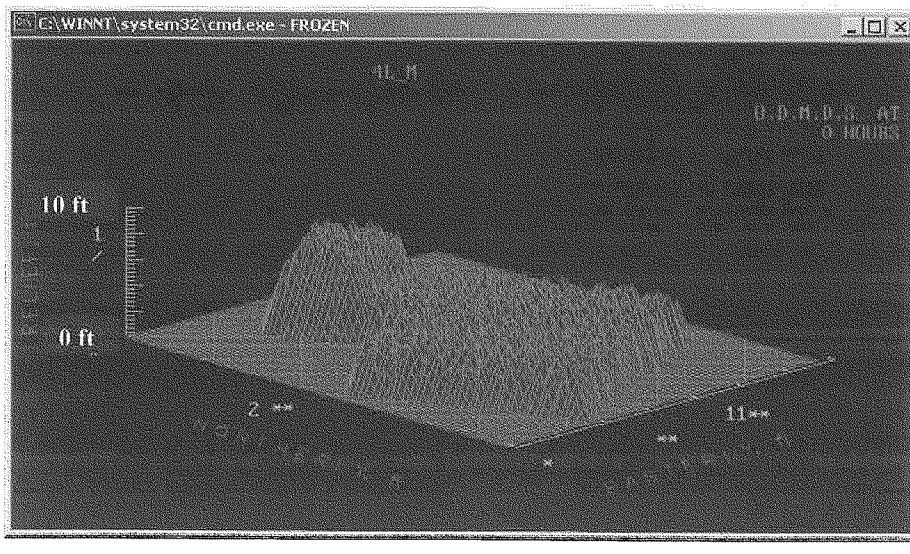
Placement Area 4, New Work Material, Small hopper. Max mound height = 3.94 ft (3.47 ft).
324 dump points at 500 ft spacing.



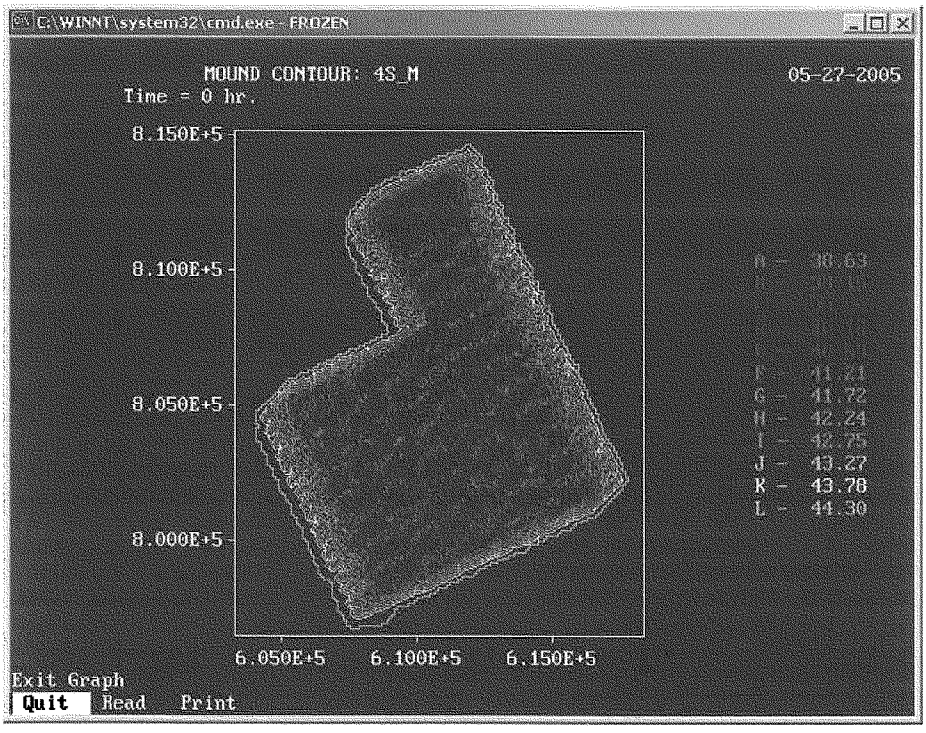



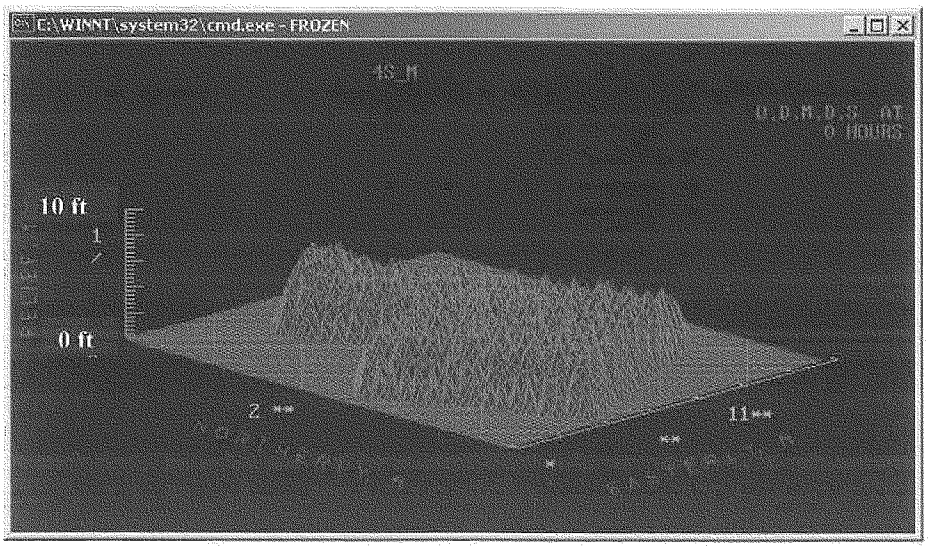
Placement Area 4, Maintenance Material, Large hopper. Max mound height = 7.46 ft. 447 dump points at 500 ft spacing.



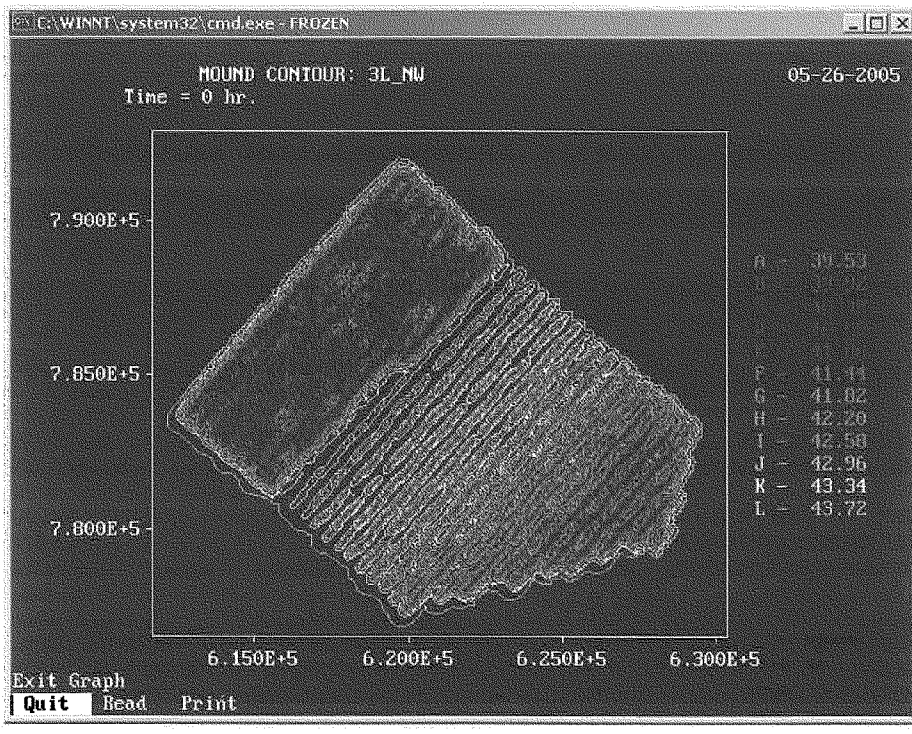



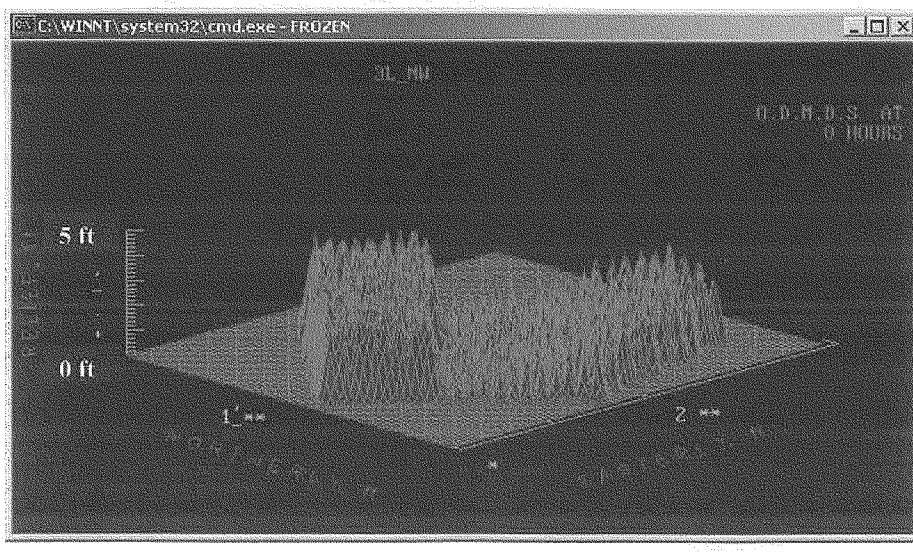
Placement Area 4, Maintenance Material, Small hopper. Max mound height = 5.67 ft. 420 dump points at 500 ft spacing.



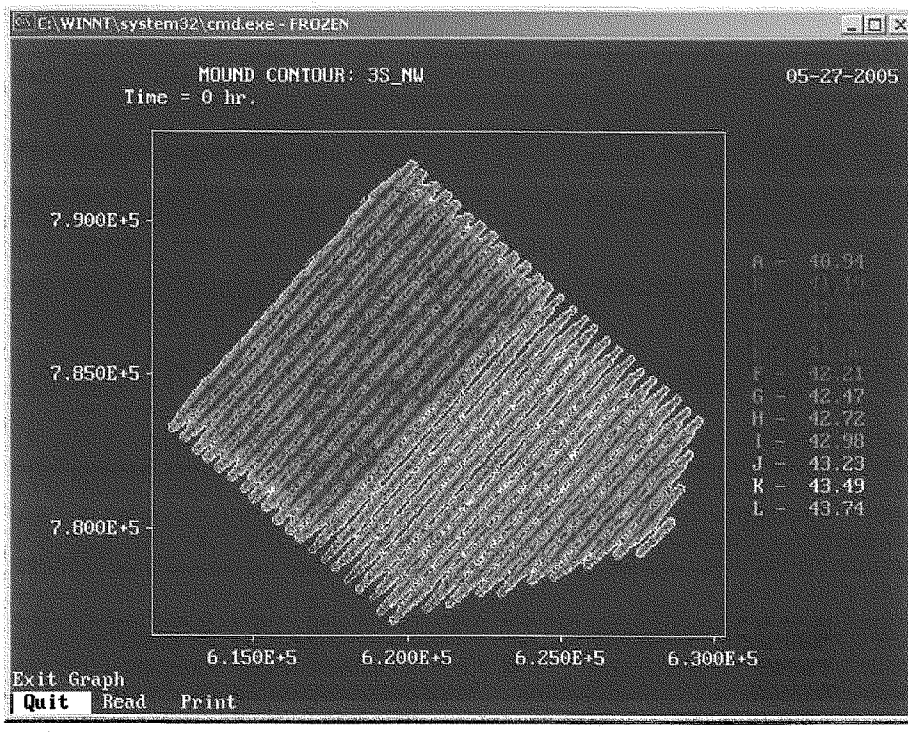



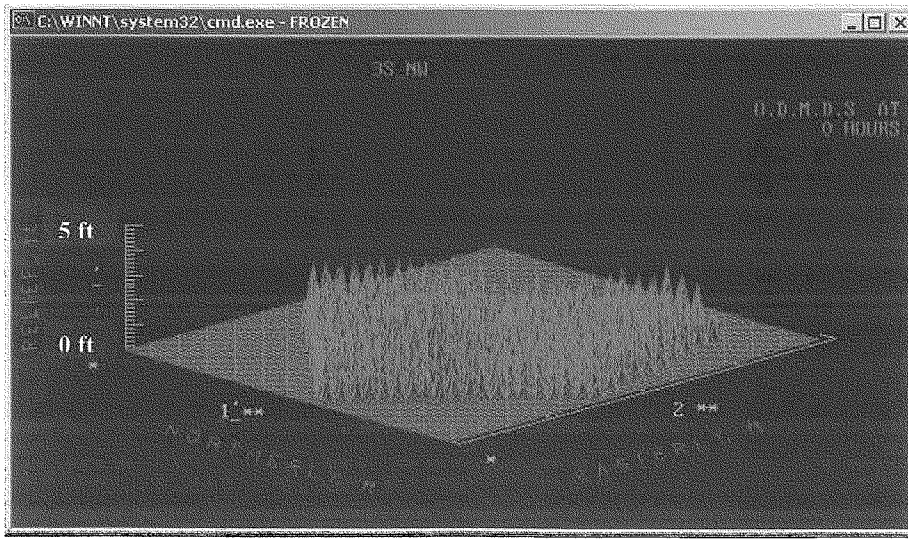
Placement Area 3, New Work Material, Large hopper. Max mound height = 4.67 ft (4.21 ft).
526 dump points at 500 ft spacing.



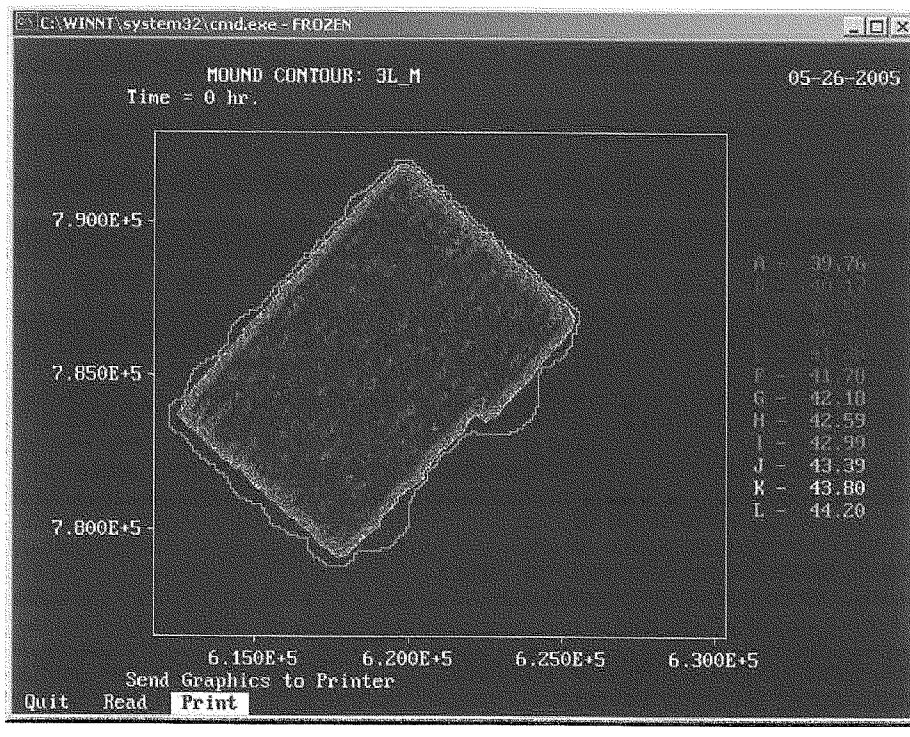



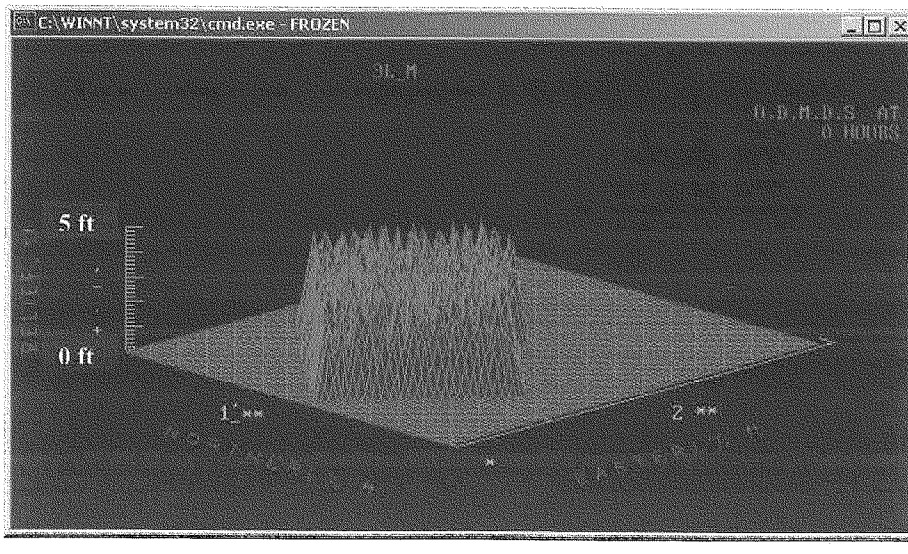
Placement Area 3, New Work Material, Small hopper. Max mound height =3.26 ft (2.81 ft).
526 dump points at 500 ft spacing.



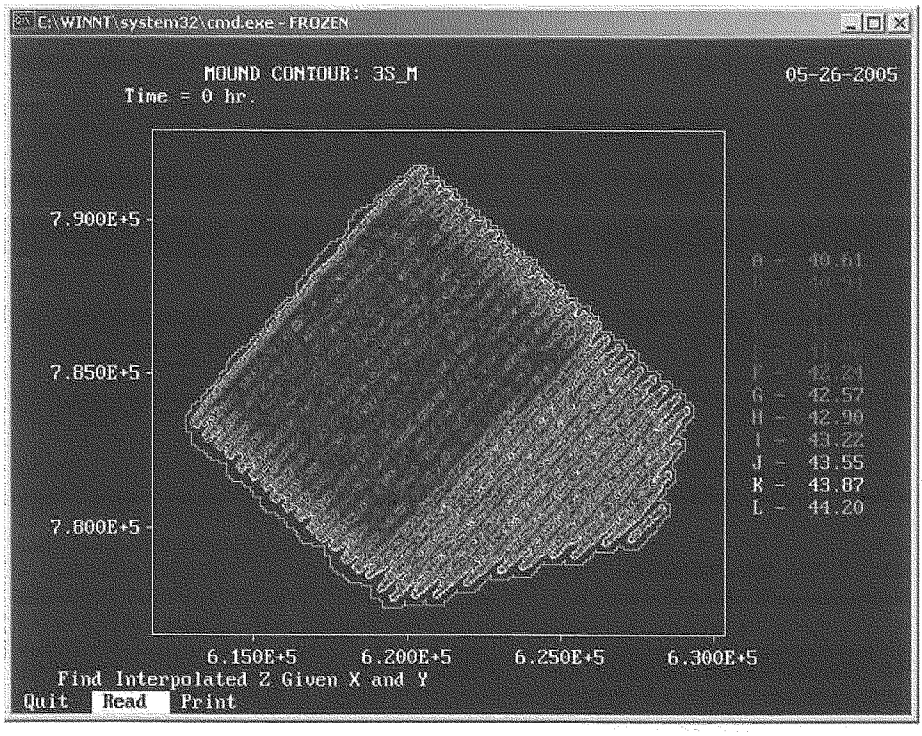



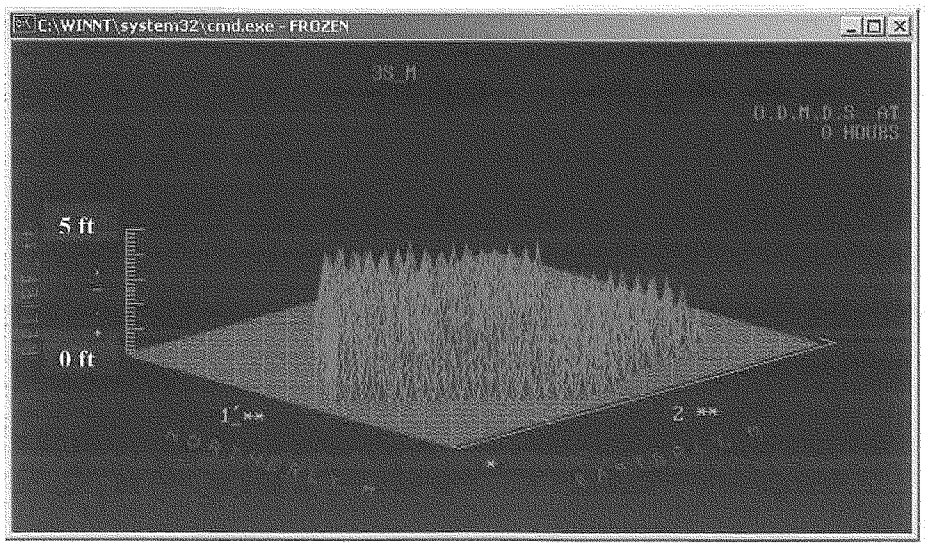
Placement Area 3, Maintenance Material, Large hopper. Max mound height = 4.44 ft. 324 dump points at 500 ft spacing.



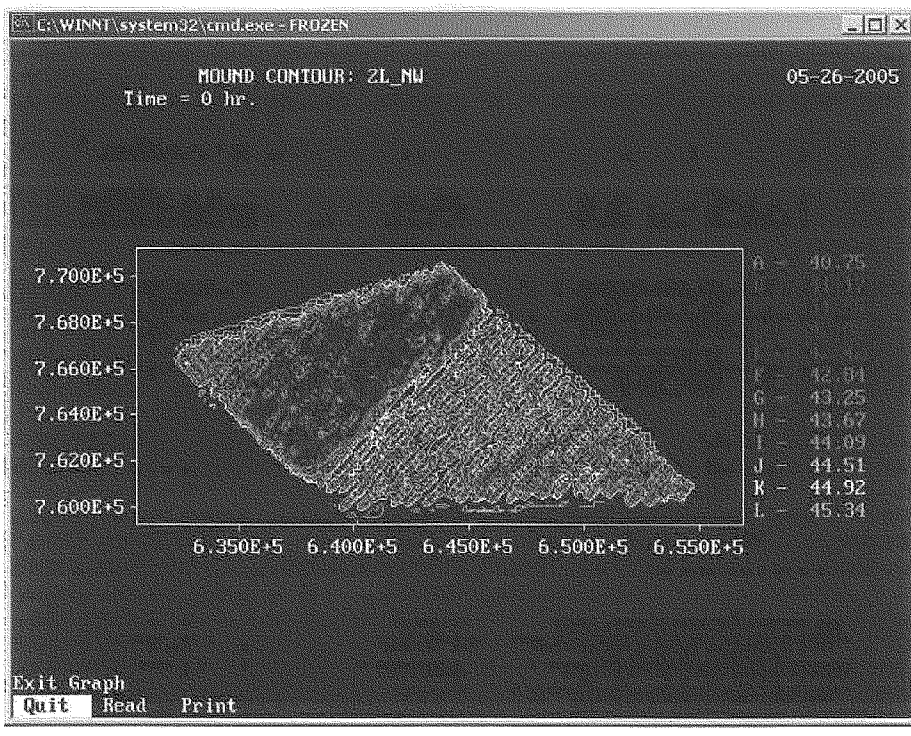



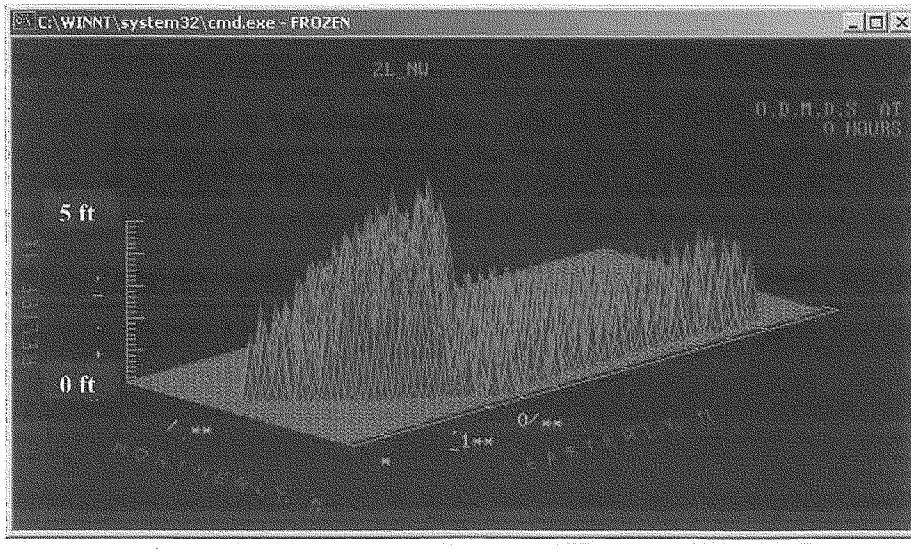
Placement Area 3, Maintenance Material, Small hopper. Max mound height = 3.59 ft.
464 dump points at 500 ft spacing.



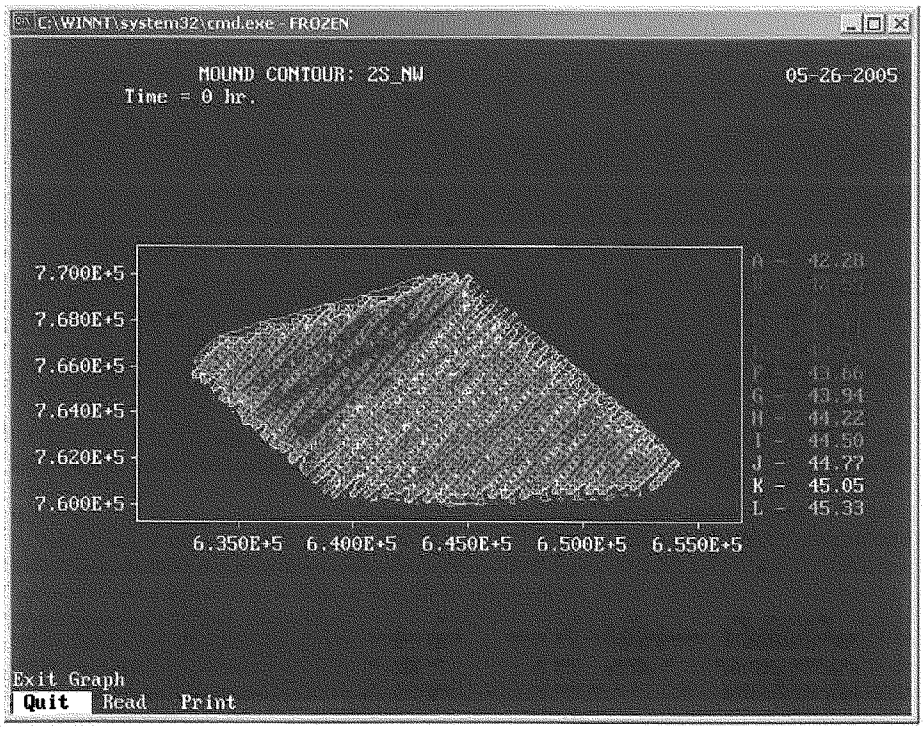



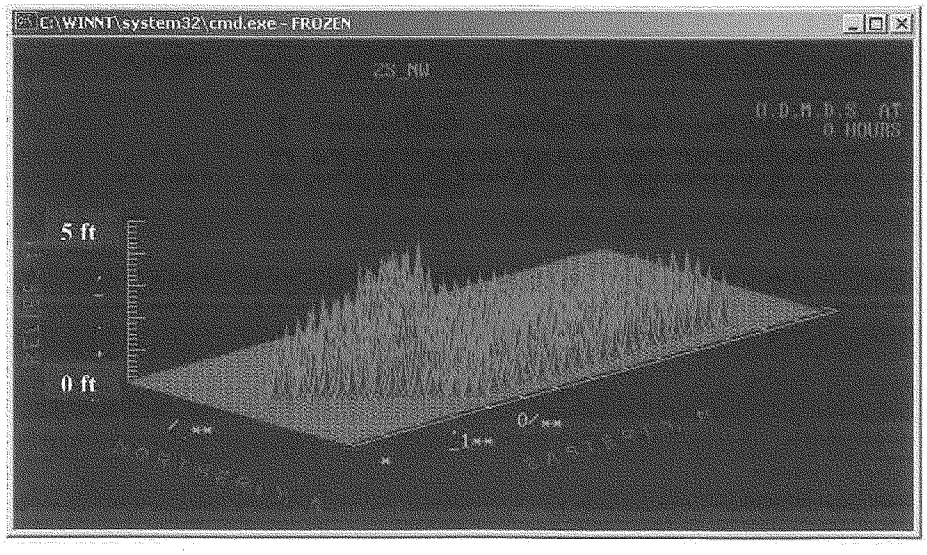
Placement Area 2, New Work Material, Large hopper. Max mound height = 5.05 ft (4.62 ft).
503 dump points at 500 ft spacing.



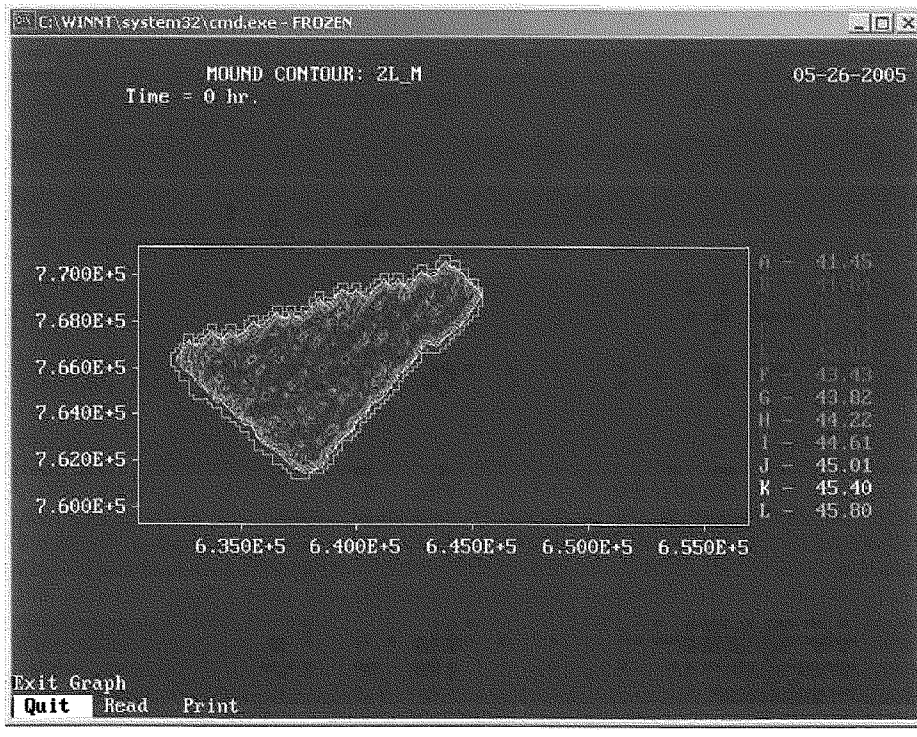



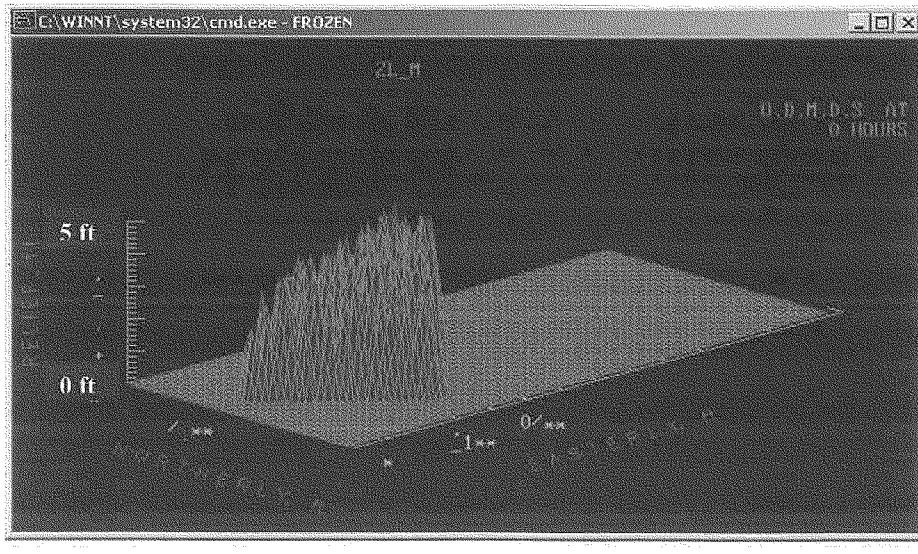
Placement Area 2, New Work Material, Small hopper. Max mound height = 3.53 ft (3.08 ft).
431 dump points at 500 ft spacing.



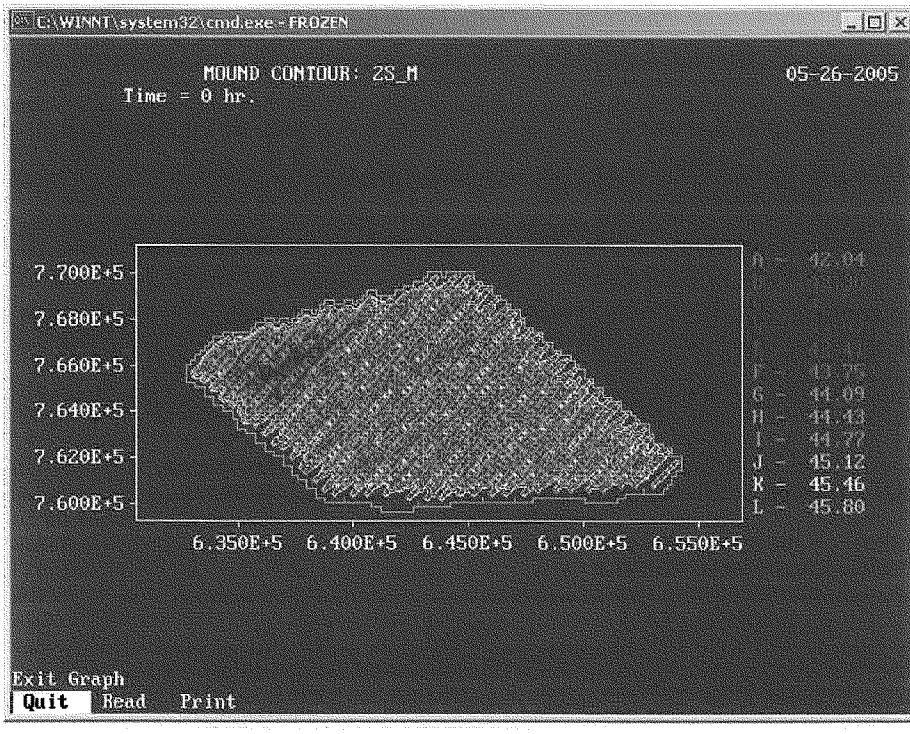



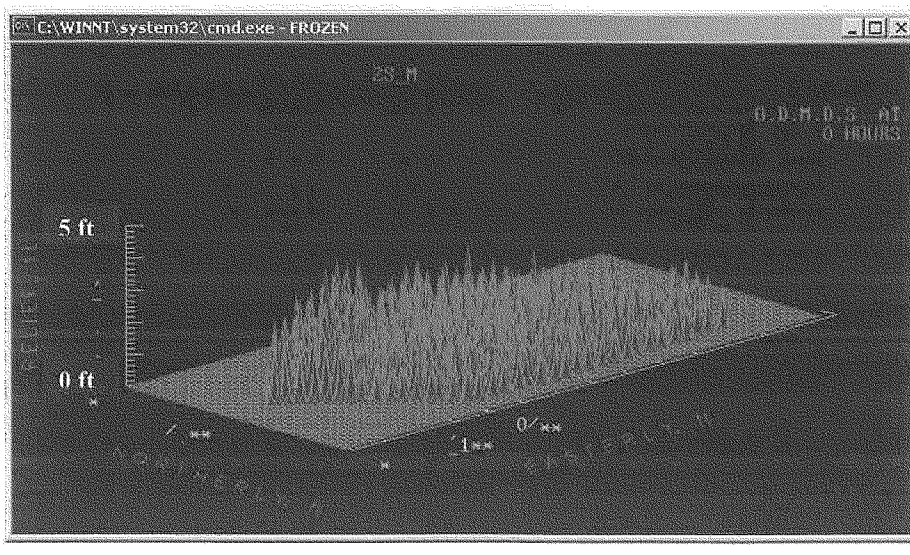
Placement Area 2, Maintenance Material, Large hopper. Max mound height = 4.35 ft. 191 dump points at 500 ft spacing.



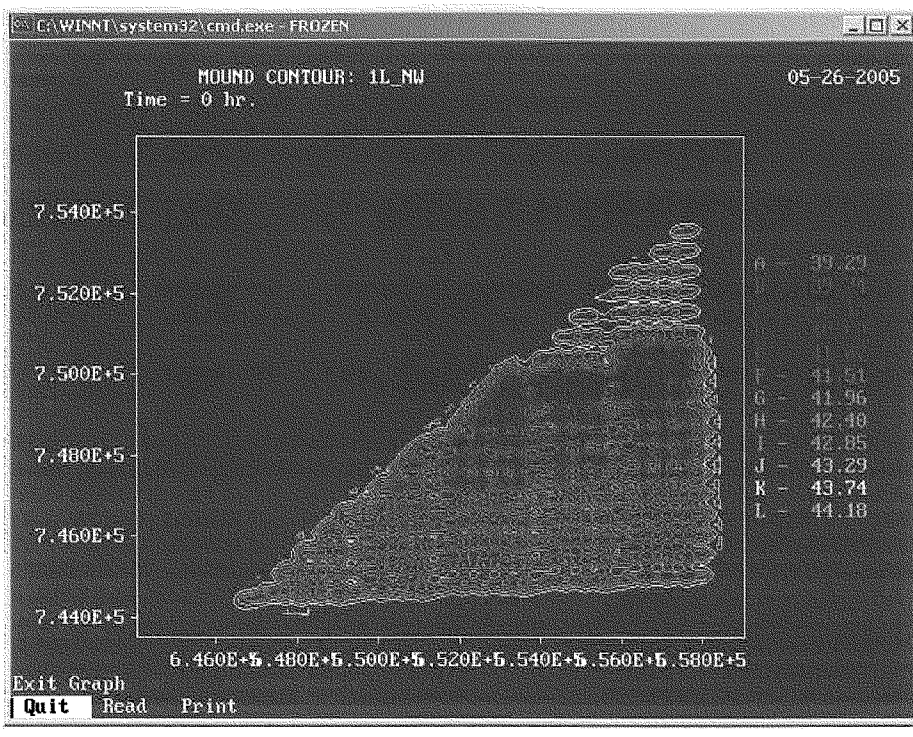



Placement Area 2, Maintenance Material, Small hopper. Max mound height = 3.76 ft.
431 dump points at 500 ft spacing.

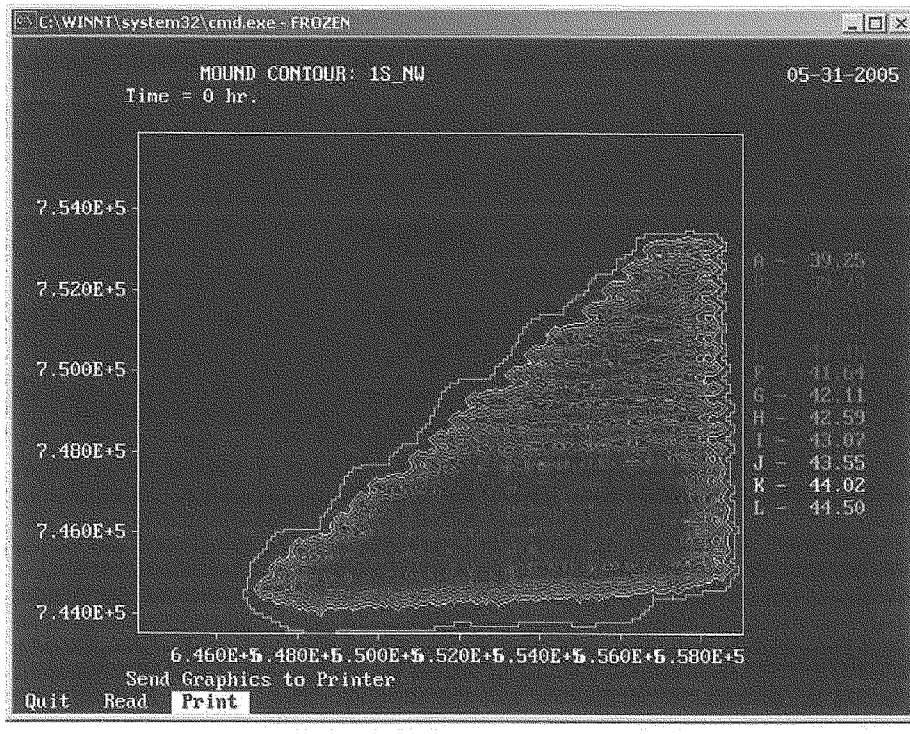


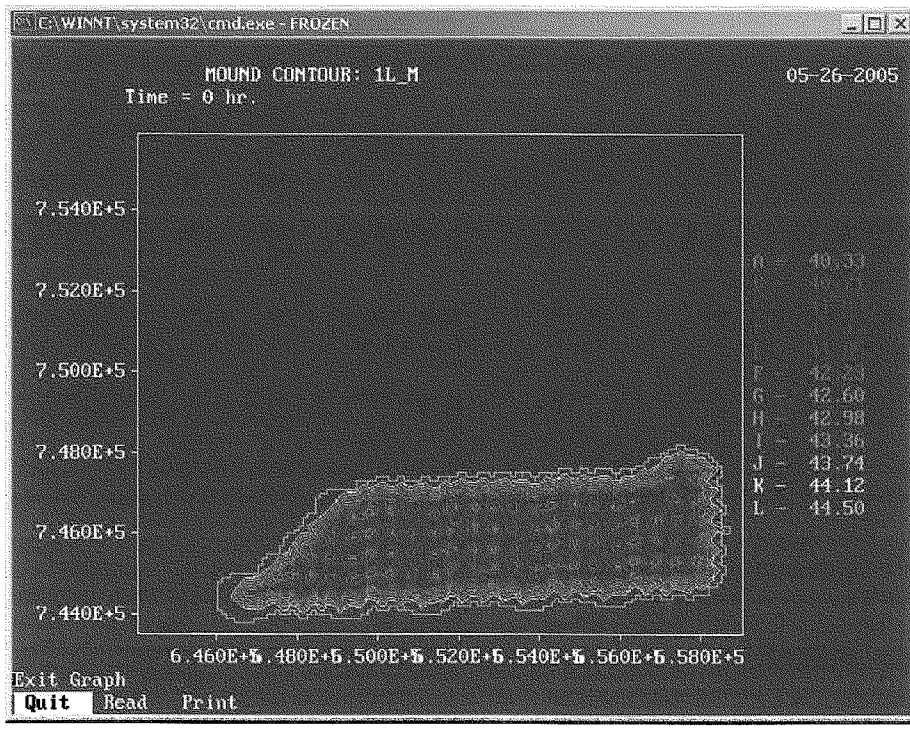
Placement Area 1, New Work Material, Large hopper. Max mound height = 5.21 ft (4.9 ft).
213 dump points at 500 ft spacing.



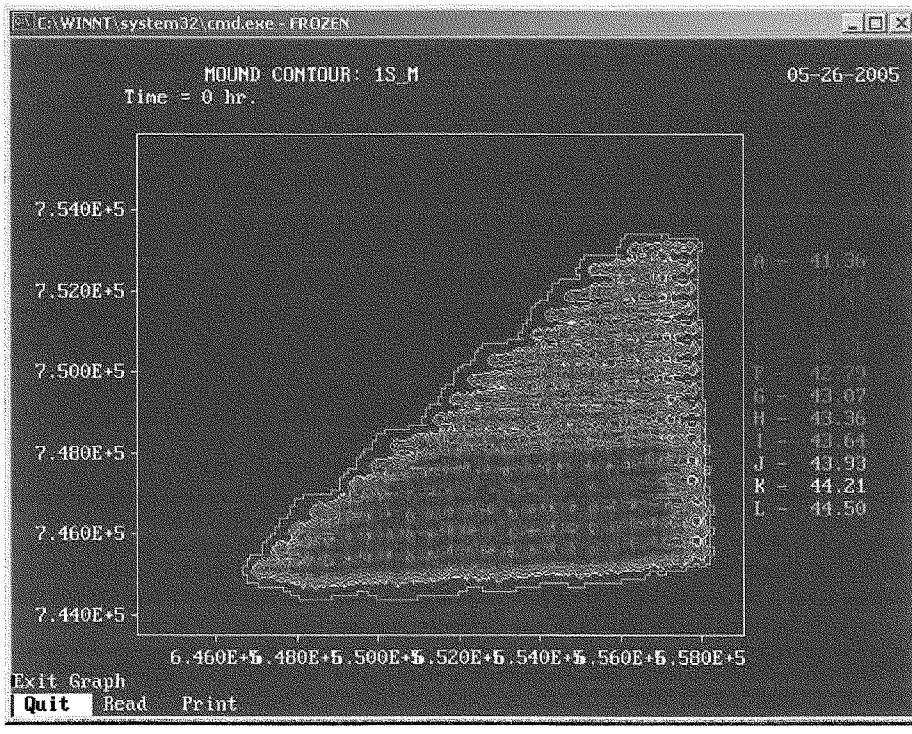
Placement Area 1, New Work Material, Small hopper. Max mound height = 5.25 ft.
185 dump points at 500 ft spacing.



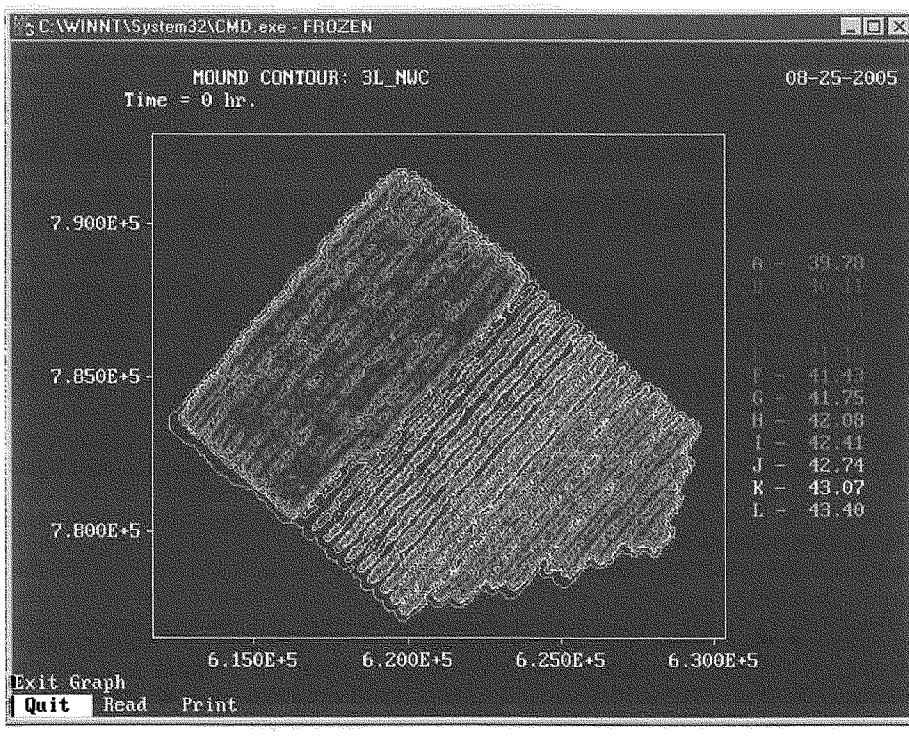
Placement Area 1, Maintenance Material, Large hopper. Max mound height = 4.17 ft.
109 dump points at 500 ft spacing.

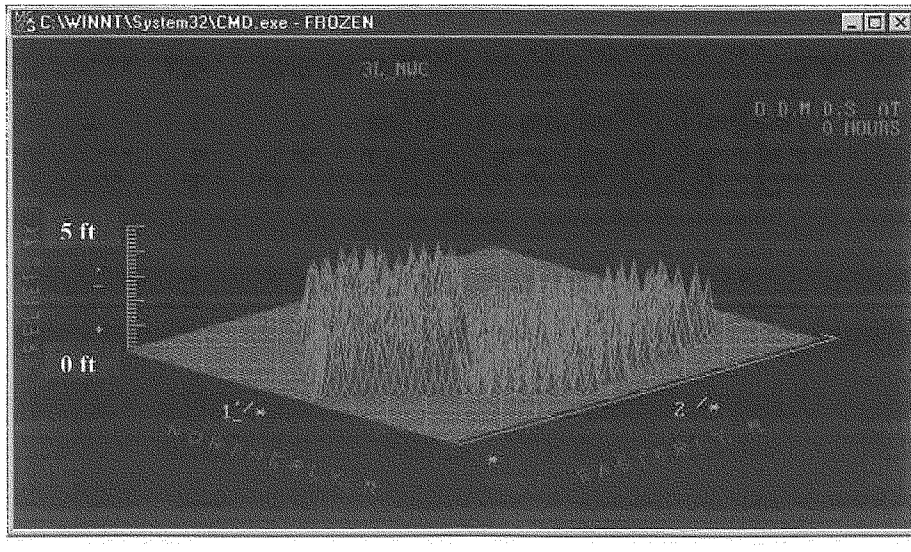


Placement Area 1, Maintenance Material, Small hopper. Max mound height = 3.14 ft.
173 dump points at 500 ft spacing.

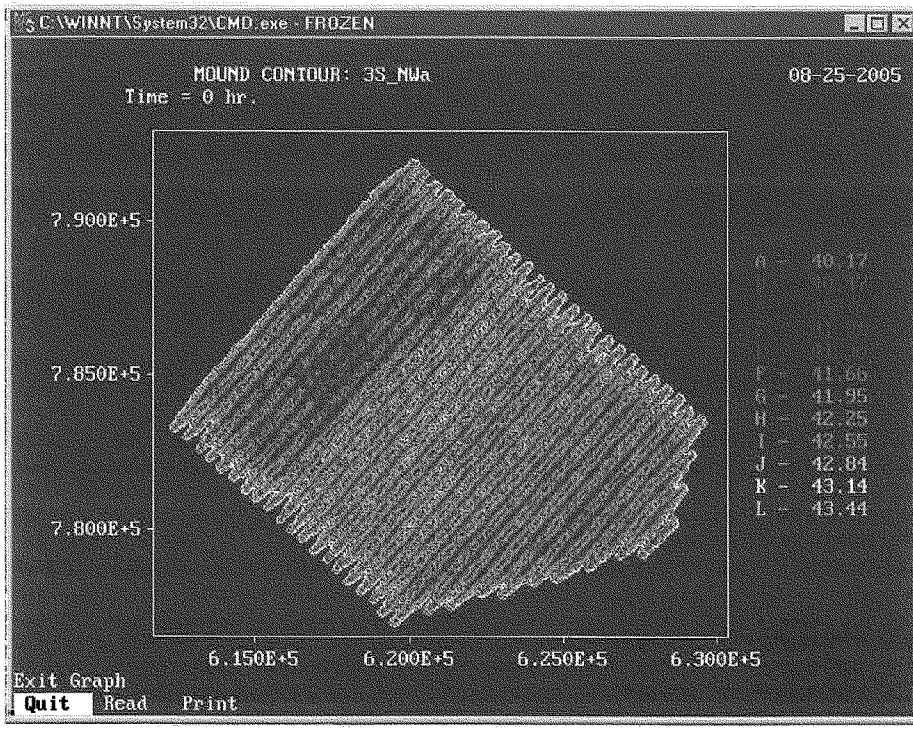


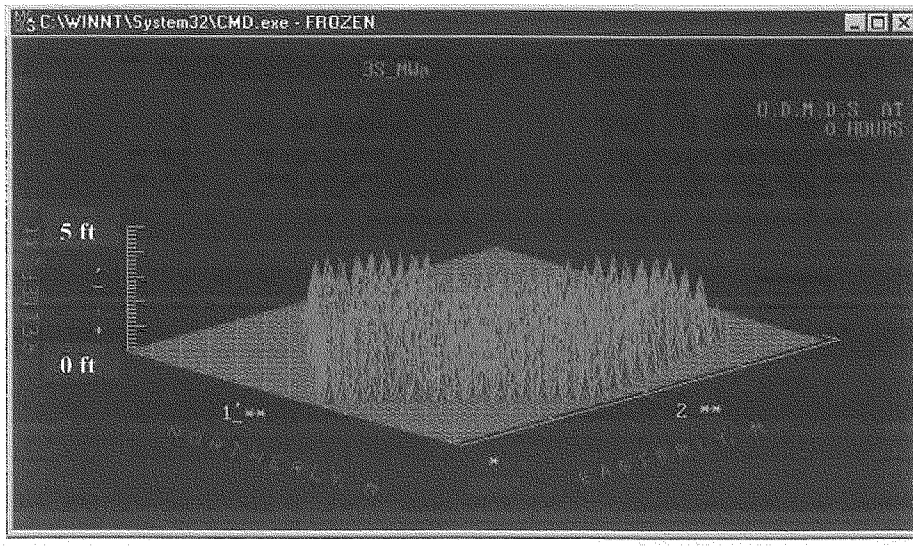
Placement Area 3, New Work Material destined for ODMDS B and PA3 placed into PA3, Large hopper. Max mound height = 4.42 ft (3.66 ft).
1319 dump points at 500 ft spacing.



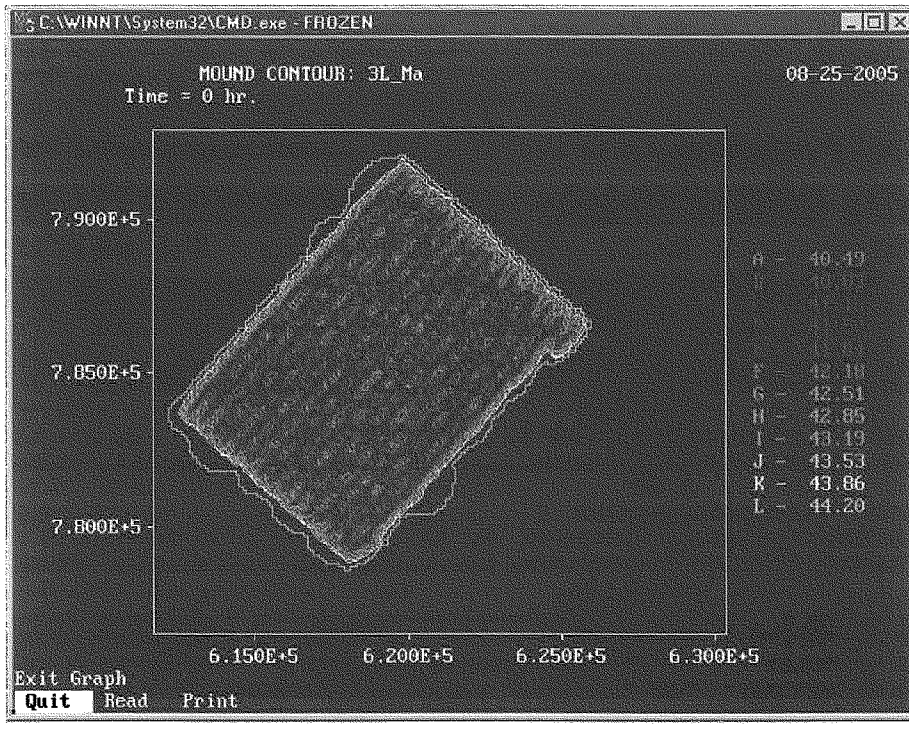



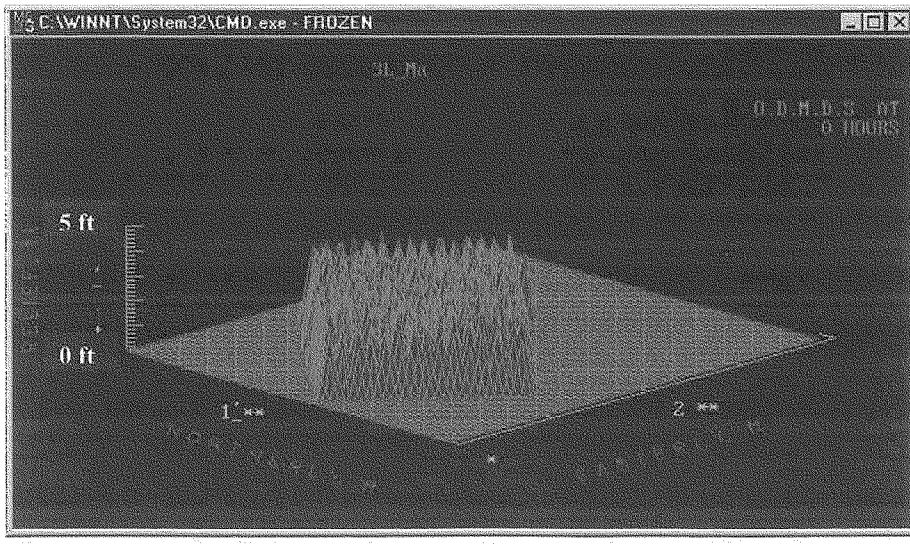
Placement Area 3, New Work Material destined for ODMDS B and PA3 placed into PA3, Small hopper. Max mound height =4.03 ft (3.27 ft).
3364 dump points at 500 ft spacing.



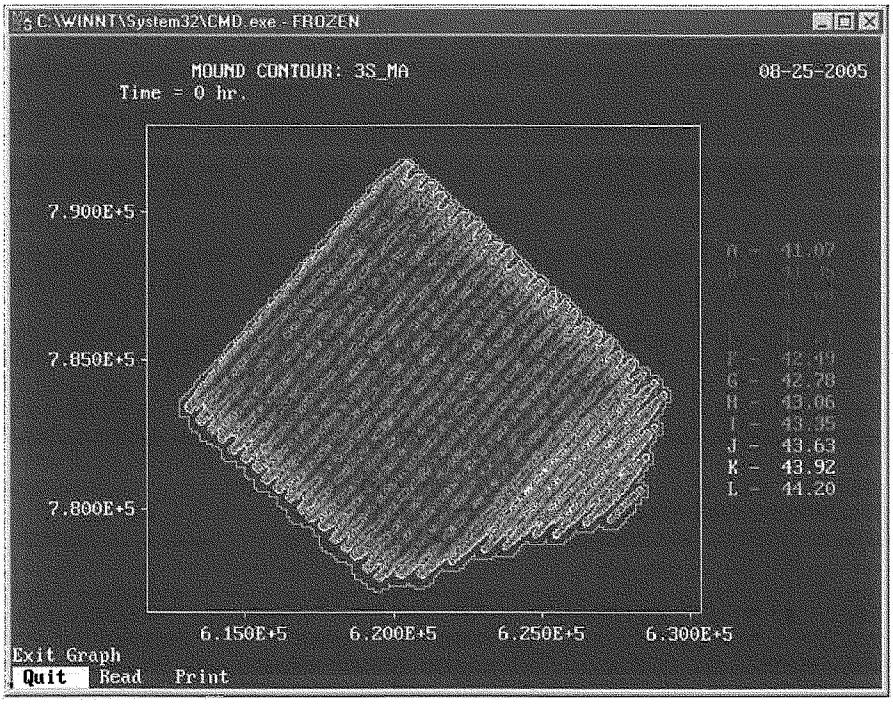



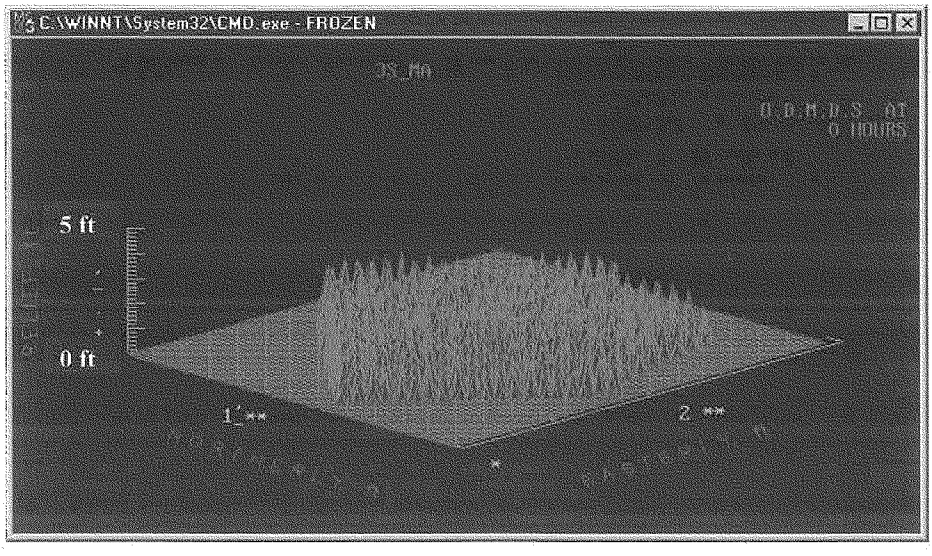
Placement Area 3, Maintenance Material destined for ODMDS B and PA3 placed into PA3, Large hopper. Max mound height = 3.71 ft.
340 dump points at 500 ft spacing.



Placement Area 3, Maintenance Material destined for ODMDS B and PA3 placed into PA3, Small hopper. Max mound height = 3.12 ft.
865 dump points at 500 ft spacing.



# Attachment B

# Tables from PBS&J (2004)

TABLE 1

STANDARD PARAMETERS
SNWW ENTRANCE CHANNEL EXTENSION

| Station | Date | Time | Channel Station | Water Depth (ft) | Dissolved Oxygen (mg/L) | pH | Salinity (‰) | Water Temp (°C) | Air Temp (°C) | Coordinates Latitude (N) Deg. | Min. | Sec. | Longitude (W) Deg. | Min. | Sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN-CH- 100A | 3/9/2004 | 0824 | 100+000 | 48.0 | 9.06 | 8.05 | 28.38 | 16.9 | 17.4 | 29 | 25 | 24.4 | 93 | 40 | 3.7 |
| SN-CH- 100B | 3/9/2004 | 0940 | 100+000 | 48.0 | 9.01 | 8.10 | 24.00 | 16.9 | 17.5 | 29 | 25 | 24.4 | 93 | 40 | 0.6 |
| SN-CH- 100C | 3/9/2004 | 1645 | 100+000 | 48.0 | 9.52 | 8.03 | 23.27 | 18.2 | 19.5 | 29 | 25 | 24.4 | 93 | 39 | 57.5 |
| SN-CH- 130A | 3/9/2004 | 1722 | 130+000 | 48.0 | 9.70 | 8.04 | 26.60 | 17.7 | 19.5 | 29 | 20 | 26.9 | 93 | 40 | 3.7 |
| SN-CH- 130B | 3/9/2004 | 1740 | 130+000 | 48.0 | 9.76 | 8.10 | 26.75 | 17.8 | 19.0 | 29 | 20 | 26.9 | 93 | 40 | 0.6 |
| SN-CH- 130C | 3/9/2004 | 1755 | 130+000 | 48.0 | 9.66 | 8.09 | 26.72 | 17.8 | 18.8 | 29 | 20 | 26.9 | 93 | 39 | 57.5 |
| SN-CH- 160A | 3/9/2004 | 1939 | 160+000 | 45.0 | 9.08 | 8.00 | 31.56 | 17.6 | 18.5 | 29 | 15 | 30.0 | 93 | 40 | 3.7 |
| SN-CH- 160B | 3/9/2004 | 1950 | 160+000 | 45.0 | 9.08 | 8.00 | 31.55 | 17.6 | 18.5 | 29 | 15 | 30.0 | 93 | 40 | 0.6 |
| SN-CH- 160C | 3/9/2004 | 2000 | 160+000 | 45.0 | 9.09 | 8.01 | 31.56 | 17.6 | 18.5 | 29 | 15 | 30.0 | 93 | 39 | 57.5 |
| SN-ZSF- 01 | 3/9/2004 | 0745 | N/A | 48.0 | 8.77 | 8.10 | 28.81 | 16.9 | 16.6 | 29 | 25 | 20.8 | 93 | 41 | 13.7 |
| SN-ZSF- 02 | 3/9/2004 | 0727 | N/A | 48.0 | | | | | | 29 | 25 | 21.6 | 93 | 42 | 10.3 |
| SN-ZSF- 03 | 3/9/2004 | 0715 | N/A | 48.0 | | | | | | 29 | 25 | 21.6 | 93 | 43 | 6.4 |
| SN-ZSF- 04 | 3/9/2004 | 0650 | N/A | 47.0 | | | | | | 29 | 25 | 22.3 | 93 | 44 | 3.6 |
| SN-ZSF- 05 | 3/9/2004 | 1030 | N/A | 47.0 | | | | | | 29 | 24 | 35.0 | 93 | 41 | 13.3 |
| SN-ZSF- 06 | 3/9/2004 | 1039 | N/A | 46.0 | | | | | | 29 | 24 | 35.0 | 93 | 42 | 10.2 |
| SN-ZSF- 07 | 3/9/2004 | 1047 | N/A | 46.0 | | | | | | 29 | 24 | 34.5 | 93 | 43 | 6.5 |
| SN-ZSF- 08 | 3/9/2004 | 1054 | N/A | 43.0 | 9.71 | 8.13 | 23.75 | 16.9 | 18.5 | 29 | 24 | 34.5 | 93 | 44 | 3.4 |
| SN-ZSF- 09 | 3/9/2004 | 1148 | N/A | 42.0 | | | | | | 29 | 23 | 45.5 | 93 | 41 | 14.0 |
| SN-ZSF- 10 | 3/9/2004 | 1135 | N/A | 33.0 | | | | | | 29 | 23 | 45.7 | 93 | 42 | 10.5 |
| SN-ZSF- 11 | 3/9/2004 | 1127 | N/A | 40.0 | 9.69 | 8.08 | 26.40 | 17.0 | 18.8 | 29 | 23 | 45.3 | 93 | 43 | 6.4 |
| SN-ZSF- 12 | 3/9/2004 | 1111 | N/A | 40.0 | | | | | | 29 | 23 | 5.7 | 93 | 44 | 2.9 |
| SN-ZSF- 13 | 3/9/2004 | 1205 | N/A | 46.0 | | | | | | 29 | 22 | 55.7 | 93 | 41 | 13.3 |
| SN-ZSF- 14 | 3/9/2004 | 1220 | N/A | 41.0 | 9.69 | 8.00 | 25.28 | 17.4 | 19.3 | 29 | 22 | 55.7 | 93 | 42 | 10.4 |
| SN-ZSF- 15 | 3/9/2004 | 1314 | N/A | 42.0 | | | | | | 29 | 22 | 56.1 | 93 | 43 | 6.9 |
| SN-ZSF- 16 | 2/28/2004 | 1433 | N/A | 40.0 | | | | | | 29 | 22 | 55.8 | 93 | 44 | 3.4 |
| SN-ZSF- 17 | 2/28/2004 | 1320 | N/A | 44.6 | 8.80 | 8.15 | 35.94 | 14.9 | 17.0 | 29 | 22 | 6.5 | 93 | 41 | 12.0 |
| SN-ZSF- 18 | 2/28/2004 | 1336 | N/A | 44.5 | | | | | | 29 | 22 | 6.2 | 93 | 42 | 10.3 |
| SN-ZSF- 19 | 2/28/2004 | 1355 | N/A | 44.5 | | | | | | 29 | 22 | 6.1 | 93 | 43 | 6.5 |
| SN-ZSF- 20 | 2/28/2004 | 1416 | N/A | 43.5 | | | | | | 29 | 22 | 6.2 | 93 | 44 | 3.0 |
| SN-ZSF- 21 | 2/28/2004 | 1256 | N/A | 43.7 | | | | | | 29 | 21 | 17.1 | 93 | 41 | 12.6 |
| SN-ZSF- 22 | 2/28/2004 | 1237 | N/A | 43.0 | | | | | | 29 | 21 | 16.8 | 93 | 42 | 10.2 |
| SN-ZSF- 23 | 2/28/2004 | 1220 | N/A | 45.0 | | | | | | 29 | 21 | 16.6 | 93 | 43 | 6.7 |
| SN-ZSF- 24 | 2/28/2004 | 1201 | N/A | 45.5 | 9.05 | 8.14 | 35.41 | 14.7 | 17.0 | 29 | 21 | 16.7 | 93 | 44 | 3.4 |
| SN-ZSF- 25 | 2/28/2004 | 1045 | N/A | 44.0 | | | | | | 29 | 20 | 27.2 | 93 | 41 | 12.7 |
| SN-ZSF- 26 | 2/28/2004 | 1055 | N/A | 45.0 | | | | | | 29 | 20 | 26.8 | 93 | 42 | 10.4 |
| SN-ZSF- 27 | 2/28/2004 | 1119 | N/A | 44.3 | 8.74 | 8.14 | 35.56 | 14.7 | 16.7 | 29 | 20 | 27.2 | 93 | 43 | 6.5 |
| SN-ZSF- 28 | 2/28/2004 | 1130 | N/A | 46.0 | | | | | | 29 | 20 | 26.7 | 93 | 44 | 3.0 |
| SN-ZSF- 29 | 2/28/2004 | 0930 | N/A | 45.9 | | | | | | 29 | 19 | 38.0 | 93 | 41 | 12.8 |
| SN-ZSF- 30 | 2/28/2004 | 0915 | N/A | 44.3 | 8.65 | 8.15 | 35.65 | 14.8 | 16.0 | 29 | 19 | 37.9 | 93 | 42 | 9.9 |
| SN-ZSF- 31 | 2/28/2004 | 0900 | N/A | 45.2 | | | | | | 29 | 19 | 37.7 | 93 | 43 | 6.6 |
| SN-ZSF- 32 | 2/28/2004 | 0825 | N/A | 45.3 | | | | | | 29 | 19 | 37.8 | 93 | 44 | 3.4 |
| SN-ZSF- 33 | 2/27/2004 | 1945 | N/A | 44.8 | 8.92 | 8.18 | 34.84 | 14.5 | 10.9 | 29 | 18 | 47.7 | 93 | 41 | 12.7 |
| SN-ZSF- 34 | 2/27/2004 | 2004 | N/A | 46.0 | | | | | | 29 | 18 | 47.9 | 93 | 42 | 10.4 |
| SN-ZSF- 35 | 2/27/2004 | 2015 | N/A | 46.0 | | | | | | 29 | 18 | 48.0 | 93 | 43 | 6.5 |
| SN-ZSF- 36 | 2/28/2004 | 0800 | N/A | 48.8 | | | | | | 29 | 18 | 48.3 | 93 | 44 | 2.9 |
| SN-ZSF- 37 | 2/27/2004 | 1726 | N/A | 44.5 | | | | | | 29 | 17 | 58.8 | 93 | 41 | 13.1 |
| SN-ZSF- 38 | 2/27/2004 | 1915 | N/A | 46.0 | | | | | | 29 | 17 | 58.7 | 93 | 42 | 10.8 |
| SN-ZSF- 39 | 2/27/2004 | 1902 | N/A | 46.5 | | | | | | 29 | 17 | 59.1 | 93 | 43 | 6.6 |
| SN-ZSF- 40 | 2/27/2004 | 1849 | N/A | 46.5 | 8.92 | 8.18 | 35.04 | 14.6 | 10.7 | 29 | 17 | 58.6 | 93 | 44 | 3.3 |
| SN-ZSF- 41 | 2/27/2004 | 1752 | N/A | 44.9 | | | | | | 29 | 17 | 9.1 | 93 | 41 | 13.3 |
| SN-ZSF- 42 | 2/27/2004 | 1802 | N/A | 43.9 | | | | | | 29 | 17 | 9.3 | 93 | 42 | 10.6 |
| SN-ZSF- 43 | 2/27/2004 | 1817 | N/A | 43.3 | 8.92 | 8.18 | 35.26 | 14.9 | 11.5 | 29 | 17 | 9.4 | 93 | 43 | 7.0 |
| SN-ZSF- 44 | 2/27/2004 | 1827 | N/A | 44.5 | | | | | | 29 | 17 | 9.2 | 93 | 44 | 2.8 |
| SN-ZSF- 45 | 2/27/2004 | 1742 | N/A | 43.0 | | | | | | 29 | 16 | 21.5 | 93 | 41 | 12.7 |
| SN-ZSF- 46 | 2/27/2004 | 1730 | N/A | 42.5 | 8.86 | 8.17 | 35.88 | 15.0 | 13.0 | 29 | 16 | 20.9 | 93 | 42 | 10.4 |
| SN-ZSF- 47 | 2/27/2004 | 1718 | N/A | 43.0 | | | | | | 29 | 16 | 20.4 | 93 | 43 | 6.0 |
| SN-ZSF- 48 | 2/27/2004 | 1707 | N/A | 44.2 | | | | | | 29 | 16 | 19.7 | 93 | 44 | 2.9 |
| SN-ZSF- 49 | 2/27/2004 | 1602 | N/A | 45.2 | 8.88 | 8.15 | 36.71 | 15.4 | 13.2 | 29 | 15 | 30.4 | 93 | 41 | 12.6 |
| SN-ZSF- 50 | 2/27/2004 | 1621 | N/A | 44.0 | | | | | | 29 | 15 | 30.3 | 93 | 42 | 10.6 |
| SN-ZSF- 51 | 2/27/2004 | 1630 | N/A | 43.8 | 8.86 | 8.16 | 36.48 | 15.2 | 13.2 | 29 | 15 | 30.4 | 93 | 43 | 6.4 |
| SN-ZSF- 52 | 2/27/2004 | 1655 | N/A | 44.0 | | | | | | 29 | 15 | 30.8 | 93 | 44 | 3.0 |
| SN-ZSF- 53 | 2/27/2004 | 1346 | N/A | 48.3 | | | | | | 29 | 14 | 41.0 | 93 | 41 | 13.7 |
| SN-ZSF- 54 | 2/27/2004 | 1329 | N/A | 46.4 | | | | | | 29 | 14 | 40.9 | 93 | 42 | 10.4 |
| SN-ZSF- 55 | 2/27/2004 | 1317 | N/A | 45.8 | | | | | | 29 | 14 | 41.0 | 93 | 43 | 6.8 |
| SN-ZSF- 56 | 2/27/2004 | 1305 | N/A | 44.6 | 9.05 | 8.11 | 36.82 | 15.3 | 17.7 | 29 | 14 | 40.8 | 93 | 44 | 3.2 |

TABLE 3

CONCENTRATIONS OF DETECTED COMPOUNDS (µg/L)
WATER
SNWW ENTRANCE CHANNEL EXTENSION

Date Sampled: February 28, 2004

| Parameter | WQC** Acute | WQC** Chronic | Detection Limit | SN-03- CH-100 | SN-03- CH-130 | SN-03- CH-130 Dup | SN-03- CH-160 | SN-03- ZSF-REF | Field Blank |
|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 69 | 36 | 1.00 | 2.17 | 3.24 | 3.63 | 3.67 | 2.21 | BDL |
| Chromium, Total | N/A | N/A | 1.00 | BDL | BDL | BDL | BDL | BDL | BDL |
| Chromium, III | N/A | N/A | 1.00 | BDL | BDL | BDL | BDL | BDL | BDL |
| Copper | 4.8 | 3.10 | 1.00 | 2.28 | 2.29 | 2.47 | 1.69 | **5.10** | BDL |
| Mercury | 1.8 | 0.94 | 0.20 | BDL | BDL | 0.83 | 1.21 | BDL | BDL |
| Nickel | 74 | 8.2 | 1.00 | 1.02 | BDL | BDL | BDL | BDL | BDL |
| Selenium | 290 | 71.0 | 2.00 | BDL | BDL | 2.62 | BDL | BDL | BDL |
| Zinc | 90.0 | 81.0 | 1.00 | 2.70 | BDL | 1.71 | BDL | 2.34 | 2.12 |
| Ammonia* | N/A | N/A | 0.03 | 0.04 | 0.06 | 0.05 | 0.05 | 0.04 | N/A |
| TOC* | N/A | N/A | 0.10 | 3.65 | 2.26 | 1.86 | 2.46 | 3.64 | N/A |
| Dibutylphthalate | 2,944*** | 3.4*** | 1.00 | BDL | BDL | 1.10 | BDL | BDL | N/A |
| Cyanide* | 1.0 | 1.0 | 0.10 | BDL | BDL | BDL | BDL | BDL | N/A |

Dup = Duplicate Sample
BDL = Below Detection Limits
* mg/L
** For Saltwater
*** Lowest Observable Effect Level for this class of compounds, not a chemical specific WQC

TABLE 4

CONCENTRATIONS OF DETECTED COMPOUNDS (µg/L)
ELUTRIATE
SNWW ENTRANCE CHANNEL EXTENSION

Date Sampled: February 28, 2004

| Parameter | WQC** Acute | WQC** Chronic | Detection Limit | SN-03- CH-100 | SN-03- CH-130 | SN-03- CH-130 Dup | SN-03- CH-160 | SN-03- ZSF-REF |
|---|---|---|---|---|---|---|---|---|
| Arsenic | 69 | 36 | 1.00 | 3.98 | 3.08 | 3.94 | 4.40 | 2.73 |
| Chromium, Total | N/A | N/A | 1.00 | BDL | BDL | BDL | BDL | 9.70 |
| Chromium, III | N/A | N/A | 1.00 | BDL | BDL | BDL | BDL | 9.70 |
| Copper | 4.8 | 3.10 | 1.00 | 1.70 | 1.47 | 1.24 | 1.76 | **7.02** |
| Mercury | 1.8 | 0.94 | 0.20 | BDL | 0.32 | 0.44 | 0.31 | BDL |
| Nickel | 74 | 8.2 | 1.00 | 1.67 | 1.49 | 1.38 | 1.58 | **16.9** |
| Selenium | 290 | 71.0 | 2.00 | BDL | BDL | BDL | BDL | BDL |
| Zinc | 90.0 | 81.0 | 1.00 | 2.45 | 10.5 | 2.00 | 1.76 | **84.1** |
| Ammonia* | N/A | N/A | 0.03 | 0.06 | 0.07 | 0.07 | 0.08 | 0.07 |
| TOC* | N/A | N/A | 0.10 | 3.22 | 4.92 | 2.51 | 3.13 | 3.64 |
| Dibutylphthalate | 2,944*** | 3.4*** | 2.00 | BDL | BDL | BDL | BDL | BDL |
| Cyanide* | 1.0 | 1.0 | 0.10 | BDL | BDL | 0.19 | BDL | BDL |

Dup = Duplicate Sample
BDL = Below Detection Limits
* mg/L
** For Saltwater

TABLE 5

CONCENTRATIONS OF DETECTED COMPOUNDS (dry weight)
SEDIMENT
SNWW ENTRANCE CHANNEL EXTENSION

Date Sampled: February 28, 2004

| | | | | SN-03- | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Units | Detection Limit | NOAA ERL | CH-100 | CH-130 | CH-130 Dup | CH-160 | ZSF-REF | ZSF-01 | ZSF-02 | ZSF-03 | ZSF-04 | ZSF-05 |
| Arsenic | mg/kg | 0.30 | 8.2 | 3.88 | 3.96 | 2.12 | 2.79 | 1.99 | | | | | |
| Chromium, Total | mg/kg | 1.00 | 81.0 | 12.8 | 14.0 | 5.34 | 5.81 | 8.02 | | | | | |
| Chromium III | mg/kg | 1.00 | N/A | 12.8 | 14.0 | 5.34 | 5.81 | 8.02 | | | | | |
| Copper | mg/kg | 1.00 | 34.0 | 3.52 | 27.4 | 2.00 | 2.44 | BDL | | | | | |
| Lead | mg/kg | 0.30 | 46.7 | 5.82 | 4.62 | 3.96 | 5.79 | 2.24 | | | | | |
| Nickel | mg/kg | 0.50 | 20.9 | 6.26 | 13.8 | 4.49 | 5.39 | 3.22 | | | | | |
| Selenium | mg/kg | 0.50 | N/A | BDL | BDL | BDL | BDL | BDL | | | | | |
| Thallium | mg/kg | 0.20 | N/A | 0.29 | 0.44 | BDL | 0.44 | 0.27 | | | | | |
| Zinc | mg/kg | 2.00 | 150 | 35.0 | 18.0 | 9.68 | 9.42 | 18.2 | | | | | |
| Ammonia | mg/kg | 0.10 | N/A | 44.1 | 11.1 | 22.1 | 23.9 | 8.11 | | | | | |
| TOC | % | 0.1 | N/A | 0.42 | 0.12 | 0.26 | 0.25 | 0.15 | | | | | |
| Percent Solids | % | 0.10 | N/A | 73.4 | 79.0 | 78.1 | 78.2 | 81.5 | | | | | |
| Gravel | % | N/A | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sand | % | N/A | | 63.9 | 90.1 | 89.4 | 74.8 | 97.6 | 59.4 | 53.5 | 58.4 | 56.8 | 46.3 |
| Silt | % | N/A | | 21.0 | 8.3 | 7.7 | 7.8 | 0.3 | 26.8 | 39.0 | 35.8 | 17.4 | 37.9 |
| Clay | % | N/A | | 7.0 | 1.6 | 2.9 | 8.0 | 1.2 | 7.2 | 6.5 | 4.9 | 6.5 | 6.4 |
| D50 | mm | N/A | | 0.25 | 0.20 | 0.19 | 0.25 | 0.29 | 0.18 | 0.12 | 0.17 | 0.23 | 0.16 |

TABLE 5 (Cont'd)

| Parameter | Units | Detection Limit | NOAA ERL | SN-03- ZSF-06 | ZSF-07 | ZSF-08 | ZSF-09 | ZSF-10 | ZSF-11 | ZSF-12 | ZSF-13 | ZSF-14 | ZSF-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gravel | % | N/A | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sand | % | N/A | | 56.8 | 38.9 | 82.6 | 89.7 | 95.3 | 98.1 | 92.7 | 64.5 | 99.7 | 97.8 |
| Silt | % | N/A | | 31.2 | 53.2 | 12.4 | 6.6 | 0.0 | 0.7 | 0.1 | 22.7 | 0.0 | 0.0 |
| Clay | % | N/A | | 5.8 | 4.0 | 5.0 | 2.2 | 2.9 | 1.2 | 6.6 | 5.9 | 1.2 | 3.6 |
| D50 | mm | N/A | | 0.22 | 0.07 | 0.23 | 0.25 | 0.50 | 0.21 | 0.23 | 0.23 | 0.27 | 0.22 |

| Parameter | Units | Detection Limit | NOAA ERL | SN-03- ZSF-16 | ZSF-17 | ZSF-18 | ZSF-19 | ZSF-20 | ZSF-21 | ZSF-22 | ZSF-23 | ZSF-24 | ZSF-25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gravel | % | N/A | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sand | % | N/A | | 92.0 | 81.9 | 58.1 | 90.6 | 87.6 | 93.3 | 73.1 | 67.8 | 78.9 | 73.9 |
| Silt | % | N/A | | 5.2 | 10.0 | 39.1 | 4.5 | 12.0 | 2.0 | 24.7 | 25.3 | 18.0 | 21.4 |
| Clay | % | N/A | | 2.8 | 6.1 | 1.5 | 4.0 | 0.4 | 4.2 | 1.6 | 4.2 | 3.1 | 4.4 |
| D50 | mm | N/A | | 0.22 | 0.19 | 0.15 | 0.23 | 0.18 | 0.23 | 0.17 | 0.20 | 0.18 | 0.20 |

TABLE 5 (Cont'd)

| Parameter | Units | Detection Limit | NOAA ERL | SN-03- | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ZSF-26 | ZSF-27 | ZSF-28 | ZSF-29 | ZSF-30 | ZSF-31 | ZSF-32 | ZSF-33 | ZSF-34 | ZSF-35 |
| Gravel | % | N/A | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sand | % | N/A | | 67.8 | 63.6 | 72.0 | 59.4 | 63.5 | 68.1 | 68.4 | 74.4 | 73.1 | 70.3 |
| Silt | % | N/A | | 27.8 | 28.0 | 21.7 | 34.3 | 30.2 | 24.4 | 24.6 | 19.7 | 20.2 | 23.8 |
| Clay | % | N/A | | 4.4 | 8.4 | 5.4 | 6.3 | 6.3 | 7.0 | 4.4 | 5.6 | 5.7 | 5.9 |
| D50 | mm | N/A | | 0.16 | 0.14 | 0.21 | 0.14 | 0.15 | 0.17 | 0.21 | 0.18 | 0.22 | 0.18 |

| Parameter | Units | Detection Limit | NOAA ERL | SN-03- | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ZSF-36 | ZSF-37 | ZSF-38 | ZSF-39 | ZSF-40 | ZSF-41 | ZSF-42 | ZSF-43 | ZSF-44 | ZSF-45 |
| Gravel | % | N/A | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sand | % | N/A | | 62.5 | 87.1 | 75.8 | 62.3 | 57.3 | 86.1 | 94.7 | 93.3 | 77.0 | 74.1 |
| Silt | % | N/A | | 28.7 | 7.0 | 15.3 | 30.4 | 35.9 | 9.1 | 3.5 | 1.3 | 16.3 | 15.7 |
| Clay | % | N/A | | 7.4 | 5.9 | 8.1 | 6.4 | 6.8 | 4.5 | 1.8 | 5.4 | 6.7 | 4.2 |
| D50 | mm | N/A | | 0.22 | 0.20 | 0.22 | 0.22 | 0.17 | 0.21 | 0.24 | 0.22 | 0.22 | 0.24 |

TABLE 5 (Cont'd)

| Parameter | Units | Detection Limit | NOAA ERL | SN-03- ZSF-46 | ZSF-47 | ZSF-48 | ZSF-49 | ZSF-50 | ZSF-51 | ZSF-52 | ZSF-53 | ZSF-54 | ZSF-55 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gravel | % | N/A | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sand | % | N/A | | 70.2 | 96.8 | 83.5 | 62.0 | 81.9 | 78.5 | 66.8 | 58.0 | 94.2 | 99.1 |
| Silt | % | N/A | | 20.1 | 0.2 | 10.6 | 29.3 | 16.2 | 0.7 | 22.9 | 36.7 | 3.9 | 0.0 |
| Clay | % | N/A | | 5.1 | 3.0 | 5.9 | 6.6 | 1.9 | 4.3 | 10.3 | 4.9 | 1.9 | 3.2 |
| D50 | mm | N/A | | 0.23 | 0.21 | 0.23 | 0.18 | 0.23 | 0.32 | 0.18 | 0.14 | 0.22 | 0.24 |

| Parameter | Units | Detection Limit | ZSF-56 |
|---|---|---|---|
| Gravel | % | N/A | 0.0 |
| Sand | % | N/A | 98.3 |
| Silt | % | N/A | 0.0 |
| Clay | % | N/A | 1.7 |
| D50 | mm | N/A | 0.21 |

Dup = Duplicate Sample
BDL = Below Detection Limit
N/A = Not Applicable.

TABLE 6
THE NUMBER AND PERCENTAGES OF SURVIVING ORGANISMS
SUSPENDED PARTICULATE PHASE BIOASSAYS
100% TEST SOLUTION
March 2004

| | | Number of Survivors | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Replicate | Dilution Control | Reference Control | Dilution Control | SN-CH-100 | Dilution Control | SN-CH-130 | Dilution Control | SN-CH-160 |
| *A. bahia* | 1 | 10 | 9 | 10 | 10 | 10 | 9 | 10 | 9 |
| juveniles | 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 10/replicate | 3 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 10 |
| | 4 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 5 | 10 | 10 | 10 | 10 | 10 | 9 | 10 | 10 |
| | Average | 10.0 | 9.8 | 10.0 | 10.0 | 10.0 | 9.6 | 9.8 | 9.8 |
| | (%) | 100.0% | 98.0% | 100.0% | 100.0% | 100.0% | 96.0% | 98.0% | 98.0% |
| *A. bahia* | 1 | 9 | 9 | 9 | 10 | 9 | 10 | 9 | 10 |
| adults | 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 10/replicate | 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 4 | 9 | 10 | 9 | 9 | 9 | 10 | 9 | 10 |
| | 5 | 10 | 9 | 10 | 10 | 10 | 10 | 10 | 10 |
| | Average | 9.6 | 9.6 | 9.6 | 9.8 | 9.6 | 10.0 | 9.6 | 10.0 |
| | (%) | 96.0% | 96.0% | 96.0% | 98.0% | 96.0% | 100.0% | 96.0% | 100.0% |
| *M. beryllina* | 1 | 10 | 9 | 10 | 10 | 10 | 10 | 10 | 9 |
| 10/replicate | 2 | 9 | 10 | 9 | 8 | 9 | 10 | 9 | 7 |
| | 3 | 9 | 10 | 9 | 10 | 9 | 10 | 9 | 10 |
| | 4 | 10 | 9 | 10 | 10 | 10 | 9 | 10 | 10 |
| | 5 | 9 | 10 | 9 | 10 | 9 | 10 | 9 | 9 |
| | Average | 9.4 | 9.6 | 9.4 | 9.6 | 9.4 | 9.8 | 9.4 | 9.0 |
| | (%) | 94.0% | 96.0% | 94.0% | 96.0% | 94.0% | 98.0% | 94.0% | 90.0% |

TABLE 7
THE NUMBER AND PERCENTAGES OF SURVIVING ORGANISMS
10-DAY SOLID PHASE BIOASSAYS & 28-DAY BIOACCUMULATION STUDY
SNWW ENTRANCE CHANNEL EXTENSION

| | | Number of Survivors | | | | |
|---|---|---|---|---|---|---|
| | Replicate (n=5) | True Control | Reference Control | SN-CH-100 | SN-CH-130 | SN-CH-160 |
| 10-DAY | 1 | 12 | 11 | 11 | 17 | 17 |
| *L. plumulosis* | 2 | 16 | 16 | 16 | 19 | 18 |
| 20/replicate | 3 | 18 | 18 | 15 | 17 | 16 |
| | 4 | 16 | 11 | 15 | 13 | 17 |
| | 5 | 19 | 15 | 14 | 9 | 15 |
| | Average | 16.2 | 14.2 | 14.2 | 15.0 | 16.6 |
| | (%) | 81.0% | 71.0% | 71.0% | 75.0% | 83.0% |
| *A. bahia* | 1 | 19 | 19 | 20 | 18 | 19 |
| 20/replicate | 2 | 20 | 20 | 19 | 20 | 20 |
| | 3 | 20 | 20 | 20 | 20 | 18 |
| | 4 | 20 | 20 | 20 | 20 | 19 |
| | 5 | 19 | 19 | 19 | 20 | 19 |
| | Average | 19.6 | 19.6 | 19.6 | 19.6 | 19.0 |
| | (%) | 98.0% | 98.0% | 98.0% | 98.0% | 95.0% |
| Total Organisms | 1 | 31 | 30 | 31 | 35 | 36 |
| 30/replicate | 2 | 36 | 36 | 35 | 39 | 38 |
| | 3 | 38 | 38 | 35 | 37 | 34 |
| | 4 | 36 | 31 | 35 | 33 | 36 |
| | 5 | 38 | 34 | 33 | 29 | 34 |
| | Average | 35.8 | 33.8 | 33.8 | 34.6 | 35.6 |
| | (%) | 89.5% | 84.5% | 84.5% | 86.5% | 89.0% |
| 28-DAY | 1 | 15 | 15 | 16 | 18 | 19 |
| *N. virens* | 2 | 18 | 16 | 17 | 15 | 17 |
| 20/replicate | 3 | 20 | 14 | 12 | 17 | 15 |
| | 4 | 17 | 16 | 12 | 18 | 17 |
| | 5 | 16 | 20 | 13 | 17 | 17 |
| | Average | 17.2 | 16.2 | 14.0 | 17.0 | 17.0 |
| | (%) | 86.0% | 81.0% | 70.0% | 85.0% | 85.0% |
| | 1 | 20 | 19 | 20 | 19 | 19 |
| *M. mercenaria* | 2 | 20 | 20 | 20 | 19 | 20 |
| 15/replicate | 3 | 20 | 19 | 20 | 19 | 20 |
| | 4 | 20 | 20 | 20 | 20 | 20 |
| | 5 | 19 | 20 | 19 | 20 | 20 |
| | Average | 19.8 | 19.6 | 19.8 | 19.4 | 19.8 |
| | (%) | 99.0% | 98.0% | 99.0% | 97.0% | 99.0% |

TABLE 8
CONCENTRATIONS OF DETECTED COMPOUNDS
IN TISSUE SAMPLES OF
*N. virens*
SNWW ENTRANCE CHANNEL EXTENSION

| | | STATION | | | | |
|---|---|---|---|---|---|---|
| Parameter | Replicate | True Control | Reference Control | SN-CH-100 | SN-CH-130 | SN-CH-160 |
| Metals (mg/kg) | | | | | | |
| Arsenic | 1 | 3.53 | 2.21 | 2.54 | 2.74 | 2.84 |
| | 2 | 3.43 | 2.48 | 2.81 | 2.51 | 2.69 |
| | 3 | 3.76 | 2.46 | 2.37 | 2.70 | 2.71 |
| | 4 | 3.30 | 2.81 | 2.23 | 2.51 | 3.08 |
| | 5 | 3.68 | 3.44 | 2.41 | 2.83 | 2.76 |
| | Total | 17.70 | 13.40 | 12.36 | 13.29 | 14.08 |
| | Average | 3.54 | 2.68 | 2.47 | 2.66 | 2.82 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Chromium | 1 | 0.14 | 0.15 | 0.12 | 0.27 | 0.20 |
| | 2 | 0.14 | 0.12 | 0.12 | 0.32 | 0.12 |
| | 3 | 0.14 | 0.21 | 0.12 | 0.23 | 0.15 |
| | 4 | 0.16 | 0.27 | 0.13 | 0.25 | 0.12 |
| | 5 | 0.15 | 0.19 | 0.29 | 0.25 | 0.13 |
| | Total | 0.73 | 0.94 | 0.78 | 1.32 | 0.72 |
| | Average | 0.15 | 0.19 | 0.16 | 0.26 | 0.14 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Copper | 1 | 1.37 | 1.25 | 1.31 | 1.33 | 1.42 |
| | 2 | 1.31 | 1.39 | 1.30 | 1.46 | 1.30 |
| | 3 | 1.19 | 1.27 | 1.36 | 1.32 | 1.34 |
| | 4 | 1.38 | 1.56 | 1.24 | 1.40 | 1.28 |
| | 5 | 1.33 | 1.26 | 1.29 | 1.32 | 1.38 |
| | Total | 6.58 | 6.73 | 6.50 | 6.83 | 6.72 |
| | Average | 1.32 | 1.35 | 1.30 | 1.37 | 1.34 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Lead | 1 | < 0.10 | < 0.10 | < 0.10 | 0.12 | < 0.10 |
| | 2 | < 0.10 | < 0.10 | < 0.10 | 0.11 | < 0.10 |
| | 3 | < 0.10 | 0.12 | < 0.10 | < 0.10 | < 0.10 |
| | 4 | < 0.10 | 0.13 | 0.11 | 0.12 | < 0.10 |
| | 5 | 0.13 | < 0.10 | 0.16 | < 0.10 | < 0.10 |
| | Total | 0.53 | 0.55 | 0.57 | 0.55 | 0.10 |
| | Average | 0.11 | 0.11 | 0.11 | 0.11 | 0.10 |
| | | Parameter concentration in test tissues are not greater than in reference tissues, therefore, no statistical analyses of the data are required. | | | | |
| Mercury | 1 | 0.03 | 0.02 | 0.03 | 0.04 | 0.04 |
| | 2 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| | 3 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 |
| | 4 | 0.03 | 0.04 | 0.03 | 0.03 | 0.04 |

TABLE 8 (Concluded)

| Parameter | Replicate | STATION True Control | Reference Control | SN-CH-100 | SN-CH-130 | SN-CH-160 |
|---|---|---|---|---|---|---|
| Metals (mg/kg) | | | | | | |
| Nickel | 1 | 0.27 | 0.33 | 0.31 | 0.28 | 0.31 |
| | 2 | 0.24 | 0.34 | 0.29 | 0.30 | 0.29 |
| | 3 | 0.28 | 0.41 | 0.29 | 0.28 | 0.29 |
| | 4 | 0.29 | 0.28 | 0.29 | 0.33 | 0.32 |
| | 5 | 0.31 | 0.29 | 0.28 | 0.30 | 0.30 |
| | Total | 1.39 | 1.65 | 1.46 | 1.49 | 1.51 |
| | Average | 0.28 | 0.33 | 0.29 | 0.30 | 0.30 |
| | | Parameter concentration in test tissues are not greater than in reference tissues, therefore, no statistical analyses of the data are required. | | | | |
| Selenium | 1 | 0.29 | 0.30 | 0.30 | 0.30 | 0.35 |
| | 2 | 0.29 | 0.30 | 0.29 | 0.26 | 0.29 |
| | 3 | 0.26 | 0.29 | 0.30 | 0.29 | 0.30 |
| | 4 | 0.27 | 0.30 | 0.27 | 0.30 | 0.29 |
| | 5 | 0.29 | 0.26 | 0.29 | 0.29 | 0.28 |
| | Total | 1.40 | 1.45 | 1.45 | 1.44 | 1.51 |
| | Average | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Zinc | 1 | 32.0 | 9.58 | 26.5 | 41.2 | 10.0 |
| | 2 | 39.1 | 33.4 | 33.2 | 25.4 | 28.6 |
| | 3 | 9.90 | 37.1 | 30.3 | 33.8 | 22.0 |
| | 4 | 10.1 | 24.9 | 9.88 | 36.2 | 28.9 |
| | 5 | 27.3 | 13.6 | 42.7 | 9.49 | 26.2 |
| | Total | 118.4 | 118.6 | 142.6 | 146.1 | 115.7 |
| | Average | 23.7 | 23.7 | 28.5 | 29.2 | 23.1 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Cyanide | 1 | < 1.00 | < 1.00 | 2.30 | < 1.00 | < 1.00 |
| | 2 | < 1.00 | < 1.00 | 2.51 | < 1.00 | 3.09 |
| | 3 | < 1.00 | < 1.00 | 2.01 | < 1.00 | < 1.00 |
| | 4 | < 1.00 | < 1.00 | < 1.00 | < 1.00 | < 1.00 |
| | 5 | < 1.00 | < 1.00 | 1.13 | < 1.00 | 2.43 |
| | Total | 5.00 | 5.00 | 8.95 | 5.00 | 8.52 |
| | Average | 1.00 | 1.00 | 1.79 | 1.00 | 1.70 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |

TABLE 9
CONCENTRATIONS OF DETECTED COMPOUNDS
IN TISSUE SAMPLES OF
*M. mercenaria*
SNWW ENTRANCE CHANNEL EXTENSION

| | | Station | | | | |
|---|---|---|---|---|---|---|
| Parameter | Replicate | True Control | Reference Control | SN-CH-100 | SN-CH-130 | SN-CH-160 |
| Metals (mg/kg) | | | | | | |
| Arsenic | 1 | 1.91 | 2.29 | 1.68 | 2.20 | 2.12 |
| | 2 | 2.46 | 2.66 | 2.51 | 2.03 | 2.14 |
| | 3 | 2.37 | 2.42 | 2.26 | 2.47 | 2.40 |
| | 4 | 2.26 | 2.31 | 2.51 | 2.31 | 2.13 |
| | 5 | 2.26 | 2.13 | 2.37 | 2.43 | 1.96 |
| | Total | 11.26 | 11.81 | 11.33 | 11.44 | 10.75 |
| | Average | 2.25 | 2.36 | 2.27 | 2.29 | 2.15 |
| | | Parameter concentration in test tissues are not greater than in reference tissues, therefore, no statistical analyses of the data are required. | | | | |
| Chromium | 1 | 0.18 | 0.10 | 0.13 | 0.15 | 0.13 |
| | 2 | 0.08 | 0.12 | 0.07 | 0.13 | 0.37 |
| | 3 | 0.13 | 0.15 | 0.09 | 0.10 | 0.11 |
| | 4 | 0.11 | 0.11 | 0.08 | 0.12 | 0.08 |
| | 5 | 0.18 | 0.12 | 0.08 | 0.14 | 0.56 |
| | Total | 0.68 | 0.60 | 0.45 | 0.64 | 1.25 |
| | Average | 0.14 | 0.12 | 0.09 | 0.13 | 0.25 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Copper | 1 | 1.64 | 1.48 | 1.56 | 1.87 | 1.71 |
| | 2 | 1.57 | 1.88 | 1.06 | 1.53 | 1.69 |
| | 3 | 1.67 | 1.68 | 1.21 | 1.65 | 1.82 |
| | 4 | 1.67 | 1.54 | 1.25 | 1.56 | 1.41 |
| | 5 | 1.79 | 1.31 | 1.18 | 1.43 | 1.30 |
| | Total | 8.34 | 7.89 | 6.26 | 8.04 | 7.93 |
| | Average | 1.67 | 1.58 | 1.25 | 1.61 | 1.59 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Lead | 1 | < 0.10 | < 0.10 | < 0.10 | 0.13 | 0.17 |
| | 2 | 0.11 | 0.16 | < 0.10 | 0.18 | 0.18 |
| | 3 | 0.15 | 0.17 | < 0.10 | 0.11 | 0.15 |
| | 4 | 0.12 | 0.12 | < 0.10 | 0.17 | 0.13 |
| | 5 | 0.16 | < 0.10 | < 0.10 | < 0.10 | 0.12 |
| | Total | 0.64 | 0.65 | 0.50 | 0.69 | 0.75 |
| | Average | 0.13 | 0.13 | 0.10 | 0.14 | 0.15 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Mercury | 1 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| | 2 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| | 3 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| | 4 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |

TABLE 9 (Concluded)

| Parameter | Replicate | Station: True Control | Reference Control | SN-CH-100 | SN-CH-130 | SN-CH-160 |
|---|---|---|---|---|---|---|
| Metals (mg/kg) | | | | | | |
| Nickel | 1 | 0.49 | 0.47 | 0.49 | 0.47 | 0.60 |
| | 2 | 0.49 | 0.61 | 0.31 | 0.43 | 0.78 |
| | 3 | 0.69 | 0.67 | 0.37 | 0.52 | 0.57 |
| | 4 | 0.52 | 0.50 | 0.36 | 0.47 | 0.42 |
| | 5 | 0.73 | 0.46 | 0.41 | 0.47 | 0.64 |
| | Total | 2.92 | 2.71 | 1.94 | 2.36 | 3.01 |
| | Average | 0.58 | 0.54 | 0.39 | 0.47 | 0.60 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Selenium | 1 | 0.19 | 0.18 | 0.18 | 0.17 | 0.21 |
| | 2 | 0.21 | 0.21 | 0.15 | 0.17 | 0.22 |
| | 3 | 0.22 | 0.21 | 0.14 | 0.17 | 0.21 |
| | 4 | 0.22 | 0.18 | 0.15 | 0.19 | 0.18 |
| | 5 | 0.21 | 0.16 | 0.14 | 0.17 | 0.21 |
| | Total | 1.05 | 0.94 | 0.76 | 0.87 | 1.03 |
| | Average | 0.21 | 0.19 | 0.15 | 0.17 | 0.21 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Silver | 1 | 0.11 | 0.17 | 0.12 | 0.11 | 0.16 |
| | 2 | 0.15 | 0.23 | 0.08 | 0.18 | 0.21 |
| | 3 | 0.18 | 0.21 | 0.07 | 0.13 | 0.18 |
| | 4 | 0.11 | 0.09 | 0.06 | 0.19 | 0.12 |
| | 5 | 0.19 | 0.12 | 0.06 | 0.16 | 0.18 |
| | Total | 0.74 | 0.82 | 0.39 | 0.77 | 0.85 |
| | Average | 0.15 | 0.16 | 0.08 | 0.15 | 0.17 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Zinc | 1 | 10.8 | 9.53 | 11.2 | 11.6 | 13.4 |
| | 2 | 10.1 | 12.7 | 7.00 | 10.5 | 14.1 |
| | 3 | 17.3 | 13.7 | 7.51 | 11.0 | 12.4 |
| | 4 | 12.5 | 12.1 | 7.67 | 11.6 | 9.60 |
| | 5 | 14.7 | 10.5 | 8.66 | 10.5 | 13.1 |
| | Total | 65.4 | 58.5 | 42.0 | 55.2 | 62.6 |
| | Average | 13.1 | 11.7 | 8.41 | 11.0 | 12.5 |
| | | Parameter concentration in test tissues are greater than in reference tissues, therefore, statistical analyses of the data are required. | | | | |
| Cyanide | 1 | < 1.00 | < 1.00 | < 1.00 | < 1.00 | < 1.00 |
| | 2 | < 1.00 | < 1.00 | < 1.00 | 1.05 | 1.06 |
| | 3 | < 1.00 | 1.34 | < 1.00 | 1.08 | 1.73 |
| | 4 | < 1.00 | 1.22 | < 1.00 | < 1.00 | < 1.00 |
| | 5 | < 1.00 | < 1.00 | < 1.00 | < 1.00 | < 1.00 |
| | Total | 5.00 | 5.56 | 5.00 | 5.13 | 5.79 |
| | Average | 1.00 | 1.11 | 1.00 | 1.03 | 1.16 |

# Attachment C

# Site Management and Monitoring Plan

# ATTACHMENT C
# SITE MANAGEMENT AND MONITORING PLAN
# SABINE-NECHES WATERWAY, TEXAS
# OCEAN DREDGED MATERIAL DISPOSAL SITES

## I. GENERAL

The Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 (33 USC Section 1401, et seq.) is the legislative authority regulating the disposal of dredged material into ocean waters, including the territorial sea. The transportation of dredged material for the purpose of placement into ocean waters is permitted by the U.S. Army Corps of Engineers (USACE) or in the case of Federal projects, authorized for disposal under MPRSA Section 103(e), applying environmental criteria established by the U.S. Environmental Protection Agency (EPA) in the Ocean Dumping Regulations (40 CFR Parts 220–229).

Section 102(c) of the MPRSA and 40 CFR 228.4(e)(l) authorize the EPA to designate Ocean Dredged Material Disposal Sites (ODMDS) in accordance with requirements at 40 CFR 228.5 and 228.6. Section 103(b) of MPRSA requires that the USACE use dredged material sites designated by EPA to the maximum extent feasible. Where use of an EPA-designated site is not feasible, the USACE may, with concurrence of EPA, select an alternative site in accordance with MPRSA 103(b).

Section 228.3 of the Ocean Dumping Regulations established disposal site management responsibilities; however, the Water Resources Development Act of 1992 (WRDA 92; Public Law 102-580) included a number of amendments to the MPRSA specific to ODMDS management. Section 102(c) of MPRSA as amended by Section 506 of WRDA 92 provides that:

1. Site management plans shall be developed for each ODMDS designated pursuant to Section 102(c) of MPRSA.
2. After January 1, 1995, no ODMDS shall receive a final designation unless a Site Management Plan has been developed.
3. For ODMDSs that received a final designation prior to January 1, 1995, Site Management Plans shall be developed as expeditiously as practicable, but no later than January 1, 1997, giving priority to sites with the greatest potential impact on the environment.
4. Beginning on January 1, 1997, no permit or authorization for dumping shall be issued for a site unless it has received a final designation pursuant to Section 102(c) MPRSA or it is an alternate site selected by the USACE under Section 103(b) of MPRSA.

This Site Management Plan for the Sabine-Neches Waterway, Texas (SNWW) ODMDSs was developed jointly by EPA Region 6 and USACE, Galveston District (USACE-SWG). In accordance with Section 102(c)(3) of the MPRSA, as amended by WRDA 92, the plan includes the following:

1. A baseline assessment of conditions at the sites;

2. A program for monitoring the sites;
3. Special management conditions or practices to be implemented at the sites that are necessary for protection of the environment;
4. Consideration of the quantity of dredged material to be discharged at the sites, and the presence, nature, and bioavailability of the contaminants in the material;
5. Consideration of the anticipated use of the sites over the long term, including the anticipated closure date for the sites, if applicable, and any need for management of the sites after the closure; and
6. A schedule for review and revision of the plan.

## II. SITE MANAGEMENT OBJECTIVES

The purpose of ODMDS management is to ensure that placement activities do not unreasonably degrade the marine environment or interfere with other beneficial uses (e.g., navigation) of the ocean. The specific objectives of management of the SNWW ODMDSs are as follows:

1. Ocean discharge of only that dredged material that satisfies the criteria set forth in 40 CFR Part 227 Subparts B, C, D, E, and G and Part 228.4(e) and is suitable for unrestricted placement at the ODMDS; and
2. Avoidance of excessive mounding, either within the site boundaries or in areas adjacent to the sites, as a direct result of placement operations.

These objectives will be achieved through the following measures:

1. Regulation and administration of ocean dumping permits;
2. Development and maintenance of a site monitoring program; and
3. Evaluation of permit compliance and monitoring results.

## III. ROLES AND RESPONSIBILITIES

In accordance with Section 102(c) of the MPRSA and with the Regional Memorandum of Understanding (MOU) between USACE-SWG and EPA Region 6 on Management of ODMDSs signed August 13, 1993, EPA is responsible for designation of ODMDSs. Where use of an EPA-designated site is not feasible, the USACE-SWG may, with concurrence with EPA Region 6, select an alternative site in accordance with Section 103(b) of the MPRSA as amended by Section 506 of WRDA 92.

Development of Site Management Plans for ODMDSs within USACE-SWG's area of operation is the joint responsibility of EPA Region 6 and the USACE-SWG. Both agencies are responsible for assuring that all components of the Site Management Plans are implementable, practicable, and applicable to site management decision-making.

# IV. FUNDING

Physical, chemical, and biological effects–based testing of dredged material prior to placement at the ODMDS shall be undertaken and funded by the Permittee, if the project is permitted, or USACE-SWG, for Federal projects. The permittee or USACE-SWG, as appropriate, shall also be responsible for costs associated with placement site hydrographic monitoring. Should monitoring indicate that additional studies and/or tests are needed at the ODMDSs, the cost for such work would be shared by the Permittee or USACE-SWG and EPA Region 6. Physical, chemical, and biological effects-based testing at the ODMDS, or in the site environs after discharge, which is not required as a result of hydrographic monitoring, shall be funded by EPA Region 6. Federal funding of all aspects of this Site Management Plan is contingent on availability of appropriated funds.

# V. BASELINE ASSESSMENT

## A. Site Characterization (Existing Maintenance ODMDSs)

Four ODMDSs have been designated for maintenance of the SNWW (Figure 1). Following is a brief description of each site.

ODMDS No. 1 is located approximately 16 nautical miles from shore, about 6,000 feet west of the Sabine Bank Channel. This site occupies an area of approximately 2.4 square nautical miles, with depths ranging from 36 to 43 feet. The site is triangular in shape, with vertices at the following coordinates:

29°28′03″N, 93°41′14″W

29°26′11″N, 93°41′14″W

29°26′11″N, 93°44′11″W

ODMDS No. 2 is located approximately 11.8 nautical miles from shore, about 6,000 feet southwest of the Sabine Bank Channel. This site occupies an area of approximately 4.2 square nautical miles, with depths ranging from 30 to 43 feet. The site is trapezoidal in shape, with vertices at the following coordinates:

29°30′41″N, 93°43′49″W

29°28′42″N, 93°41′33″W

29°28′42″N, 93°44′49″W

29°30′08″N, 93°46′27″W

ODMDS No. 3 is located approximately 6.8 nautical miles from shore, about 6,000 feet southwest of the Sabine Bank Channel. This site occupies an area of approximately 4.7 square nautical miles, with a depth of about 33 feet. The site is a pentagon, with vertices at the following coordinates:

29°34′24″N, 93°48′13″W

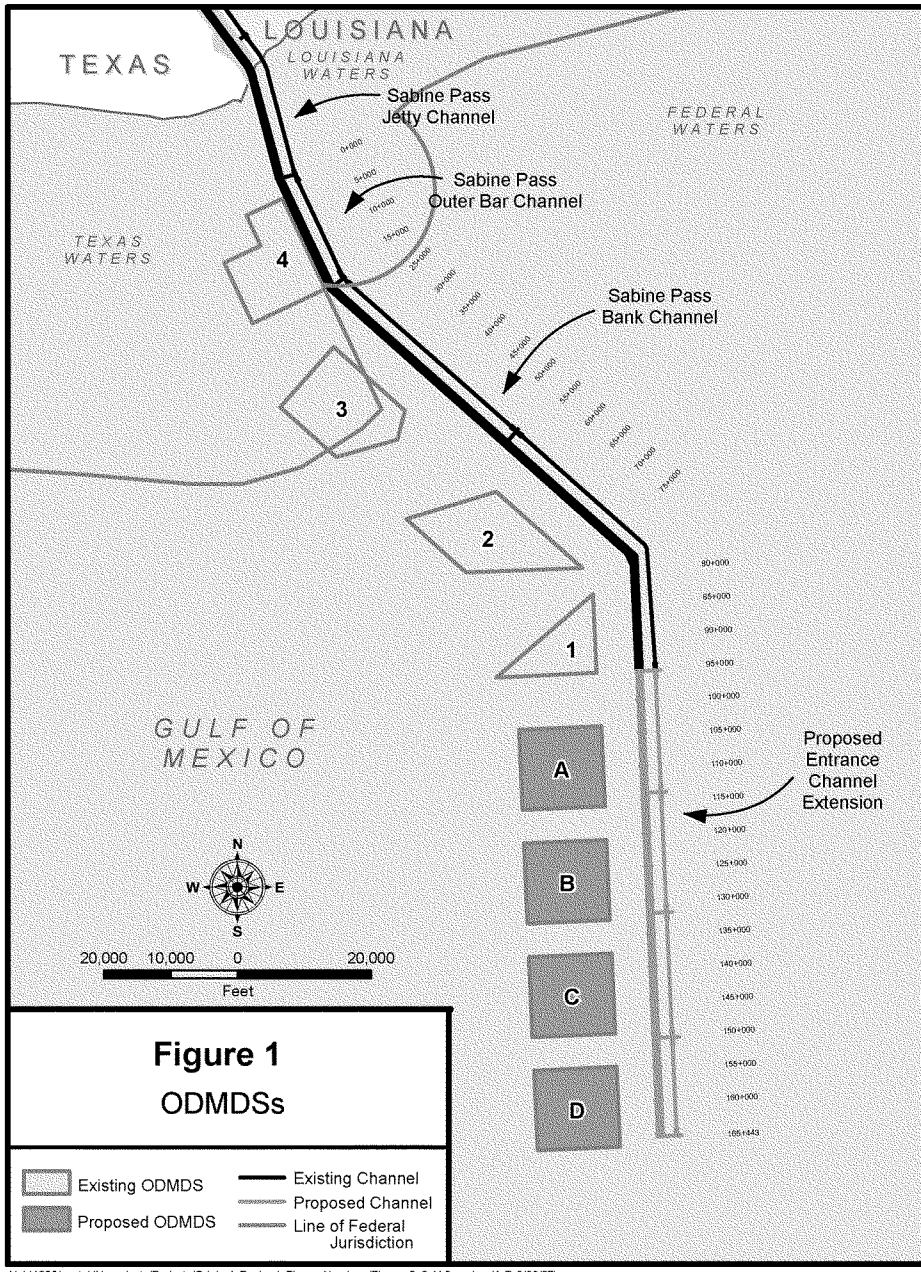



**Figure 1**

ODMDSs

N:441206/post_HU_projects/Projects/Original_Revised_Figure_Numbers/Figure_2_3_Vr2.mxd (A.P. 3/08/07)

29°32′47″N, 93°46′16″W

29°32′06″N, 93°46′29″W

29°31′42″N, 93°48′16″W

29°32′59″N, 93°49′48″W

ODMDS No. 4 is located approximately 2.7 nautical miles from shore, about 500 feet southwest of the Sabine Pass Outer Bar Channel. This site occupies an area of approximately 4.2 square nautical miles, with depths ranging from 16 to 30 feet. The site is L-shaped, with vertices at the following coordinates:

29°38′09″N, 93°49′23″W

29°35′53″N, 93°48′18″W

29°35′06″N, 93°50′24″W

29°36′37″N, 93°51′09″W

29°37′00″N, 93°50′06″W

29°37′46″N, 93°50′26″W

Two sediment reference areas have been established for this project. Reference Site 1 and 2 is located east of the Sabine Bank Channel with vertices at the following coordinates:

29°27′30″N, 93°37′00″W

29°27′30″N, 93°36′45″W

29°26′38″N, 93°36′45″W

29°26′38″N, 93°37′00″W

Reference Site 3 and 4 is located northeast of the Sabine Bank Channel with vertices at the following coordinates:

29°35′52″N, 93°41′45″W

29°35′52″N, 93°41′30″W

29°35′00″N, 93°41′30″W

29°35′00″N, 93°41′45″W

Baseline conditions at the SNWW Maintenance ODMDSs were assessed during the site designation process. Details of baseline conditions, including descriptions of the marine environment in the site vicinity and the physical, chemical and biological characteristics of the sediments and the water column at the site, are contained in the "Final Environmental Impact Statement (EIS) for the Sabine-Neches, Texas Dredged Material Disposal Site Designation" prepared by EPA, Criteria and Standards Division, in March 1983. An update of the general area of the existing ODMDSs is presented in PBS&J (2009).

## B. Site Characterization (Proposed Extension Channel ODMDSs)

The proposed ODMDSs A–D are anticipated to receive both virgin material from project construction and future maintenance material from the Extension Channel (see Figure 1). They are located 21 to 30 miles offshore, with vertices at the following coordinates:

ODMDS A

29° 24′ 47″ N, 93° 43′ 29″ W

29° 24′ 47″ N, 93° 41′ 08″ W

29° 22′ 48″ N, 93° 41′ 09″ W

29° 22′ 49″ N, 93° 43′ 29″ W

ODMDS B

29° 21′ 59″ N, 93° 43′ 29″ W

29° 21′ 59″ N, 93° 41′ 08″ W

29° 20′ 00″ N, 93° 41′ 09″ W

29° 20′ 00″ N, 93° 43′ 29″ W

ODMDS C

29° 19′ 11″ N, 93° 43′ 29″ W

29° 19′ 11″ N, 93° 41′ 09″ W

29° 17′ 12″ N, 93° 41′ 09″ W

29° 17′ 12″ N, 93° 43′ 29″ W

ODMDS D

29° 16′ 22″ N, 93° 43′ 29″ W

29° 16′ 22″ N, 93° 41′ 10″ W

29° 14′ 24″ N, 93° 44′ 10″ W

29° 14′ 24″ N, 93° 43′ 29″ W

These ODMDSs occupy areas of approximately 5.3 square miles each with depths ranging from 44 to 46 feet. One sediment reference area is proposed for the proposed ODMDSs, since the ODMDS EIS found that the offshore area is very constant, both in depth and grain-size characteristics. Reference Site A–D is located east of the Extension Channel with vertices at the following coordinates:

29° 20′ 00″ N, 93° 37′ 00″ W

29° 20′ 00″ N, 93° 36′ 45″ W

29° 19′ 08″ N, 93° 36′ 45″ W

29° 19′ 08″ N, 93° 37′ 00″ W

Baseline conditions at the proposed ODMDSs A–D were assessed during the site designation process. Details of baseline conditions, including descriptions of the marine environment in the site vicinity and the physical, chemical, and biological characteristics of the sediments and the water column at the site, are contained in the ODMDS Site Designation EIS to which this Attachment is appended.

## C. Historical Use of Sites

ODMDS Nos. 1, 2, 3, and 4 received final designation on September 10, 1987 (52 FR 175). The present configurations of these sites were established in 1971. They received interim designation in 1977 (42 FR 7), and were historically used for placement of dredged material throughout this period. A description of dredged volumes from 1960 through 1979 is contained within the designation EIS. Dredged quantities between 1979 and 2009 are depicted in Table 1.

TABLE 1

DREDGED QUANTITIES, 1979 TO 2009

| Dredging Interval | Quantity of Dredged Material (cubic yards) |
|---|---|
| October 1– 4, 1979 | 58,080 |
| March 19–May 30, 1981 | 3,589,486 |
| April 27–May 20, 1982 | 1,693,264 |
| July 24–August 7, 1983 | 200,000 |
| July 22–September 30, 1984 | 5,835,135 |
| June 13–September 7, 1985 | 5,353,000 |
| May 12–July 13, 1986 | 5,626,837 |
| July 11–September 21, 1987 | 3,972,320 |
| September 4–October 16, 1988 | 3,002,319 |
| April 5–July 20, 1991 | 5,251,477 |
| August 22–October 21, 1991 | 5,566,950 |
| September 11–November 7, 1992 | 2,363,981 |
| December 10, 1993–January 10, 1994 | 1,911,311 |
| August 12–September 12, 1994 | 1,337,096 |
| September 1 –October 30, 1994 | 2,899,203 |
| January 23–April 26, 1996 | 3,723,835 |
| March 12–September 25, 1997 | 4,742,465 |
| August 13–October 7, 1998 | 4,398,064 |
| January 11–May 2, 2000 | 4,782,702 |
| May 12–June 18, 2001 | 4,063,603 |
| July 27 –August 13, 2002 | 2,877,918 |
| August 6–September 27, 2003 | 3,544,956 |
| December 17, 2004–January 8, 2005 | 2,922,465 |
| July 28–August 26, 2006 | 1,524,203 |
| December 28, 2007–April 24, 2008 | 2,646,462 |
| 2009 | Maintenance Dredging-Ongoing |
| Total | 83,887,132 |
| Average | 3,355,485 |

The material is dredged from the SNWW: Sabine Bank, Sabine Pass Outer Bar, and Sabine Pass Jetty channels, and transported to the ODMDS by hopper dredge or scow. The dredge, either a conventional bottom-opening hopper or a split-hulled hopper, travels from the dredging site with its doors closed. Upon reaching the designated ODMDS, the hoppers are opened and the material is released as the dredge travels through the site. The hoppers are closed before the dredge leaves the site. The disposal operations occur 24 hours a day, 7 days a week until the dredging is completed. Historically, dredged material release points were not specified; however, a 500-foot-wide no-discharge zone immediately inside the boundaries of each ODMDS was observed to prevent short-term transport of the material out of the sites.

### D. Proposed ODMDSs

The proposed ODMDSs have not previously received any dredged material from the existing SNWW project.

## VI. QUANTITY OF MATERIAL AND LEVEL OF CONTAMINATION

### A. Summary of Information Used to Determine Size of the Site

Historically, the dredging frequency for this navigation project ranges from 1 year for the Outer Bar Channel to 5 years for the Jetty Channel, with an average of about 3,355,485 cubic yards (cy) of material excavated per dredging contract. The excavated channel sediments can be characterized as clayey-sandy-silts. Average particle-size distributions are described in Table 2.

TABLE 2

EXCAVATED CHANNEL SEDIMENT AVERAGE PARTICLE-SIZE DISTRIBUTION

| Location | % Sand | % Silt | % Clay |
|---|---|---|---|
| Channel | 14.6 | 45.8 | 39.6 |
| ODMDS No. 1 | 95.3 | 2.3 | 2.4 |
| ODMDS No. 2 | 60.0 | 24.3 | 15.8 |
| ODMDS No. 3 | 49.4 | 28.6 | 22.1 |
| ODMDS No. 4 | 9.1 | 45.8 | 45.1 |
| Reference Area 1 and 2 | 48.8 | 35.4 | 15.9 |
| Reference Area 3 and 4 | 49.1 | 33.5 | 17.4 |

As described in the site designation EIS, the existing interim designated ODMDSs were evaluated as an alternative for final designation, as were other mid-shelf and deepwater areas. Although no specific analyses were conducted to determine optimal size for each placement area, the existing sites were determined to be the preferred alternative for final designation. However, the sizes of the sites have been re-examined by the use of the MDFATE model from USACE Engineering Research and Design Center (ERDC) (PBS&J, 2009) to ensure the sites were large enough to handle the expected maintenance material from the SNWW Channel Improvement Project (CIP). Primary considerations in EPA (1983) for selecting these sites were as follows:

1. Benthic sampling data indicated that despite more than 20 years of disposal, no significant changes had occurred in the faunal communities as a result of disposal operations, and that future changes in the benthic community were not anticipated to occur from continued disposal into these sites.
2. The sites are situated in a high-energy erosional zone and can generally accept large volumes of dredged material with little apparent net change to the bottom.
3. The sites are within the inlet zone and are adjacent to the channel, providing easy access for dredged material placement operations and reduce costs.
4. Studies have shown that there are no unique fisheries in the area.
5. Regulations require that, wherever feasible, historically used sites be designated.

The irregular shapes of the areas are a result of their locations. ODMDS No. 1 is situated adjacent to the safety fairway and Sabine Bank, whereas ODMDS No. 2 is located between the intersection of two safety fairways, and Sabine Bank. Similarly, ODMDS No. 3 is located at the intersection of two safety fairways.

### B. Summary of Testing Requirements per Regional Implementation Agreement and Summary of Past Dredged Material Evaluations

On September 24, 1992, a Regional Implementation Agreement (RIA) was executed between EPA Region 6, and SWG. The RIA was revised and updated, and a new RIA issued November 3, 2003. This RIA described protocols for evaluating the quality of the dredged material and implementation of the *Green Book* (EPA/USACE, 1991). These protocols describe chemical parameters to be analyzed, as well as required detection limits. It also specifies how toxicity testing and bioaccumulation assessments are to be conducted, as well as organisms to be utilized. Since that time, all sediment evaluations have been conducted in accordance with the RIA. Since the mid-1970s before development of the RIA, dredged material from the SNWW had been evaluated numerous times to determine suitability for offshore placement. This testing was performed to determine levels of metals and organic constituents, as well as toxicity and bioaccumulation assessments. Testing performed for this project is summarized in Table 3. The testing indicated that the material was suitable for offshore placement without special management conditions.

## VII. ANTICIPATED SITE USE

As previously discussed, the dredging frequency for this project ranges from 1 to 5 years with an average of approximately 3,355,000 cy of material excavated per dredging contract. It is anticipated that, with the SNWW CIP, the existing maintenance ODMDSs would receive a total of 10.5 million cubic yards (mcy) of dredged material per maintenance cycle, and the proposed channel extension ODMDSs would receive a total of 3.0 mcy of dredged material per maintenance cycle. Presently, the ODMDSs are coordinated to receive dredged material from the federally maintained SNWW CIP. Material from other sources is not presently placed at these sites, and none is expected in the foreseeable future, except the construction material from the SNWW CIP.

TABLE 3

DREDGED MATERIALS TIMETABLE

| Date | Type of Testing |
|---|---|
| February 22 and March 1, 1977 | Pre-dredging Bulk Analyses |
| June 1978 | Toxicity and Bioaccumulation Assessment |
| October 1978 | Toxicity and Bioaccumulation Assessment |
| September 1979 | Toxicity and Bioaccumulation Assessment |
| December 1, 1981 | Pre-dredging Bulk Analyses |
| November 30, 1982 | Pre-dredging Bulk Analyses |
| November 1983 | Toxicity and Bioaccumulation Assessment |
| December 1983 | Toxicity and Bioaccumulation Assessment |
| May 14, 1984 | Pre-dredging Bulk Analyses |
| February 24, 1986 | Pre-dredging Bulk Analyses |
| January 29, 1987 | Pre-dredging Bulk Analyses |
| May 22, 1992 | Pre-dredging Bulk Analyses |
| November 1993 | Toxicity and Bioaccumulation Assessment |
| December 8, 1993 | Pre-dredging Bulk Analyses |
| November 16, 1995 | Pre-dredging Bulk Analyses |
| February 4, 1998 | Pre-dredging Bulk Analyses |
| June 10, 1999 | Toxicity and Bioaccumulation Assessment |
| July 12, 2004 | Toxicity and Bioaccumulation Assessment |

Currently, no beneficial use of the material dredged from the offshore segments of the SNWW is practiced. It is the policy of the USACE-SWG to implement beneficial uses of dredged material, wherever practicable. However, beneficial uses of the material from this project have not yet been identified.

## VIII. SPECIAL MANAGEMENT CONDITIONS OR PRACTICES

Currently, no special management conditions or practices related to placement of dredged material into the designated ODMDSs have been required. As previously discussed, evaluations of sediment quality have indicated that the material from the channel is suitable for offshore placement without such requirements. However, all operations shall be conducted such that the dredged material remains within the bounds of the ODMDS immediately following descent to the ocean floor.

A seasonal restriction has been recommended by the National Marine Fisheries Service (NMFS), during formal consultation undertaken pursuant to the Endangered Species Act (NMFS, 2007). This restriction was based on potential impacts of hopper dredging operations on several species of threatened and endangered sea turtles. The recommendation is to restrict hopper dredging to the period from December 1 through March 31, during which turtle abundance is at a minimum. This recommendation pertains, however, only to actual dredging operations, and not placement of the material into the ODMDSs. While it may not be practical to observe this restriction for all dredging cycles, it will be practiced when feasible.

# IX. MONITORING PROGRAM

The primary purpose of the Site Monitoring Program is to evaluate the impact of the placement of dredged material on the marine environment. The evaluations will be used for making decisions, preventing unacceptable adverse effects beyond the site boundary, and ensuring regulatory compliance over the life of the ODMDS. Emphasis will be placed on determining physical impacts since, to date, dredged material from the SNWW has been determined to be acceptable for ocean placement without special conditions; however, consideration of contaminants will also be included. Testing of dredged material is conducted based on *Green Book* and RIA procedures; however, it is necessary to verify that the decisions made regarding the suitability of the dredged material are correct and that the material is not having an adverse impact to the environment. In the event that the material persists in the ODMDS, there may be potential for long-term contaminant effects on the benthos.

The size and location of the SNWW ODMDSs were determined pursuant to the General Criteria as listed in 40 CFR 228.5 and the Specific Criteria at 40 CFR 228.6(a). There are no significant environmental resources delineated within or immediately outside of the designated ODMDSs. Since these sites are dispersive in nature, the primary concern of the use of the sites is the potential short-term build-up of dredged material, such that a hazard to navigation is presented. Another concern is whether there is significant short-term movement of the dredged material beyond the ODMDS boundaries; specifically, the benthic community can be impacted if significant rapid movement of material off the sites occurs, resulting in burial of benthic populations outside the sites. Studies have shown that benthic organisms can burrow through 6 to 9 inches of dredged material without significant impacts on the community (EPA/USACE, 1996).

The Site Monitoring Program is designed as a tiered program. If initial tier results fail predetermined limits, then a more complex set of tests is invoked at the next tier to determine the extent of impact. The tiers are used to facilitate rapid, accurate, and economical collection of information for use by the EPA Region 6, and the USACE-SWG. The tiered testing for these factors is described below.

## A. Construction Material

While the literature on maintenance material disposal on the Gulf Coast indicates only minor short-term and negligible long-term mounding from placement activities, little information is available for virgin material ODMDSs. Mounding from the construction material, while acceptable, is higher and of firmer material than is true for the maintenance material. Additionally, construction placement is expected to last for only a period of 2 years or less, and more-frequent monitoring would be expected than would be necessary for the periodic but short-term placement that occurs with maintenance dredging. The following monitoring and surveillance program is proposed for the SNWW CIP ODMDSs during construction. The monitoring is discussed in detail below. ODMDS 1 and ODMDS C are the existing and proposed ODMDSs, respectively, expected to receive the most construction material and are selected as worst cases for the monitoring described below.

A major consideration in the acceptability of the size of the ODMDSs was the location of the dredge when each discharge occurs. To prevent excessive mounding, it is necessary that a method be utilized to record the location of each discharge to ensure that the dredge distributes material uniformly over the ODMDS, while it avoids approaching the edges of the ODMDS too closely. The following is the scheme used in the modeling to avoid excessive mounding and dispersal of material outside the ODMDS: two discharges at all exterior placement points (one should a larger dredge be used), followed by one discharge at each of the interior placement points in a given sequence until each has been utilized (figures 2a and 2b, ODMDS C and ODMDS 1, respectively). Continue repeating the sequence with one discharge at each interior placement point until construction is complete.

### Tier CI

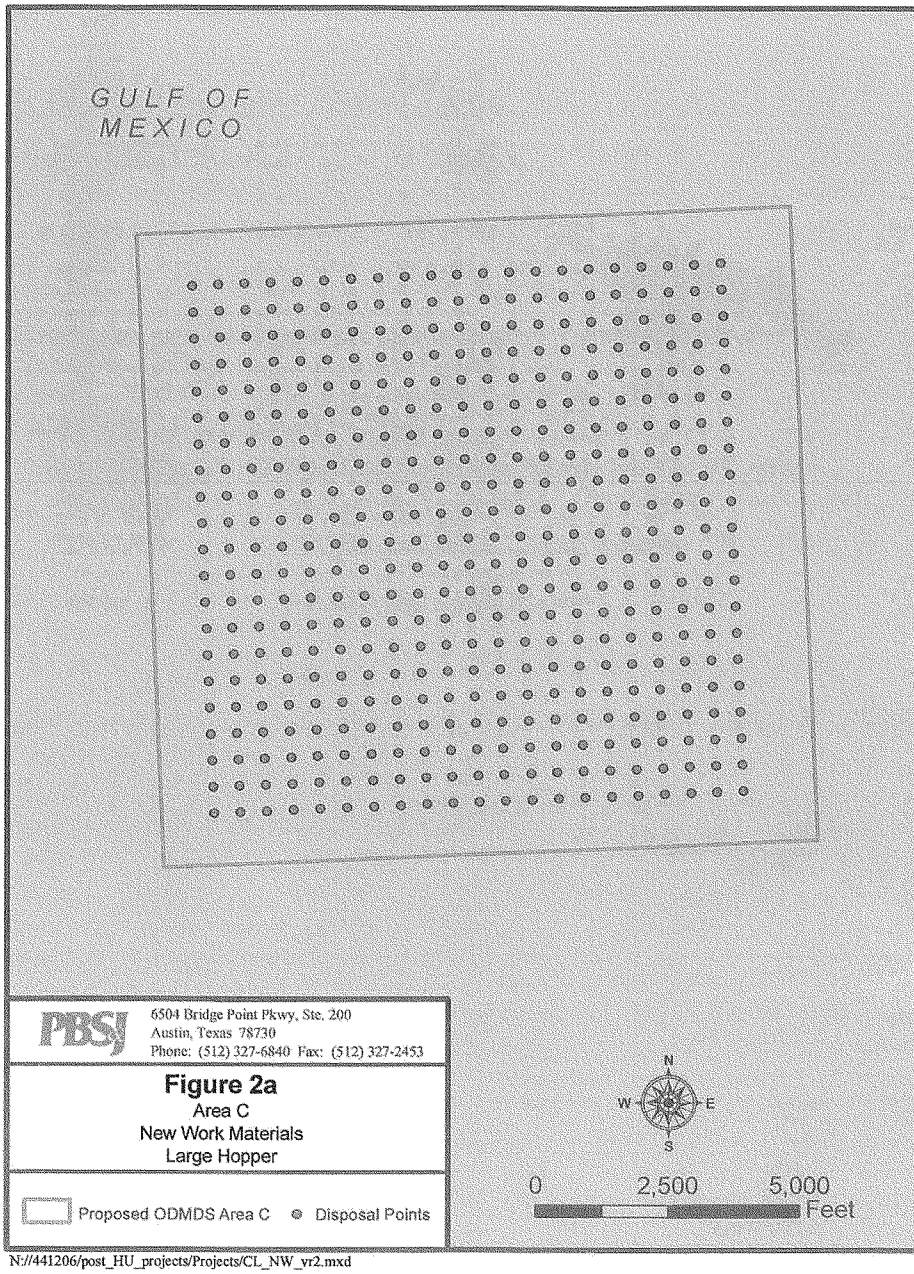
*Bathymetric Surveys*

Routine bathymetric scans shall be conducted for the ODMDSs to determine that there is no excessive mounding, e.g., to elevations greater than 10 feet above the existing bottom elevation (unless an alternate height is determined in agreement between the EPA and USACE on a case-by-case basis), and that there is no short-term transport of material beyond the limits of the ODMDS. Therefore, an accumulation of 1 foot of sedimentation along the ODMDS boundary will be considered the threshold level for movement of material outside of the designated ODMDSs. These determinations will be based on a comparison of the results with predisposal surveys.

Bathymetric surveys shall be obtained before the start of disposal operations and monthly thereafter until operations are complete. Additional surveys shall then be performed after 6 months and 1 year.

Hydrographic surveys shall be conducted along transects within the ODMDSs. These transects shall be oriented perpendicular to the channel in the direction of sediment transport (i.e., southwest). Transect intervals shall be every 1,000 feet extending 1,000 feet outside each boundary. In addition, a depth profile shall be obtained along the boundary.

Surveys shall be obtained using a USACE or contract survey vessel equipped with electronic surveying capabilities. The vessel must be equipped with positioning equipment with a horizontal precision of 1 foot. The fathometer, which shall display real-time depth on real-time location, must have a precision of 0.5 foot. All data shall be collected using methodology described in Engineer Manual (EM) 1110-2-1003, dated January 1, 2002.

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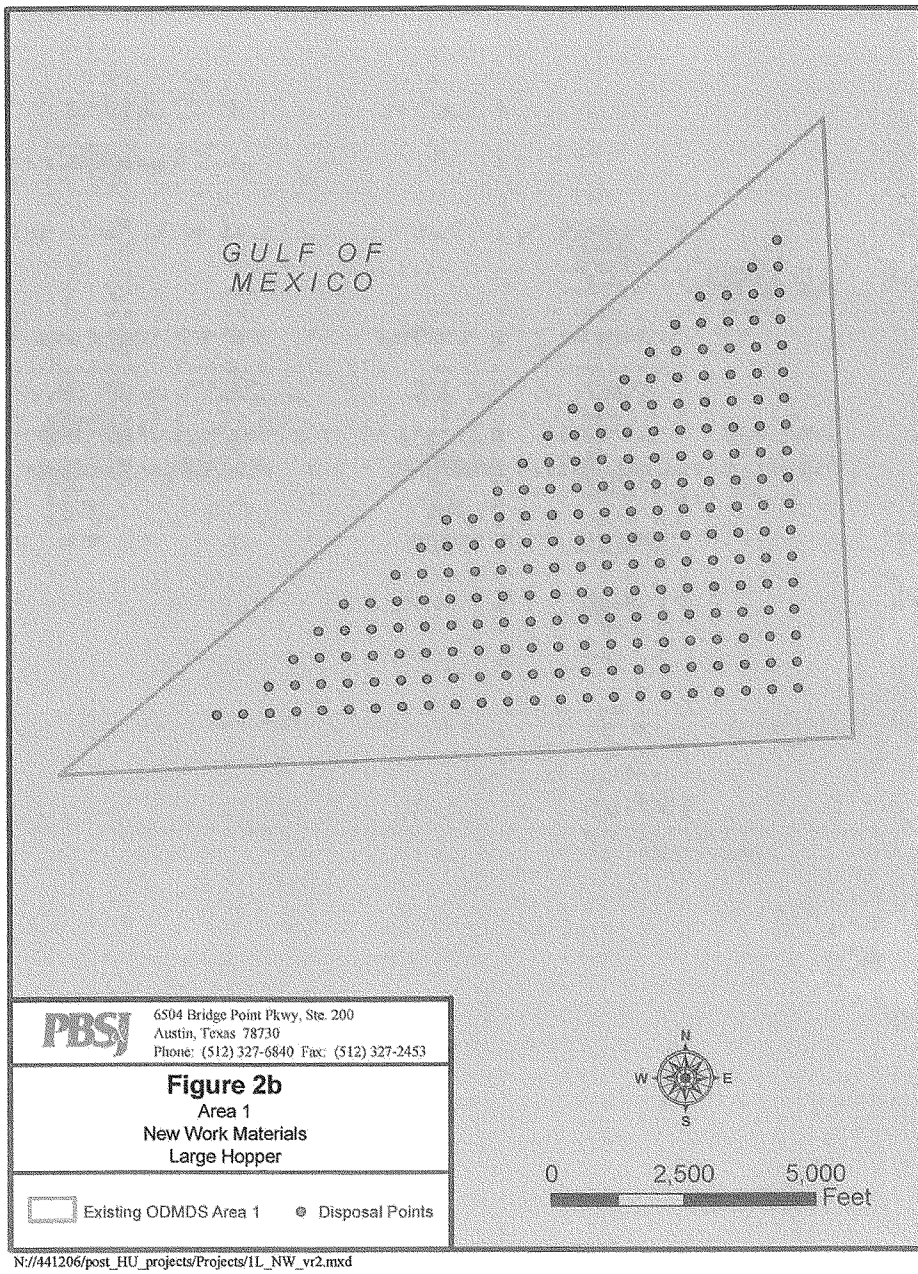


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*Data Analysis*

If the surveys indicate deposited dredged material is not mounding to elevations greater than the threshold elevation above the existing bottom elevation, and there is no short-term movement of material beyond the limits of the ODMDS, then the management objectives are being met. Further monitoring shall be conducted as scheduled.

If the monthly surveys indicate movement of material outside of the designated limits, then the disposal operation will be reviewed to determine whether the disposal sequence is being properly followed. The disposal sequence shall be adjusted as necessary to compensate for the movement.

If the after-disposal surveys indicate mounding to elevations greater than the threshold elevation and/or movement of material out of the ODMDS has occurred, then the monitoring program shall proceed to Tier C2.

*Sediment Chemistry*

Monitoring stations, which consist of a control station, stations located immediately outside the ODMDS, and stations located some distance downcurrent from the site should be sampled for the items noted in the following paragraph to determine whether impacts are occurring outside of the ODMDS. Monitoring stations will entail two stations on each side of the ODMDS, roughly 300 feet from the ODMDS edges, a control site located upcurrent of the ODMDS, and two stations located 10,000 feet downcurrent (southwest) of the downcurrent edge of the ODMDS. This program is duplicated for ODMDS 1 and C (Figure 3). One additional monitoring site is added on the northwest side of ODMDS 1 to accommodate the irregular shape. Substrate elevation should also be determined at each sampling station during each sampling event.

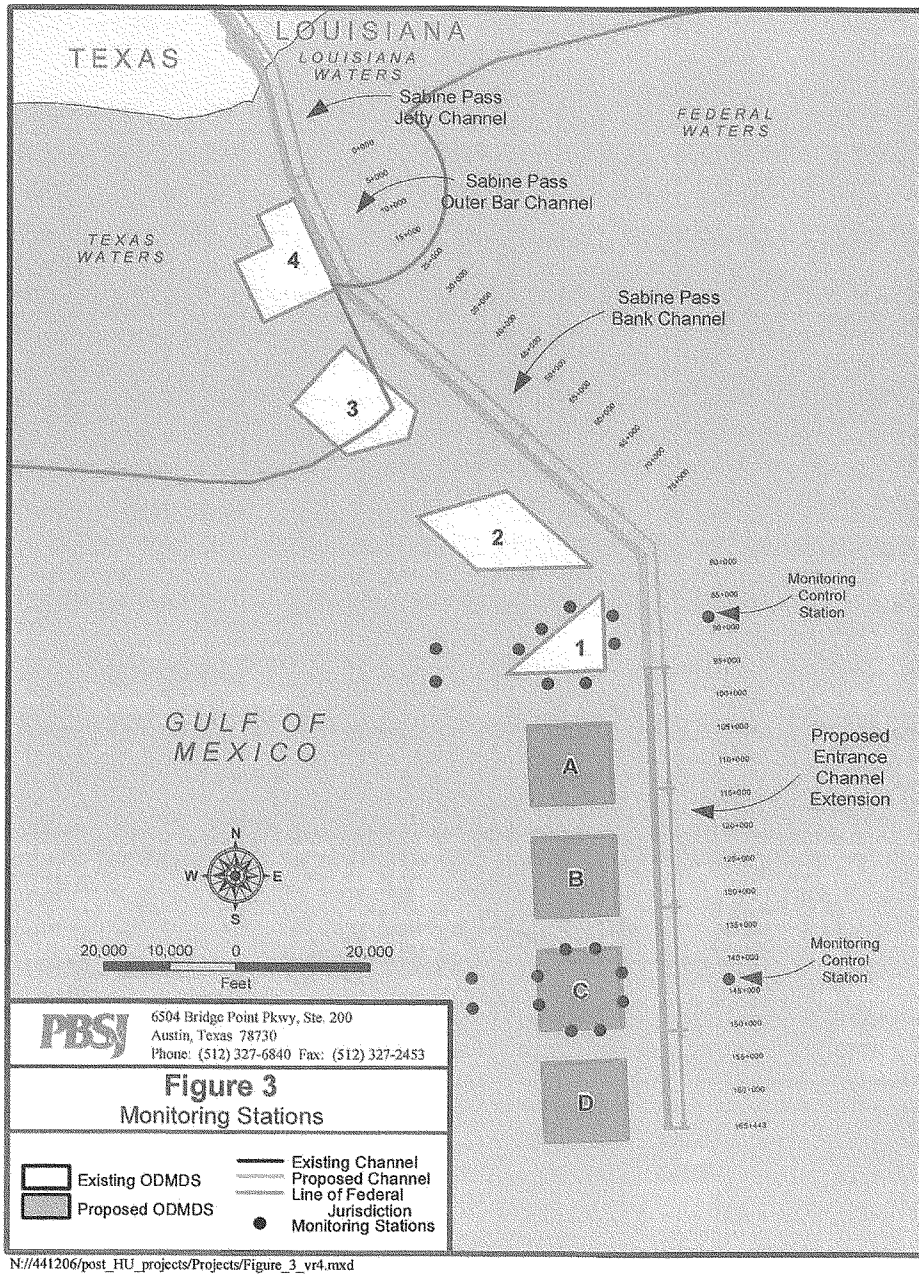
These stations shall be sampled before and at the completion of disposal operations. Postdisposal sampling shall occur 6 months and 1 year after the cessation of discharge of virgin material at the site. Samples shall be collected for (1) grain-size analysis, and (2) chemical characterization of sediments.

*Data Analysis*

If contaminant concentrations are not significantly different from before-disposal data, then the management objectives are being met. Further monitoring shall be conducted as scheduled.

- If significant increases in levels of contaminants are observed but bathymetric monitoring indicates that there is no short-term transport of material beyond the limits of the ODMDS, as determined in Bathymetric Surveys Tier C1, then this is an indication that the increase is not a result of dredged material placement. Further monitoring shall be conducted as scheduled.

  If significant increases in levels of contaminants are observed and bathymetric monitoring indicates that there is short-term transport of material beyond the limits of the ODMDS, as determined in Bathymetric Surveys Tier C1, then a determination will be made whether a

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bioassay/bioaccumulation study is warranted to determine effects to the benthic community. The studies are described below as Biological Testing under Tier C2.

*Benthos*

Monitoring stations, which consist of a control station, stations located immediately outside the ODMDS, and stations located some distance downcurrent from the site should be sampled for the items noted in the following paragraph to determine whether impacts are occurring outside of the ODMDS. Monitoring stations will entail two stations on each side of the ODMDS, roughly 300 feet from the ODMDS edges (stations B1 through B8), a control site located upcurrent of the ODMDS, and two stations located 10,000 feet downcurrent (southwest) of the downcurrent edge of the ODMDS. These should be the same stations used for sediment chemistry (see Figure 3). Substrate elevation should also be determined at each sampling station during each sampling event.

These stations shall be sampled before and at the completion of disposal operations. Postdisposal sampling shall occur 6 months and 1 year after the cessation of discharge of virgin material at the site. Samples shall be collected for macrobenthic invertebrates (in triplicate). Macrobenthic community structure during each sampling event shall be compared to the control sample to eliminate effects of potential seasonal variation. Significant changes are defined as statistically significant differences in community structure or population density.

*Data Analysis*

If macrobenthic community structure is not significantly different than the control, then the management objectives are being met. Further monitoring shall be conducted as scheduled.

If significant changes are observed, then further analysis shall be conducted under Tier C2.

**Tier C2**

*Bathymetric Surveys*

If deposited dredged material mounds to elevations above the threshold value, then monitoring shall continue as scheduled and could possibly be extended. A Notice to Mariners shall be posted as appropriate.

If transport of material from the site is occurring, hydrographic surveys shall be expanded to include the impacted areas to determine the changes in dispersion of the material. An accumulation of more than 1 foot of sedimentation along the ODMDS boundary will be considered the threshold level for significant movement of material outside of the designated ODMDS.

*Data Analysis*

**During Dredging:**

If deposited dredged material is mounding to elevations above the threshold value but less than 15 feet above the existing bottom elevation, and there is no significant short-term transport of material beyond the limits of the ODMDS, then monitoring shall continue as scheduled. A Notice to Mariners shall be issued as appropriate.

If deposited dredged material is mounding to elevations greater than 15 feet above the existing bottom elevation, and there is no significant short-term transport of material beyond the limits of the ODMDS, then bathymetric monitoring shall continue as scheduled. A Notice to Mariners shall be posted as appropriate. If mounding is considered to be excessive, alterations to the placement operations may be warranted.

If significant movement of material out of the ODMDS is occurring, bathymetric monitoring shall be expanded to include the impacted areas to determine the changes in dispersion of the material. Following completion of disposal operations, surveys shall continue on a quarterly basis for 1 year or until agreement is reached between the EPA and USACE-SWG to discontinue monitoring. Findings shall be documented for future reference.

**After Dredging:**

If deposited dredged material has mounded to elevations above the threshold value but less than 15 feet above the existing bottom elevation, and there is no significant short-term transport of material beyond the limits of the ODMDS, then bathymetric monitoring shall continue at predetermined 6-month intervals for 1 year or until agreement is reached between the EPA and USACE-SWG to discontinue monitoring. Findings shall be documented for future reference, and a Notice to Mariners shall be issued as appropriate.

If deposited dredged material is mounding to elevations greater than 15 feet above the existing bottom elevation, and there is no significant short-term transport of material beyond the limits of the ODMDS, then bathymetric monitoring shall continue at predetermined 6-month intervals for 1 year or until agreement is reached between the EPA and USACE-SWG to discontinue monitoring. Findings shall be documented for future reference, and a Notice to Mariners shall be issued as appropriate.

If significant movement of material out of the ODMDS has occurred, bathymetric monitoring shall be expanded to include the impacted areas to determine the changes in dispersion of the material and shall continue on a quarterly basis for a 1-year period or until agreement is reached between the EPA and USACE-SWG to discontinue monitoring. Findings shall be documented for future reference.

*Sediment Chemistry*

If the results of the Tier C1 sediment chemistry evaluation suggest the need for additional testing, then solid-phase bioassay and bioaccumulation testing shall be conducted in accordance with the procedures described in the RIA. If the sediment can be attributable to recent dredging, funding for testing under this Tier will be provided by USACE-SWG or the Permittee, as appropriate; otherwise funding will be provided by EPA, Region 6. Any such testing is contingent on availability of appropriated funds.

*Data Analysis*

If significant toxicity is not found, testing shall continue as described in Tier C1. However, subsequent sampling shall continue on a quarterly basis for the 1-year period following completion of disposal operations or until agreement is reached between the EPA and USACE-SWG to discontinue monitoring. Findings shall be documented for future reference.

If significant toxicity is found, the USACE-SWG together with EPA Region 6 will consider various management options to rectify the situation. Because the ODMDS is a dispersive site, potential sources of toxicity other than dredged material must also be considered. A decision must also be made whether to allow continued use of this site. Findings shall be documented for future reference.

*Benthos*

A significant change in community structure or population density may be an indication that the substrate has changed. This could be a result of natural redistribution of sediments or the dredged material may be moving beyond the ODMDS at a faster rate than anticipated. A change in community structure could also indicate that toxicity has occurred. Monitoring the macrobenthic community shall continue on a quarterly basis until 1 year following completion of discharge operations has elapsed or until agreement is reached between the EPA and USACE-SWG to discontinue monitoring.

*Data Analysis*

If significant changes are observed but bathymetric monitoring indicates that there is no short-term transport of material beyond the limits of the ODMDS, as determined in Bathymetric Surveys Tier C1, then this is an indication that the changes are not a result of dredged material placement. Further monitoring shall be conducted as scheduled.

If significant changes are observed and bathymetric monitoring indicates that there is short-term transport of material beyond the limits of the ODMDS, as determined in Bathymetric Surveys Tier C1, then this is an indication that the changes may be a result of dredged material placement. Further monitoring shall be conducted as scheduled.

- If significant changes are observed 1 year following completion of disposal operations, then the monitoring shall continue on a quarterly basis for 1 additional year. If significant changes are

observed after the second year, further monitoring plans will be developed based on the degree of impact.

If significant changes are observed and there is an indication that the sediments are toxic, as determined in Sediment Chemistry Tier C2, then this is an indication that the changes may be a result of dredged material placement. Further monitoring shall be conducted as scheduled.

- If significant changes are observed 1 year following completion of disposal operations, then the monitoring shall continue on a quarterly basis for 1 additional year. If significant changes are observed after the second year, further monitoring plans will be developed based on the degree of impact.

## B. Maintenance Material

### Tier MI

Physical and chemical evaluations of the ODMDS material shall be conducted to characterize possible effects from the placement of dredged material occurring at the site(s). Physical analyses of the sediment can assist in assessing the impact of disposal practices on the benthic environment at the disposal site and determine if dredged material is migrating offsite. Chemical analyses of the sediment shall be conducted to establish whether contaminants of concern are suspected to be affecting the benthic environment at the disposal site(s).

*Bathymetric Surveys*

The ODMDSs are located outside of the safety fairway for large vessel traffic; therefore, the mounding will be considered in regard to shallow-draft vessels only. Considering the grain-size characteristics of typical maintenance dredged material from this channel, significant mounding is not expected subsequent to discharge operations. The threshold elevation for mounding of dredged material within the ODMDS will be 10 feet, or other mutually agreed-upon elevation, above the existing bottom elevation.

Since the sites are dispersive, movement of material from the sites is expected to occur after disposal operations cease. In order to detect if short-term movement of the material out of the designated ODMDS is occurring at a significant rate, hydrographic surveys of the ODMDS shall be obtained before the start of disposal operations and soon after completion of disposal operations. An accumulation of 1 foot of sedimentation along the ODMDS boundary will be considered the threshold level for movement of material outside of the designated ODMDS. This determination shall be based on a comparison of the results of these before and after surveys.

Hydrographic surveys shall be conducted along transects within the ODMDS. These transects shall be oriented perpendicular to the channel in the direction of sediment transport (i.e., southwest). Transect intervals shall be every 1,000 feet extending 1,000 feet outside each boundary. In addition a depth profile shall be obtained along the boundary.

Surveys shall be obtained using a USACE or contract survey vessel equipped with electronic surveying capabilities. The vessel must be equipped with positioning equipment with a horizontal precision of 1 foot. The fathometer, which shall display real-time depth on real-time location, must have a precision of 0.5 foot. All data shall be collected using methodology described in EM 1110-2-1003, dated January 1, 2002.

*Data Analysis*

If deposited dredged material is not mounding to elevations greater than the threshold elevation above the existing bottom elevation, and there is no short-term movement of material beyond the limits of the ODMDS, then the management objectives are met. No further postdisposal monitoring will be required.

If mounding to elevations greater than the threshold elevation and/or movement of material out of the ODMDS has occurred, as determined by the postdredging survey, then the monitoring program shall proceed to Tier M2.

*Sediment Chemistry*

Sediment chemistry analyses shall be conducted in conjunction with the dredged material evaluations from samples collected in the navigation channel. Collecting samples from both the navigation channel and ODMDS during the same sampling event has been determined to be the most efficient use of resources. Because most ODMDSs lie directly adjacent to the navigation channels, there are relatively short distances between the two areas. As described in the RIA, sediment testing in the navigation channels generally occurs on a 5-year cycle. Sediment chemistry results from the ODMDSs should be compared to the results collected from the navigation channel. Significantly elevated sediment concentrations are defined as concentrations above the range of contaminant levels in dredged sediments that the Regional Administrator and the District Engineer found to be suitable for disposal at the ODMDS.

*Data Analysis*

If contaminant concentrations are not significantly different than navigation channel concentrations, then no further testing is needed.

If significant increases in levels of contaminants are observed at the ODMDS, then a determination will be made whether a bioassay/bioaccumulation study is warranted to determine effects to the benthic community. The studies are described below as Biological Testing under Tier M2.

**Tier M2**

*Bathymetric Surveys*

If transport of material from the sites is occurring, hydrographic surveys shall be expanded to include the impacted areas and shall be performed on a semiannual basis to determine the changes in dispersion of the material until the impacts are no longer observed. An accumulation of more than 1 foot of sedimentation along the ODMDS boundary will be considered the threshold level for significant movement of material outside of the designated ODMDS.

*Data Analysis*

If deposited dredged material is mounding to elevations above the threshold value, but less than 15 feet above the existing bottom elevation, and there is no significant short-term transport of material beyond the limits of the ODMDS, then semiannual postdisposal monitoring shall occur as described.

If at 6 months after disposal, deposited dredged material remains mounded to elevations greater than half the postdisposal elevations, then bathymetric surveys shall be continued.

If deposited dredged material is mounding to elevations greater than 15 feet and/or significant movement of material out of the ODMDS has occurred, the Galveston District, together with EPA Region 6, will consider various management options to rectify the situation. Such options could include, but are not limited to, expansion of the ODMDS or relocation of the ODMDS within the zone of siting feasibility described in the designation EIS.

*Biological Testing*

If the results of the Tier M1 sediment chemistry evaluation suggest the need for additional testing, then solid-phase bioassay and bioaccumulation testing shall be conducted in accordance with the procedures described in the RIA. If the sediment can be attributable to recent dredging, funding for testing under this Tier will be provided by USACE-SWG or the permittee, as appropriate; otherwise funding will be provided by EPA, Region 6. Any such testing is contingent on availability of appropriated funds.

*Data Analysis*

If toxicity is not indicated, then no further testing is needed, and disposal activities can continue at the ODMDS.

If toxicity is indicated at the ODMDS, the Galveston District, together with EPA Region 6, will consider various management options to rectify the situation. Because the ODMDS is a dispersive site, potential sources of toxicity other than dredged material must also be considered. If planned use of the ODMDS is imminent, a decision must also be made whether to allow continued use of this site.

## X. SITE MANAGEMENT PLAN REVIEW AND REVISION

Pursuant to Section 102(c) of the MPRSA, as amended by WRDA 92, the Site Management Plan for the SNWW ODMDSs will be reviewed and revised, if necessary, not less frequently than 10 years after adoption and every 10 years, thereafter.

Modifications or updates to the Site Management Plan may be necessary, based on specific needs identified for specific authorized projects. Modifications or updates to the Site Management Plan may be proposed by the USACE-SWG or EPA Region 6. Following a 30-day review period of the changes(s), the modifications may be incorporated into the plan by mutual consent of both agencies.

## XI. REFERENCES

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This Site Management and Monitoring Plan complies with Section 102(c)(3) of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 USC Sections 1401, et seq.) as amended by Section 506 of the Water Resources Development Act of 1992 (WRDA 92; Public Law 102-580) and has been approved by the following officials of Region 6 of the U.S. Environmental Protection Agency, and Galveston District of the U.S. Army Corps of Engineers. This plan goes into effect upon the date of the last signature:

Al Armendariz
Regional Administrator
Region 6
U.S. Environmental Protection Agency

5/7/10
Date

David C. Weston
Colonel, Corps of Engineers
District Engineer
Galveston District
U.S. Army Corps of Engineers

29 APRIL 2010
Date

1992

# FINAL ENVIRONMENTAL IMPACT STATEMENT FOR SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

## VOLUME IV: APPENDICES C–K

COOPERATING AGENCIES:

U.S. ENVIRONMENTAL PROTECTION AGENCY
U.S. DEPARTMENT OF THE INTERIOR – FISH AND WILDLIFE SERVICE
U.S. DEPARTMENT OF COMMERCE – NATIONAL MARINE FISHERIES SERVICE
TEXAS GENERAL LAND OFFICE
LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

March 2011

**Appendices**

**VOLUME IV**

C Wetlands Value Assessment Ecological Modeling Report
D Dredged Material Management Plan
E Clean Water Act Section 404(b)(1) Evaluation
F Final General Conformity Determination
G Biological Assessment and Biological Opinion
G1 Biological Assessment
G2 Biological Opinion
H Historic Properties Programmatic Agreement
I Compliance with the Texas and Louisiana Coastal Management Programs
I1 Compliance with Texas Coastal Management Program
I2 Compliance with Louisiana Coastal Management Program
J SNWW CIP Mitigation/Beneficial Use Monitoring Plan
K Public Meeting Transcripts

1994

# Appendix C

# Wetlands Value Assessment Ecological Modeling Report

1995

# APPENDIX C

# ECOLOGICAL MODELING REPORT
# SABINE-NECHES WATERWAY,
# TEXAS AND LOUISIANA
# CHANNEL IMPROVEMENT PROJECT

Prepared by:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

September 2010

1996

# Appendix C
# Ecological Modeling Report
# Sabine-Neches Waterway, Texas and Louisiana
# Channel Improvement Project

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## LIST OF ACRONYMS

| | |
|---|---|
| °F | degrees Fahrenheit |
| 3-D | three dimensional |
| AAHU | Average Annualized Habitat Units |
| ATR | agency technical review |
| BEG | Bureau of Economic Geology |
| BHM | Bottomland Hardwoods Model |
| BU | beneficial use |
| CAIP | Center for Aquatic and Invasive Plants |
| CAP | Continuing Authorities Project |
| CE/ICA | Cost Effectiveness/Incremental Cost Analysis |
| CEPRA | Coastal Erosion Planning and Response Act |
| CHL | Coastal Hydraulics Laboratory |
| CWPPRA | Coastal Wetlands Planning, Protection, and Restoration Act |
| cy | cubic yards |
| CZMA | Coastal Zone Management Act |
| CZMP | Coastal Zone Management Plan |
| dbh | diameter at breast height |
| DMMP | Dredged Material Management Plan |
| DOWSMM | desk-top off-channel wetlands salinity mitigation model |
| EMCM | Emergent Mash Community Model |
| EnvWG | Environmental Work Group |
| EPA | U.S. Environmental Protection Agency |
| ERDC | Engineer Research and Design Center |
| FEIS | Final Environmental Impact Statement |
| FEMA | Federal Emergency Management Agency |
| FFR | Final Feasibility Report |
| FNAEC | Flora of North America Editorial Committee |
| FWOP | future without-project |
| FWP | future with-project |
| GEC | Gulf Engineers and Consultants, Inc. |
| GIS | geographic information system |
| GIWW | Gulf Intracoastal Waterway |
| GLO | General Land Office |
| GPS | Global Positioning System |
| HEP | Habitat Evaluation Procedures |
| HQUSACE | Headquarters, U.S. Army Corps of Engineers |
| HS | hydrodynamic-salinity |

| | |
|---|---|
| HSI | Habitat Suitability Index |
| ICT | Interagency Coordination Team |
| IEPR | Independent External Peer Review |
| IH | Interstate Highway |
| IPCC | Intergovernmental Panel on Climate Change |
| LBG | Louis Berger Group |
| LCWCR/WCRA | Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority |
| LDEQ | Louisiana Department of Environmental Quality |
| LDNR | Louisiana Department of Natural Resources |
| LDWF | Louisiana Department of Wildlife and Fisheries |
| LPP | Locally Preferred Plan |
| LSU | Louisiana State University |
| mcy | million cubic yards |
| MFWP | mitigated future with project |
| MLLW | mean lower low water |
| mm | millimeters |
| NGS | National Geological Survey |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NRC | National Research Council |
| NRCS | Natural Resources Conservation Service |
| NWI | National Wetland Inventory |
| NWR | National Wildlife Refuge |
| NWRC | National Wetlands Research Center |
| O&M | operation and maintenance |
| PA | Placement Area |
| PCX | Planning Center of Expertise |
| PIE | Pacific International Engineering |
| ppt | parts per thousand |
| RSL | relative sea level |
| RSLR | relative sea-level rise |
| SAV | submerged aquatic vegetation |
| SCM | Swamp Community Model |
| SI | suitability index |
| SIV | variable suitability indices |
| SNND | Sabine Neches Navigation District |
| SNWW CIP | Sabine-Neches Waterway, Texas and Louisiana Channel Improvement Project |

| | |
|---|---|
| SRA-TX | Sabine River Authority of Texas |
| SWG | Galveston District, U.S. Army Corps of Engineers |
| TCEQ | Texas Commission on Environmental Quality |
| TEA | Toxicological and Environmental Associates |
| TIO | Texas Invasive Org |
| TPWD | Texas Parks and Wildlife Department |
| TWDB | Texas Water Development Board |
| TxDOT | Texas Department of Transportation |
| TY | target year |
| USACE | U.S. Army Corps of Engineers |
| USDC | U.S. Department of Commerce |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| WAM | TCEQ Water Availability Models |
| WC | Wildflower Center |
| WMA | Wildlife Management Area |
| WRDA | Water Resources Development Act |
| WVA | Wetland Value Assessment |

# 1.0 INTRODUCTION

## 1.1 PURPOSE OF ECOLOGICAL MODELING

The U.S. Army Corps of Engineers (USACE), Galveston District, and the Sabine Neches Navigation District (SNND) are conducting a feasibility study and environmental impact assessment of navigation improvements to the Sabine-Neches Waterway, Texas and Louisiana Channel Improvement Project (SNWW CIP). As part of this study, ecological modeling was conducted to evaluate impacts and benefits of navigation features and mitigation measures. A detailed description of the purpose and scope of potential navigation improvements is provided in the Sabine-Neches Waterway Navigation Improvements Final Feasibility Report (FFR) and Final Environmental Impact Statement (FEIS).

## 1.2 STRUCTURE OF REPORT

This report is structured as follows:

- In the remainder of Section 1, the ecological modeling team is described (Section 1.3), protected and sensitive habitats in the study area are summarized (Section 1.4), and environmental issues and concerns identified during the scoping process are discussed (Section 1.6).
- Section 2 presents a description of the ecological modeling process, including a discussion of mitigation planning requirements and study objectives (Section 2.1), the rationale for selection of the Wetland Value Assessment (WVA) models for this study (Section 2.2), an overview description of the WVA models and assumptions (sections 2.3 and 2.4), and more-detailed descriptions of the WVA models: (1) the Emergent Marsh Community Models (Section 2.6); (2) the Swamp Community Model (Section 2.7); and (3) the Bottomland Hardwood Model (Section 2.8).
- Section 3 describes the hydrodynamic-salinity (HS) modeling that was conducted to support the WVA modeling effort. Section 3.1 describes the interagency HS Modeling Workgroup. Section 3.2 provides a summary description of the HS model. Section 3.3 describes relative sea-level rise (RSLR) and freshwater inflow considerations incorporated into the HS model.
- Section 4 describes how data were developed or collected for each variable in the SNWW application of the WVA Emergent Marsh models. For example, in Section 4.1 methods used to prepare the baseline data set for Variable $V_1$ (Percent Emergent Vegetation) are described, and the land change projection methodologies for future without-project (FWOP), future with-project (FWP), and mitigated future-with project (MFWP) conditions are presented. Similarly, methods of data collection and projections are presented for Variables $V_2$ (Percent Submerged Aquatic Vegetation, $V_3$ Marsh Edge and Interspersion), $V_4$ (Percent Open Water 1.5 feet Deep), $V_5$ (Salinity), and $V_6$ (Aquatic Organism Access) in sections 4.2 through 4.6.
- Section 5 describes methods used to develop data for the SNWW application of the Swamp model for variables $V_1$ (Stand Structure), $V_2$ (Stand Maturity), $V_3$ (Water Regime), and $V_4$ (Mean High Salinity) in sections 5.1 through 5.4.
- Section 6 describes methods used to develop data for the SNWW application of the Bottomland Hardwood model for variables $V_1$ (Tree Species Composition), $V_2$ (Stand Maturity), $V_3$

(Understory/Midstory), $V_4$ (Hydrology), $V_5$ (Size of Contiguous Forested Area), $V_6$ (Surrounding Land Uses), and $V_7$ (Disturbance) in sections 6.1 through 6.7.

- Section 7 provides the results of the modeling of FWOP and FWP conditions for each of the hydrologic units (hydro-units) in the study area. Texas hydro-units are described in Section 7.1, Louisiana hydro-units are described in Section 7.2, and hydro-units that cross the Louisiana-Texas state boundary are described in Section 7.3.
- Section 8 presents the results of WVA modeling conducted to evaluate the effectiveness of beneficial use (BU) and mitigation measures. It includes a summary of the preliminary screening and elimination of BU and mitigation measures (sections 8.1 and 8.2). Measures adopted to avoid impacts (Dredged Material Management Plan [DMMP] Features) are described in Section 8.3. Section 8.4 summarizes the feasibility screening of mitigation measures, and Section 8.5 provides the results of the final Cost Effectiveness/Incremental Cost Analysis (CE/ICA) of mitigation measures. Mitigation measures included in the CE/ICA are categorized as marsh restoration and Gulf shore nourishment and individually described in Section 8.5.1. Measures included in the Best Buy mitigation plan, which is recommended for inclusion in the Locally Preferred Plan (LPP), are identified in Section 8.6.
- Section 9 discusses risk and uncertainty in the use of these models to determine the recommended mitigation plan.
- Section 10 is a list of references cited in the report.

## 1.3 MODELING TEAM

An Interagency Coordination Team (ICT) comprised of the following Federal and State resource agency representatives from Louisiana and Texas was established to (1) involve agencies in scoping and identifying environmental issues and concerns; (2) evaluate the significance of fish and wildlife resources and select resources to be evaluated; (3) recommend and review necessary environmental studies; (4) evaluate anticipated impacts; and (5) recommend and evaluate potential mitigation measures.

SNWW ICT Members

U.S. Fish and Wildlife Service (USFWS)
National Marine Fisheries Service (NMFS)
Natural Resources Conservation Service (NRCS)
Environmental Protection Agency (EPA)
Texas General Land Office (GLO)
Texas Commission on Environmental Quality (TCEQ)
Texas Parks and Wildlife Department (TPWD)
Texas Water Development Board (TWDB)
Sabine River Authority of Texas (SRA-TX)
Louisiana Department of Natural Resources (LDNR)
Louisiana Department of Environmental Quality (LDEQ)
Louisiana Department of Wildlife and Fisheries (LDWF)
SNND
USACE, Galveston District

Representatives from other local and State agencies or governments also participated in the ICT in an advisory capacity: Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana.

The SNWW ICT established the Habitat Workgroup to apply the WVA model; representatives from 14 agencies regularly attended and agreed upon data used as inputs for the model. Over 30 ICT and workgroup meetings were conducted from 2001 to 2006, and 1 meeting was held in 2009. USFWS-Louisiana Ecological Services Field Office provided assistance to ensure that WVA methodology (USFWS, 2002a, 2002b, 2002c, 2002d) was followed properly and that WVA model Excel worksheets were being used appropriately. USACE conducted an in-house quality check for worksheet accuracy. In 2009, changes in the proposed project and HS modeling necessitated a revision of the WVA modeling. Due to schedule constraints, USACE performed the modeling without ICT involvement, basing it as closely as possible on methods and assumptions used by the ICT in the original modeling. The results of this remodeling were coordinated with the ICT. A quality check was also performed for the revised worksheets.

## 1.4 DEFINITION OF THE STUDY AREA

The study area was defined by the ICT so as to include all areas that could be affected by potential project impacts in Texas and Louisiana (Figure 1). A brief characterization of habitats in the study is provided in Section 1.6.2. Navigation improvements are being proposed for the existing 64-mile-long deep-draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, the Port Arthur Canal, the Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont. No improvements are proposed for the Channel to Orange portion of the SNWW. Environmental effects have been analyzed for coastal wetlands in the study area, which includes Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River channel up to the new Neches River Saltwater Barrier, the Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and offshore in the Gulf of Mexico to 13 miles beyond the end of the current channel.

USACE evaluation of possible deepening and widening alternatives identified a 48-foot deepening project as the LPP and the Recommended Plan. The LPP, referred to as the SNWW 48-Foot Project, consists of deepening the SNWW to Beaumont to 48 feet and extending the Sabine Bank Channel an additional 13.2 miles into the Gulf of Mexico, tapering the Sabine Bank Channel from 800 feet wide (Station 23+300) to 700 feet wide (Station 25+800) through the end of the Sabine Bank Channel extension, deepening and widening Taylor Bayou channels and turning basins, and constructing new anchorage/ turning basins on the Neches River. In order to quantify baseline and FWOP conditions, project impacts, and mitigation, the ICT applied the WVA model.

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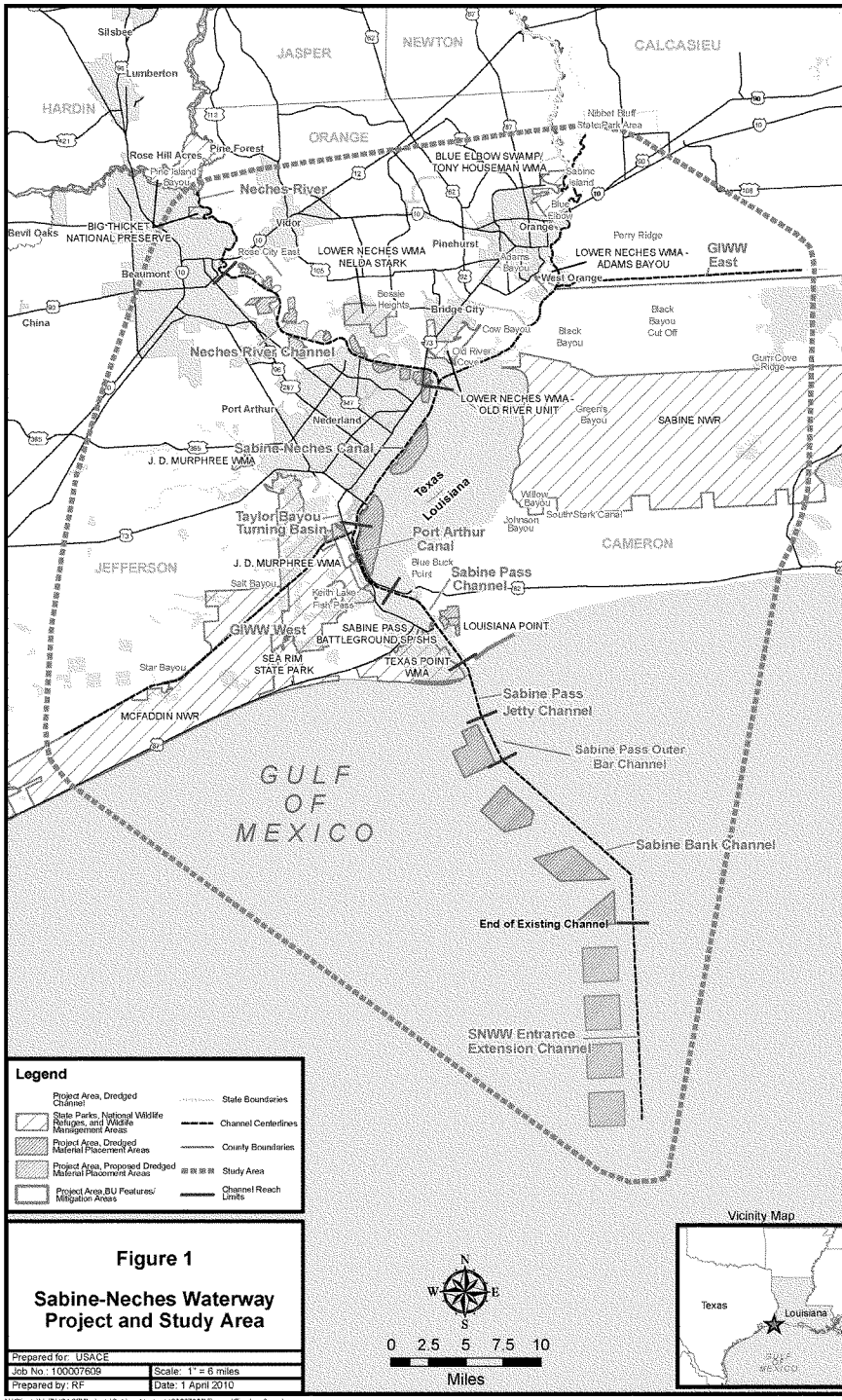


**Figure 1**

**Sabine-Neches Waterway Project and Study Area**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 6 miles |
| Prepared by: RF | Date: 1 April 2010 |

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## 1.5 PROTECTED AND SENSITIVE HABITATS IN THE STUDY AREA

The SNWW study area contains a high concentration of significant coastal wetlands. The ICT identified 108,897 acres (170 square miles) in Texas and 197,530 acres (309 square miles) in Louisiana of coastal marsh, bottomland hardwood, and cypress-tupelo swamp habitats that are addressed in this impact evaluation. Definitions of these habitat types are provided in Section 1.6.1. A summary of habitat acreage by State is provided in Table 1. Hydro-units are subdivisions of the study area that are used to facilitate discussion and impact evaluation. They are planning units that can be isolated by topography and hydrology from surrounding areas. Section 3.1.1 describes the basis for the designation of these hydro-units and explains how they were used in this study. An index of these units is provided in Table 2, and the distribution of these habitats is presented on Figure 2. Figure 3 is an area map that contains geographic place names referred to in the following descriptions.

Table 1: Summary of Habitat Acreages by State (2004)

| | Fresh | Inter-mediate | Brackish | Saline | Total Marsh | Bottomland Hardwood | Swamp | Total Wetlands |
|---|---|---|---|---|---|---|---|---|
| **Texas** | | | | | | | | |
| Acreage | 13,580 | 30,336 | 24,047 | 4,898 | 72,861 | 5,458 | 10,157 | 88,476 |
| Water | 2,117 | 9,240 | 8,254 | 810 | 20,421 | 0 | 0 | 20,421 |
| Totals | 15,697 | 39,576 | 32,301 | 5,708 | 93,282 | 5,458 | 10,157 | 108,897 |
| **Louisiana** | | | | | | | | |
| Acreage | 20,336 | 101,405 | 23,112 | 3,551 | 148,404 | 3,206 | 6,641 | 158,251 |
| Water | 4,772 | 31,872 | 2,049 | 586 | 39,279 | 0 | 0 | 39,279 |
| Totals | 25,108 | 133,277 | 25,161 | 4,137 | 187,683 | 3,206 | 6,641 | 197,530 |
| **Total** | | | | | | | | |
| Acreage | 33,916 | 131,741 | 47,159 | 8,449 | 221,265 | 8,664 | 16,798 | 246,727 |
| Water | 6,889 | 41,112 | 10,303 | 1,396 | 59,700 | 0 | 0 | 59,700 |
| Totals | 40,805 | 172,853 | 57,462 | 9,845 | 280,965 | 8,664 | 16,798 | 306,427 |

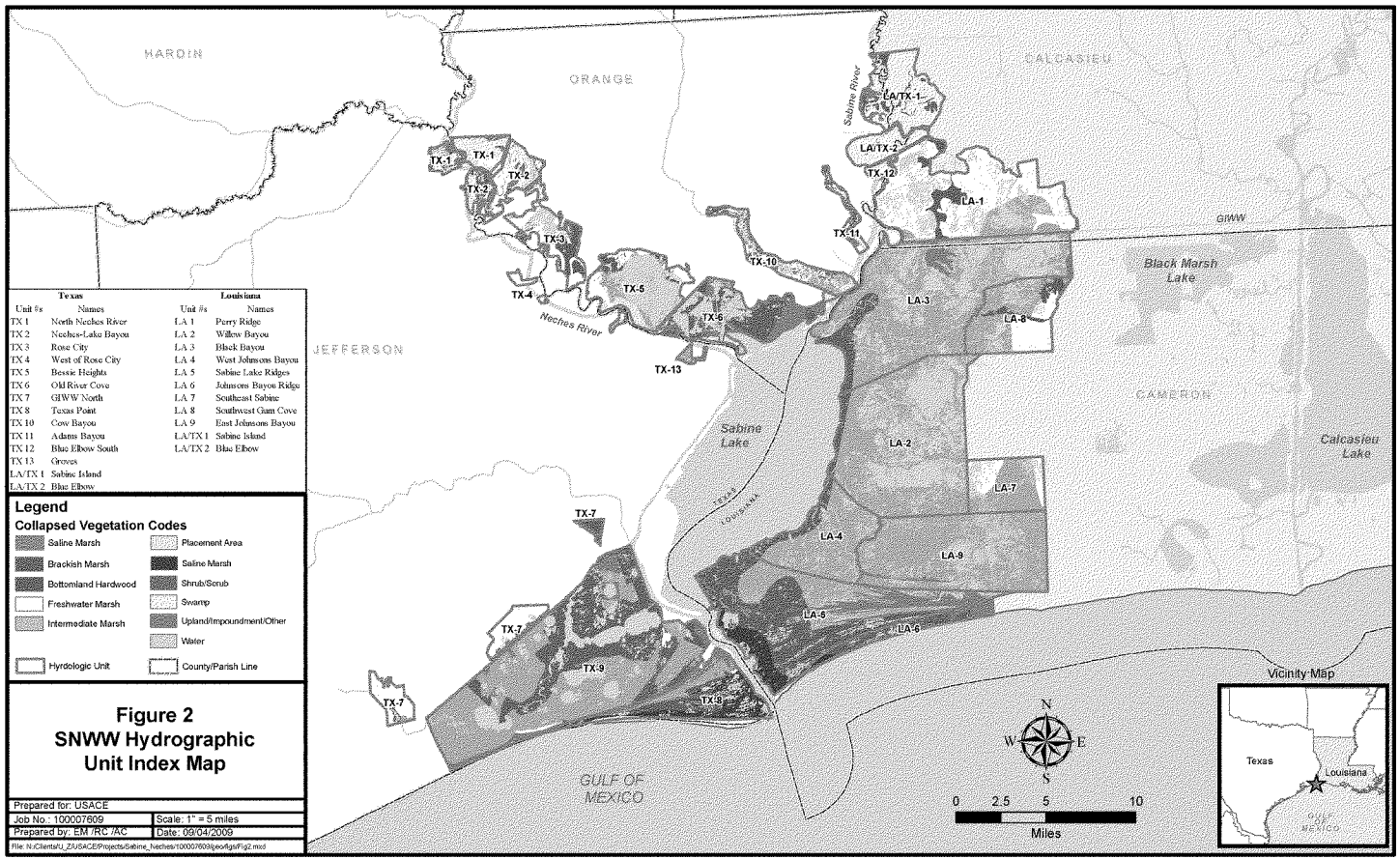
Table 2: Index of SNWW Hydrologic Units

| Texas | | Louisiana | |
|---|---|---|---|
| Unit #s | Names | Unit #s | Names |
| TX 1 | North Neches River | LA 1 | Perry Ridge |
| TX 2 | Neches-Lake Bayou | LA 2 | Willow Bayou |
| TX 3 | Rose City | LA 3 | Black Bayou |
| TX 4 | West of Rose City | LA 4 | West Johnson's Bayou |
| TX 5 | Bessie Heights | LA 5 | Sabine Lake Ridges |
| TX 6 | Old River Cove | LA 6 | Johnson's Bayou Ridge |
| TX 7 | GIWW North | LA 7 | Southeast Sabine |
| TX 8 | Texas Point | LA 8 | Southwest Gum Cove |
| TX 10 | Cow Bayou | LA 9 | East Johnson's Bayou |
| TX 11 | Adams Bayou | LA/TX 1 | Sabine Island |
| TX 12 | Blue Elbow South | LA/TX 2 | Blue Elbow |
| TX 13 | Groves | | |
| LA/TX 1 | Sabine Island | | |
| LA/TX 2 | Blue Elbow | | |

### 1.5.1 Texas Portion of the Study Area

In Texas, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area:

- Approximately 10,000 acres of fresh to salt marsh in the chenier plain west of Sabine Pass, the majority of which consists of the Texas Point National Wildlife Refuge (NWR). This NWR is part of the Texas Chenier Plain NWR complex (USFWS, 2005a). A chenier plain is characterized by relict beach fronts that form high ridges that parallel the Gulf shore. The term derives from the French name for live oak trees (*chenier*), which typically are found growing atop these ridges (Loyola University, 2006). This area is indicated as hydrologic unit (hydro-unit) TX 8 on Figure 2.
- Approximately 55,700 acres of fresh to salt marsh is located west of the Sabine River between Texas Point and the mouth of the Neches River (TX 7 and 9). Much of this area is protected by the J.D. Murphree WMA and the McFaddin NWR. Managed by the TPWD, the J.D. Murphree WMA totals 24,250 acres of fresh, intermediate, and brackish water wetlands in the Texas Chenier Plain (TPWD, 2005a). It is located just inland of the Texas Point WMA and extends north of the GIWW. The eastern half (approximately 23,000 acres) of the McFaddin NWR is part of the study area. This NWR is also part of the Texas Chenier Plain NWR complex. The McFaddin NWR protects one of the largest remaining freshwater marshes on the Texas coast and thousands of acres of intermediate to brackish marsh (USFWS, 2005a). It is located adjacent to and just west of Texas Point WMA.


HARDIN
ORANGE
CALCASIEU
JEFFERSON
CAMERON
Sabine River
Neches River
GIWW
Black Marsh Lake
Sabine Lake
Calcasieu Lake
TX-1
TX-2
TX-3
TX-4
TX-5
TX-6
TX-7
TX-8
TX-9
TX-10
TX-11
TX-12
TX-13
LA/TX-1
LA/TX-2
LA-1
LA-2
LA-3
LA-4
LA-5
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LA-7
LA-8
LA-9
TEXAS
LOUISIANA
GULF OF MEXICO
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S
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0 2.5 5 10
Miles
Vicinity Map
Texas
Louisiana
GULF OF MEXICO
Texas
Unit #s Names
TX 1 North Neches River
TX 2 Neches-Lake Bayou
TX 3 Rose City
TX 4 West of Rose City
TX 5 Bessie Heights
TX 6 Old River Cove
TX 7 GIWW North
TX 8 Texas Point
TX 10 Cow Bayou
TX 11 Adams Bayou
TX 12 Blue Elbow South
TX 13 Groves
LA/TX 1 Sabine Island
LA/TX 2 Blue Elbow
Louisiana
Unit #s Names
LA 1 Perry Ridge
LA 2 Willow Bayou
LA 3 Black Bayou
LA 4 West Johnsons Bayou
LA 5 Sabine Lake Ridges
LA 6 Johnsons Bayou Ridge
LA 7 Southeast Sabine
LA 8 Southwest Gum Cove
LA 9 East Johnsons Bayou
LA/TX 1 Sabine Island
LA/TX 2 Blue Elbow
Legend
Collapsed Vegetation Codes
Saline Marsh
Brackish Marsh
Bottomland Hardwood
Freshwater Marsh
Intermediate Marsh
Placement Area
Saline Marsh
Shrub/Scrub
Swamp
Upland/Impoundment/Other
Water
Hyrdologic Unit
County/Parish Line
Figure 2
SNWW Hydrographic
Unit Index Map
Prepared for: USACE
Job No.: 100007609
Scale: 1" = 5 miles
Prepared by: EM /RC /AC
Date: 09/04/2009
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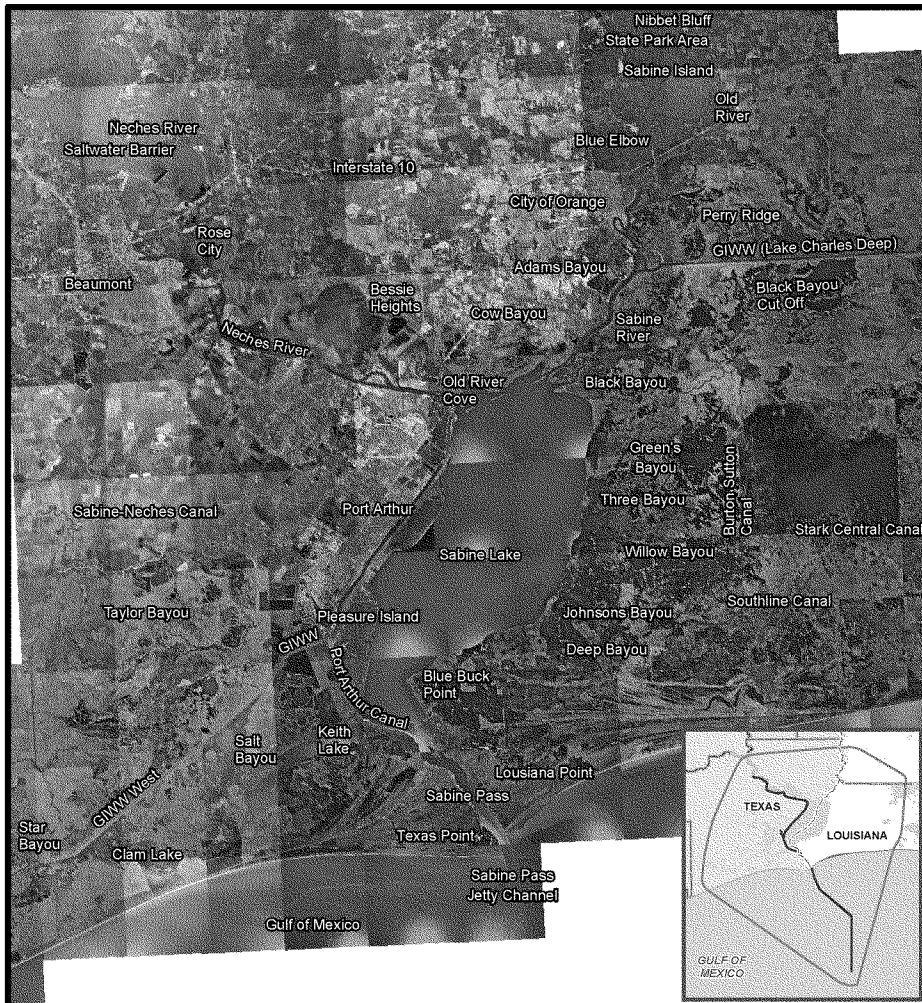


N
W E
S

0 3 6 12
Miles

**Figure 3**

**Geographic Reference Map**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1 inch equals 6 miles |
| Prepared by: Christiansen | Date: 09/08/2009 |

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- Approximately 22,000 acres of fresh, intermediate, and brackish marshes and 2,850 acres of cypress-tupelo swamp and bottomland hardwoods on the Neches River from the mouth of the river where it empties into Sabine Lake to the City of Beaumont (TX 3 through 6). Approximately 9,500 of these acres consist of open-water areas resulting from breaking and eroding marsh in the marshes at Rose City, Bessie Heights, and Old River Cove. The Nelda Stark Unit and Old River Unit of the Lower Neches River WMA (TPWD, 2005b) are located in this area.
- Approximately 6,500 acres of Neches River cypress-tupelo swamp and bottomland hardwoods and 2,000 acres of fresh marsh between the City of Beaumont and the new Neches River Saltwater Barrier near Pine Island Bayou (TX 1 and 2). A USACE-approved, privately operated, wetlands mitigation bank (the Neches River Cypress Swamp Preserve) is located within this area (USACE, 2005a).
- Approximately 4,750 acres of cypress-tupelo swamps, bottomland hardwood, and fresh and intermediate marshes on Cow and Adams bayous (TX 10 and 11). The Adams Bayou Unit of the Lower Neches River WMA (TPWD, 2005b) is located in this area.
- Approximately 700 acres of cypress-tupelo swamp west of the Sabine River and south of Interstate 10 (TX 12).
- Approximately 2,700 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp (LA/TX 2). Located north of Interstate 10 and west of the Sabine River, this area is owned by the Texas Department of Transportation (TxDOT) and managed as the USACE-approved Blue Elbow Swamp Mitigation Bank (USACE, 2005b). The area includes the Tony Houseman WMA, managed as a cooperative effort between the TxDOT and TPWD (2005c).
- Approximately 2,300 acres of cypress-tupelo swamp and bottomland hardwoods west of the Sabine River, across from the Sabine Island WMA in Louisiana (LA/TX 1).
- Approximately 6,000 acres of cypress-tupelo swamp, bottomland hardwood forest, and freshwater marsh below the Saltwater Barrier, on Big Thicket National Preserve lands in Texas (TX 1 and 2).

### 1.5.2 Louisiana Portion of the Study Area

In Louisiana, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority [LCWCR/WCRA], 1998; U.S. Geological Survey [USGS]-National Wetlands Research Center [NWRC], 2004):

- Approximately 71,500 acres of saline, brackish and intermediate marshes in the Louisiana chenier plain habitat at Louisiana Point, Blue Buck Point and Johnson's Bayou areas (LA 4, 5, 6, and 9). Sensitive areas include Sabine Lake Ridges (about 33,500 acres of chenier ridge, and saline, brackish and intermediate marsh), Johnson's Bayou Ridge (about 4,000 acres of saline and brackish marshes, and chenier ridges), West Johnson's Bayou (about 13,000 acres of brackish and intermediate marsh), and East Johnson's Bayou (about 26,700 acres of chenier ridge, and fresh, intermediate, and brackish marsh).
- Approximately 44,000 acres of brackish, intermediate, and fresh coastal marsh in the western half of the Sabine NWR (LA 3 and 7). The Sabine NWR, as a whole, contains about 124,500 acres of fresh, intermediate, and brackish marsh between Calcasieu and Sabine lakes in southwest Louisiana (USFWS, 2005b). Approximately 13,750 acres of marsh within this study area has degraded to open

water. This sensitive area contains the Willow Bayou mapping unit (about 36,300 acres) and 8,000 acres in the west section of the Southeast Sabine mapping unit.

- Approximately 46,500 acres of brackish, intermediate, and fresh marsh in an area north of Willow Bayou and south of the GIWW (LA 2 and 8). This sensitive area contains the Black Bayou mapping unit (about 36,300 acres) and 10,200 acres of fresh and intermediate marsh in the Southwest Gum Cove mapping unit.
- Approximately 25,700 acres of fresh and intermediate marsh and bottomland hardwood habitat in the Perry Ridge mapping unit, north of the GIWW and east of the Sabine River (LA 1).
- About 650 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp, east of the Sabine River and north of Interstate Highway (IH) 10 (LA/TX 2).
- Approximately 7,000 acres of cypress-tupelo swamp and bottomland hardwoods in the Sabine Island WMA, north of the Blue Elbow Swamp and east of the Sabine River (LA/TX 1).

## 1.6 ENVIRONMENTAL ISSUES AND CONCERNS

### 1.6.1 Existing Conditions

#### 1.6.1.1 Wetland Vegetation Communities

In the SNWW study area, coastal marshes occur in four distinct types. These wetland communities are differentiated by salinity, elevation, and soil regimes. Information on indicator species, salinity regime, and lists of vegetation community species provided by marsh type below was completed from references cited here (LDNR, 2002; The Nature Conservancy, 2006; USFWS, 1998; Visser and Sasser, 1998; White et al., 1987).

Salt marsh is located along the Gulf shoreline and the shores of Sabine Pass. Subjected to regular tidal inundation, low saline marsh is dominated by smooth cordgrass/oystergrass (*Spartina alterniflora*) and often accompanied by seashore saltgrass (*Distichlis spicata*), blackrush (*Juncus romerianus*), saline marsh aster (*Aster tenuifolius*), and marshhay cordgrass/wiregrass (*S. patens*). The dominant species in high salt marsh, which is subject to less-frequent tidal inundation, is glasswort (*Salicornia* spp.). Relative to other marsh types, salt marsh typically supports fewer terrestrial vertebrates although some shorebird species are common. Salinity typically averages 16 parts per thousand (ppt).

Brackish marshes in the study area grade inland from salt marsh along the Gulf shoreline and in the Sabine Pass area, line the Salt Bayou-Keith Lake watershed south of the GIWW, and fringe the northern and eastern shores of Sabine Lake. The dominant species in low brackish marsh is saltmarsh bulrush (*Scirpus robustus*); seashore saltgrass and marshhay cordgrass are co-dominant species in high brackish marsh. These species are often accompanied by marsh pea (*Vigna luteola*), waterhemp (*Amaranthus tamariscinus*), and dwarf spikerush (*Eleocharis parvula*). Brackish marshes are extremely important as nurseries for fish and shellfish. Other characteristic species include fur-bearers and shorebirds. The average salinity in the brackish marshes is 8 ppt.

Intermediate marshes are subjected to periodic pulses of salt water and maintain a year-round salinity in the range of 3 to 4 ppt. In the SNWW study area, they grade inland from brackish marshes in the Salt Bayou/Keith Lake watershed, are the major marsh type along the lower Neches River, and dominate the interior marshes east of Sabine Lake. The diversity and density of plant species are relatively high with marshhay cordgrass the most dominant species in high marsh. Co-dominant species in low marsh are seashore paspalum (*Paspalum vaginatum*), Olney bulrush (*S. americanus*), California bulrush/giant bulrush (*S. californicus*), and common reedgrass/roseau cane (*Phragmites australis*); bulltongue (*Sagittari lancifolia*) and sand spikerush (*E. montevidensis*) are also frequent. Intermediate marshes are considered extremely important for many wildlife species, such as alligators and wading birds, and serve as important nursery areas for larval marine organisms.

Freshwater marshes are heterogeneous, with local species composition governed by frequency and duration of flooding, topography, substrate, hydrology, and salinity. A large expanse of tidal fresh marsh is located between the GIWW and the Neches River, and in the riparian zone of the Neches and Sabine rivers. Tidal freshwater marsh is also present in the most interior portions of the marshes east of Sabine Lake. Co-dominant species in low marsh are maidencane (*P. hemitomen*), giant cutgrass (*Zizaniopsis milacea*), and bulltongue. Co-dominant species in high marsh are squarestem spikerush (*E. quadrangulata*) and marshhay cordgrass. Other characteristic species include American lotus (*Nelumbo lutea*), watershield (*Brasenia screben*), duckweed (*Lemna* spp.), and fanwort (*Cabomba caroliniana*). Salinity rarely increases above 2 ppt, with a year-round average of approximately 0.5 to 1 ppt. Tidal fresh marshes support extremely high densities of wildlife, such as migratory waterfowl.

Upstream of the coastal marshes in Sabine Lake estuary, the study area is dominated by dense bottomland hardwood forests and cypress-tupelo swamps. These wetland forests cover an intricate network of sloughs and sandy ridges formed within the rivers' relict meander belts. Bald cypress (*Taxodium distichum*) – tupelo-gum (*Nyssa aquatica*) swamps grow in the inundated areas between the ridges, and floodplain hardwood forest of oaks (*Quercus nigra, Q. phellos, Q. alba, Q. lyrata*), sweetgum (*Liquidambar styraciflua*), hickories (*Carya* spp.), American elm (*Ulmus americanus*), maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), American holly (*Ilex opaca*), and loblolly pine (*Pinus taeda*) grow atop the sandier ridges. In general, these are healthy, stable habitats. The hardwoods, and especially the cypress trees, have been logged repeatedly since the turn of the century and as recently, perhaps, as the 1950s (USACE, 1998). Though much of the forest is secondary growth, the swamp and bottomland hardwood habitats have medium to high value for food and cover to resident and migratory fish and wildlife.

#### 1.6.1.2 Loss of Interior Marsh

Marshes in the study area are severely threatened, with the conversion of numerous large marshes to open water documented by various mapping studies (Barras et al., 2004). In Louisiana, a net land loss of 21 percent between 1978 and 2000 has been reported in the Chenier Plain subregion of coastal Louisiana, which includes the Louisiana portion of the Sabine estuary (USACE, 2004:MR 2-24; Appendix B). In Texas, the most-extensive losses of interior coastal wetlands in the state (12,632 acres between 1930 and

1978) have occurred in the Neches River delta. In total, over 90 percent of the emergent marshes in the Lower Neches River delta have been converted to open water (White et al., 1987; Morton and Paine, 1990), which is more than half of the total wetland loss in the State of Texas (Sutherlin, 1997). The breakup of previously intact interior marshes is apparent, and shoreline erosion is occurring around larger lakes. In the conversion of marsh to open water, topsoils and nutrients have eroded, leaving dense clay substrates that do not support marsh vegetation.

More recently, however, the rate of land loss in the Chenier Plain region appears to have ameliorated and interior marshes appear to have stabilized. Over the last 20 years, rates of loss have declined and marshes do not appear to be undergoing rapid conversion of large areas to open-water like areas to the east in Louisiana (LCWCR/WCRA, 1998; TPWD, 2003; USACE, 2004). For example, 61 percent of the total land loss in the Chenier Plain region occurred between 1978 and 1990 as compared to 39 percent between 1990 and 2000 (Barras et al., 2004)

#### 1.6.1.3 Gulf Shoreline Recession

Shoreline recession due to gradual submergence associated with RSLR is also a major threat to marshes in the study area. National Oceanic and Atmospheric Administration (NOAA) has documented a trend of mean sea level rise at Sabine Pass of 5.66 millimeters (mm)/year from 1958 through 2006 (NOAA-U.S. Department of Commerce [USDC], 2009), one of the highest on the Gulf Coast. RSLR combines the relative effects of eustatic (or global) sea level changes and regional subsidence. Serious scientific debate continues regarding the historical rate of subsidence in this region, and its underlying causes (Berman, 2005; Morton, 2003; Morton et al., 2005; Shinkle and Dokka, 2004; Titus and Narayanan, 1995). However, there is evidence that the subsidence rate may be decreasing as the average rate of RSLR at Sabine Pass was 6.54 mm/year for period 1958 through 1999 (NOAA-USDC, 2006) as compared to the 5.66 mm/year rate through 2006 discussed above.

In the SNWW study area, prevailing winds and wave approach are from the southeast; however, low-pressure weather systems (northers) frequently move across the upper coast from the north during winter months (Anderson, 2007). The portions of the study area most affected by these prevailing wind patterns are the Gulf shoreline and the eastern shore of Sabine Lake. In Sabine Lake, fetch and wave attack associated with prevailing southeasterly winds primarily affect the western shore; an area that is protected from erosion by riprapped levees around Placement Areas (PAs) 8 and 11. These levees are quite large and sufficiently high such that the rates of RSLR predicted here will have little to no effect. Winter northers, however, do affect the unprotected eastern shore of Sabine Lake where shoreline recession averaged from 4.0 to 5.6 feet/year between 1978 and 2004 (Greco and Clark, 2005; Parchure et al., 2005). Rates of existing historical Gulf shoreline change were obtained from several recent studies Most of the Texas shoreline in the study area experienced very high rates of shoreline retreat from the 1950s through 2002, ranging from –5 to –51 feet/year (USACE, 2004; Bureau of Economic Geology [BEG], 2009). However, small reaches near the SNWW west jetty and near Sea Rim State Park are stable or accreting.

#### 1.6.1.4 Effects of Recent Hurricanes

While this study was in preparation, three large hurricanes occurred in and near the study area. In 2005, Hurricane Katrina devastated areas to the east but did not affect this area. The same year, Hurricane Rita's storm surge at Louisiana Point was 10.6 feet as recorded by USGS sensors (Farris et al., 2007). The surged deposited 3.3 feet of new sediment on the Hackberry Beach chenier ridge and inundated thousands of acres of coastal marsh. Bar welding of nearshore sediments to the lower shore face was also evident (Guidroz et al., 2006). Immediately after the storm, hundreds of acres of marshhay cordgrass marsh in Cameron Parish appeared to have been severely impacted by extensive flooding of high-salinity waters. When the water finally subsided, the vegetation in some areas appeared dead, and the marsh had areas that were 30 to 50 percent devegetated. Over time, porewater salinity levels should decline as rainwater flushes salinity from the system (Farris et al., 2007).

In 2008, Hurricane Ike struck the north Texas Gulf Coast, with the eye passing over the city of Galveston, approximately 60 miles southwest of the study area. Ike's hurricane-force winds, record-breaking levels of storm surge, and extensive coastal and inland flooding had a direct impact on the coastal wetlands, including significant marsh loss, scouring, and compression (Federal Emergency Management Agency [FEMA], 2008). The secondary effects of saltwater intrusion, in which freshwater habitats and species are stressed by elevated soil salinities from the surge overwash and sediments, may not be fully realized for years to come.

The Chenier Plain marshes surrounding Sabine Lake will most likely experience significant long-term impacts. Under normal conditions, these marshes do not drain rapidly, and normal drainage is impaired by numerous hydrologic modifications such as the GIWW, the SNWW, roads, and other infrastructure. This infrastructure, along with the natural topography, resulted in the slow drainage of Ike's surge waters. Furthermore, it appears that drought conditions in the year following the storm exacerbated the immediate effects of the storm surge, extending the time that higher-saline waters remained on the marshes.

The marshes of Sabine Lake comprise primarily brackish and intermediate vegetation communities, which are not tolerant of the higher salinity of Ike's storm surge. The high-salinity water was either lethal to these plants or will have sublethal effects ranging from reduced seed production, vegetative stress, and increased vulnerability to disease. Hurricane Ike also further eroded the beach ridge at the McFaddin NWR, which protects the interior marshes from exposure to full-strength seawater. Other serious effects that could have lasting impacts for decades include the covering of oyster beds and fishing grounds by sediment from the retreating storm surge. Increased marsh loss could also have devastating long-term impacts on fisheries production in terms of species like red drum, white shrimp, and blue crab, as well as on use of these marshes by migrating waterfowl and wading birds.

Marshes on the west side of Cameron Parish in the SNWW study area suffered fewer adverse effects from hurricanes Rita and Katrina than did marshes farther to the east. Marsh recovery was underway when the region was hit by Hurricane Ike. For modeling purposes, it was assumed that the marshes would rebound

to existing conditions applied in the model. Marshes in the SNWW study area are located on relatively stable landforms and thus are able to recover from the short-term effects of tropical storms and hurricanes.

### 1.6.2 Future Without-Project Conditions

The present 40-foot channel has been in existence since the early 1970s and has had adequate time for the dense clay sediments to stabilize. Deepening will be performed by making a box cut in the bottom of the existing channel. Some slumping of the side slope at the base of the channel may occur as the deeper channel stabilizes, but no slumping is expected at the top of cut. No emergent marsh or shallow bottom is present adjacent to the top of cut. Seagrasses and other types of submerged aquatic vegetation are not found along the margins of the SNWW channel because conditions conducive for submerged aquatic vegetation (SAV) growth (i.e., calm waters and low turbidity) are not present.

Future rates of freshwater inflow and RSLR are likely to result in significant changes in the FWOP condition for the SNWW study area (National Research Council [NRC], 1987; Intergovernmental Panel on Climate Change [IPCC], 2007; Milliken et al., 2008a). FWOP forecasts of salinity, shoreline recession, interior marsh loss, and related impacts to plant and animal communities in the study area are important in establishing the baseline condition against which FWP impacts are measured.

#### 1.6.2.1 Relative Sea Level Rise

The projected rate of RSLR at the Sabine-Neches estuary is very uncertain. The uncertainty inherent in the rates of eustatic sea level rise is evident in the wide range of various estimates from the NRC (1987) and the IPCC (2007). The confidence that any estimate will match actual future sea levels decreases over time, and significant deviations are possible, including amelioration in the rate of rise. However, it must be noted that the IPCC (2007) estimates assume that thermal expansion contributes 70 to 75 percent of the rise. Faster melting of the Greenland and Antarctica ice sheets would increase their contributions to twenty-first-century sea level rise and raise levels above those currently projected. Indeed, some recent studies of geologic terrestrial and marine records support the plausibility of higher projections of sea level rise, on the order 1.0±0.5 meters by A.D. 2100 (Rahmstorf, 2007; Carlson et al., 2008; Rohling et al., 2008).

The 2009 HS modeling for the SNWW study included an estimate of RSLR for the period of analysis, which ends in 2069. The estimated amount of RSLR applied in this study is 1.1 feet. Assumptions and methods used to obtain this estimate are presented in Section 3.3.

#### 1.6.2.2 Freshwater Inflows

Future projections of freshwater inflows for the study area are also highly uncertain. These flows would be influenced by changes in the timing and amount of precipitation, temperature, water demand, and water supply strategies. The Texas State Climatologist has recently concluded that it is impossible to predict with confidence what precipitation trends will be in Texas over the next half century (Nielsen-

Gammon, 2009). Unlike precipitation, there is more consensus for a predicted temperature increase in Texas of close to 4 degrees Fahrenheit (°F) by 2060. Projections of future water demand and supply strategies are also very difficult to make and often involve controversial subjects such as interbasin transfer. Freshwater inflows applied in the 2009 HS modeling were based upon the 2007 Texas State Water Plan and the associated regional plan for the study area (TWDB, 2007). The 2007 State Water Plan takes into consideration existing flows in the Sabine River that are dedicated to the State of Louisiana as prescribed by the Sabine River Compact. The states of Texas and Louisiana are apportioned equal shares of the total Sabine River flow, and therefore freshwater inflows for Louisiana in the HS modeling were equivalent to Texas inflows. The plans were based upon evaluations of population projections, water demand projections, and existing water supplies available during drought. By 2060, population in the region encompassing the study area is projected to grow 36 percent. Water demands are projected to increase 41 percent. The region has surplus water available beyond its projected demands. However, the Texas Water Code requires that flow quantities adequate to support a sound ecological environment and to maintain the productivity, extent, and persistence of key aquatic habitats be maintained. Work on setting target inflows is ongoing, and therefore specific future projections of inflow cannot be made at this time. It is reasonable to assume that this law will result in the maintenance of flows similar to existing conditions.

The State of Louisiana has no statewide water plan or comprehensive water resources management program. The most recent state legislation (Act 49 of 2003) restricts planning to groundwater management, and does not include comprehensive water resource planning. The groundwater management program is just beginning, working toward the development of a statewide plan.

#### 1.6.2.3 Gulf Shoreline Recession

Extensive shoreline retreat is projected for the Texas Gulf shoreline in the study area, based upon the historical rate of changes in sea level and local subsidence (BEG, 2009). The rate of recession of the north Texas Gulf shoreline is likely to increase with accelerated RSLR. For the Louisiana Gulf shoreline in the study area, no change is projected through the year 2050 (Barras et al., 2004). The segment of the Chenier Plain shoreline between Sabine Pass and Ocean View Beach (located 6 miles beyond the 10-mile SNWW study boundary) prograded seaward at an average rate of +12.9 feet/year between 1883 and 1994 (USACE, 2004). However, progradation has slowed in recent years to +1.2 feet/year. The shoreline in the study area is dominated primarily by the effect of the Sabine Pass jetties, which intercept the westward-moving littoral drift and tend to trap sediment along the shoreline east of the jetties.

#### 1.6.2.4 Interior Marsh Loss

Large areas of marsh at Texas Point and Salt Bayou in the Sabine Pass area, in the Neches River reach between Sabine Lake and IH 10, and in the extensive marshes east of Sabine Lake are already severely stressed. Marshes have been dying, due in large part to subsidence and salt-induced stress, and highly organic marsh soils have then eroded, leading to ever-increasing areas of open water in former marsh systems. This process is well illustrated by Rose City and Bessie Heights on the Neches River in Texas

and the Sabine NWR and Black Bayou marshes in Louisiana, where extensive former marshes have nearly disappeared.

The effects of the projected rate of RSLR on coastal marshes are very difficult to predict. Biomass accumulation would be expected to offset much if not all of the RSLR change in water surface elevation. "Primary productivity of salt marsh vegetation is regulated by changes in sea level, and the vegetation, in turn, constantly modifies the elevation of its habitat toward an equilibrium with sea level" (Morris et al., 2002:2876). A rise in relative sea level (RSL) brings an increase in production and biomass density that enhances sediment deposition by increasing the efficiency of sediment trapping. This can lead to an absolute increase in the elevation of the marsh platform and result in a landward migration of the marsh (Gardner et al., 1992; Gardner and Porter, 2001). This may change total wetland area, depending upon local geomorphology and anthropogenic barriers to migration, such as bulkheads, canals, etc.

FWOP projections of coastal land loss in the Louisiana portion of the SNWW study area forecast relatively stable landforms and shorelines through 2050 (Barras et al., 2004), not accounting for the effects of tropical storms and hurricanes. Similar large-scale FWOP land loss projections are not available for the Texas portion of the study area. However, a Geographic Information System (GIS) study of aerial photographs of the Salt Bayou-Keith Lake system confirmed that the open-water trend has slowed and possibly reversed itself in that area in recent years (TPWD, 2003). Texas interior marshes most at risk to the effects of RSLR are located just outside and to the west of the SNWW study area in the McFaddin NWR.

If RSLR accelerates to the extent that the coastal plant community cannot sustain an elevation within its range of tolerance, rates of primary production would decrease, resulting in an unstable and rapidly deteriorating marsh community (Morris et al., 2002). In addition, if shoreline recession cuts existing fore dune formations, large areas of interior marsh could quickly be exposed to higher-salinity Gulf waters and wave attack. In this case, large marsh areas could quickly be lost to the Gulf.

# 2.0 ECOLOGICAL MODELING

## 2.1 USACE MITIGATION PLANNING

### 2.1.1 USACE Mitigation Guidance

In accordance with USACE guidance (ER 1105-2-100), mitigation may include avoiding and minimizing project impacts to ecological resources, rectifying impacts by restoring the affected environment, and reducing or eliminating impacts by preservation or maintenance operations during the life of the project. After all possible actions are taken to avoid and minimize impacts to significant ecological resources, impacts are to be compensated by replacing or substituting significant resources or environments. Replacements of fish and wildlife resources will be made "in-kind." Substitutions, or replacements "out-of-kind," are also acceptable mitigation if they are at least equal in value and significance as the resources lost. Impacts to wetlands must be fully mitigated and meet the goal of no net loss to wetlands. Mitigation for bottomland hardwoods should be made in-kind to the extent possible. However, the availability of existing restorable forests and the cost and feasibility of accomplishing in-kind replacement often make this impractical. Compensation for bottomland hardwoods can also include increased management of existing forests to compensate for the loss of biological productivity. After identifying measures to avoid or minimize impacts to the greatest extent possible, the recommended plan and the LPP plan must contain sufficient mitigation to ensure that there will be no more than negligible adverse impacts on significant ecological resources (Section 906(d), Water Resources Development Act [WRDA] 86).

### 2.1.2 SNWW Mitigation Objectives

The following mitigation planning objectives were established by the ICT for the SNWW study.

- Minimize salinity impacts to the SNWW affected area
- Maximize the use of dredged material in marsh restoration measures
- Meet goal of no net loss of wetlands
- Replace lost habitat quality on a one-to-one basis as measured by Average Annualized Habitat Units (AAHUs)
- Replace habitats in-kind to the extent practicable
- Mitigate losses in the state where they occur to the extent practicable
- Share dredged material from Sabine Pass equally between Louisiana and Texas

## 2.2 SELECTION OF WETLAND VALUE ASSESSMENT MODEL

In order to comply with USACE guidance that requires that compensation be evaluated using a habitat unit that quantifies the value of habitat quality and quantity over time, the ICT selected the WVA model to identify and evaluate significant ecological resources that may be affected by SNWW navigation improvements.

The WVA was chosen as the most appropriate ecological model for the SNWW project based on a number of factors. The WVA model is a suite of ecological, habitat-based, community models known primarily from its use by a multiagency team of Federal and State agencies in Louisiana (the Environmental Work Group [EnvWG]) that prioritizes proposals for coastal restoration projects under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The WVA methodology employs a community approach that assumes that optimal conditions for all fish and wildlife within a specific type of coastal wetland habitat can be characterized by a group of significant variables, and that existing or future conditions can be compared to that optimum, providing an index of habitat quality. Using this methodology, several habitat-specific community models have been developed by the EnvWG, and three have been selected for use in this study: the Emergent Marsh Community Model (EMCM), the Swamp Community Model (SCM), and the Bottomland Hardwoods Model (BHM). The EMCM can be applied to four coastal marsh communities – fresh, intermediate, brackish, and saline marsh. Hereafter in this report, the term "WVA model" applies to the three components of the WVA model suite (EMCM, SCM, and BHM) that are used in this study.

Although WVA was developed specifically to apply to habitat types present along the Louisiana coast, the same types of coastal habitat (chenier plain, emergent coastal marsh, bottomland hardwoods, and cypress-tupelo swamp) extend into the Sabine-Neches coastal watershed in Texas. In addition, the areas contain the same fish and wildlife communities, similar soils, and topography, and the Sabine-Calcasieu basins share an interconnected hydrology. Furthermore, the types of variables measured by the WVA community models are sensitive to the types of changes that have been identified as the highest concerns by resource agencies and the general public for the SNWW project. Specifically, these are potential changes in salinity, stress and death of marsh vegetation, and further loss or degradation of already stressed coastal marshes. The variables measured by WVA are also recognized scientifically and technically as important in characterizing overall habitat quality. Variables utilized in the WVA were selected from existing, widely accepted Habitat Evaluation Procedures (HEP) models, and the model outputs were combinable across the different habitat types. A final factor is that variables were established such that data were easily estimated or collected from existing data sources. This was especially important because the study area is exceptionally large, and therefore extensive field data collection efforts were not practical. The size and habitat diversity of the study area made application of other ecological models very difficult. Other ecological models, such as the Hydrogeomorphic Approach and HEP models, were considered and rejected because extensive field data collection efforts required by these models were not feasible given time and budget constraints.

USACE regulation ER 1105-2-407 and draft EC 1105-2-14 require that a planning model be approved for use by the appropriate Planning Center of Expertise (PCX). The USACE, Galveston District's (SWG) application of the WVA model (USFWS, 2002a, 2002b, 2002c, 2002e) to the quantification of environmental impacts and mitigation for the proposed SNWW deepening and widening project was approved by a model assessment conducted in 2008 (Louis Berger Group [LBG] and Toxicological and Environmental Associates [TEA], 2008) and approved for use by the PCX for Deep Draft Navigation, in consultation with the PCX for Ecosystem Restoration by memo dated 30 June 2009 (Attachment 1). The

WVA modules that were submitted for the assessment are identical to those that were used in the revised modeling for the SNWW deepening-only project.

## 2.3 MODEL DESCRIPTION

WVA is a modification of the widely used HEP developed by USFWS (1980). It was developed by the EnvWG of the Planning and Evaluation Subcommittee of Louisiana's CWPPRA Technical Committee (USFWS, 2002a). The EnvWG reviews candidate CWPPRA projects, suggests recommended measures to achieve wetland benefits, and determines the estimated annualized benefits for those projects. USFWS chairs the EnvWG and developed the WVA model in consultation with other EnvWG agencies for the purpose of evaluating the benefits of proposed projects. While HEP models use a species-oriented approach, WVA employs a community approach that assumes that optimal conditions for all fish and wildlife within a specific type of coastal wetland habitat can be characterized by a group of significant variables, and that existing or future conditions can be compared to that optimum, providing an index of habitat quality similar to those developed under HEP.

The WVA community models were developed for the following habitat types: fresh marsh, intermediate marsh, brackish marsh, saline marsh, fresh swamp, barrier islands, and barrier headlands. A WVA Procedural Manual was prepared by the EnvWG to provide guidance in the use of these models (USFWS, 2002b). A separate procedural manual has also been prepared for the four marsh habitat models, collectively called the WVA Emergent Marsh Community Models (USFWS, 2002c). Two other habitat assessment models for bottomland hardwoods (LDNR, 1993) and coastal chenier/ridge habitat were developed outside of the CWPPRA arena and are periodically used by the EnvWG for CWPPRA project evaluation. The SNWW Habitat Workgroup chose to apply the WVA models as formulated by the EnvWG because the habitats and environmental stressors in the SNWW study area are the same as those for which the WVA models were developed.

Each model consists of (1) variables considered important to each habitat type, (2) a Suitability Index (SI) graph for each variable, and (3) a mathematical formula that combines the SIs for each variable into a single value for habitat quality (Habitat Suitability Index or HSI). HSIs are then established for the baseline (existing) condition, for FWOP, FWP conditions, and for the MFWP condition for selected target years (TY) throughout the life of the project. Habitat units are calculated by multiplying these HSIs by the affected acreage at each target year. The habitat units for the FWOP, FWP, and MFWP conditions are annualized over the project life to determine AAHUs. The impacts or benefits of the project are then quantified by comparing AAHUs between FWP and FWOP, and between MFWP and FWOP conditions. This procedure fulfills the USACE requirement that compensation be evaluated using a unit of comparison that measures quality and quantity of habitat values over time.

## 2.4 MODELING PROCESS

The SNWW ICT established the Habitat Workgroup to apply the ecological model. Any ICT agency interested in participating was invited to attend. Representatives from the following agencies participated in workgroup meetings, making all technical decisions regarding data collection and variable input.

SNWW Habitat Workgroup
- USFWS – Clear Lake (Texas) Ecological Field Office
- USFWS – Louisiana Ecological Field Office
- USFWS – Chenier Plain NWR complex
- USFWS – Sabine NWR
- NMFS – Galveston, Texas
- NMFS – Baton Rouge, Louisiana
- EPA, Region 6
- GLO
- TPWD – Federal Projects Review
- TPWD – J.D. Murphree WMA
- LDNR – Coastal Restoration Division
- LDWF
- SRA – TX
- USACE

Meetings were held at Galveston District headquarters in Galveston, Texas, at the J.D. Murphree WMA in Port Arthur, Texas, and at the USFWS – Lafayette Ecological Services Field Office. The following WVA community models were selected for use based upon baseline habitat mapping of the study area: EMCM (saline, brackish, and intermediate/fresh), the SCM, and BHM. They are individually described in sections 2.6 to 2.8.

Members of the Habitat Workgroup divided sensitive habitats into hydro-units (see Figure 2), provided GIS assistance for habitat mapping, reviewed habitat delineations, conducted field work to collect data, developed historical land loss rates, and determined values for model variables. USACE provided hydrodynamic salinity modeling results, provided GIS assistance for habitat mapping, and provided conceptual plans for FWP and MFWP navigation features and mitigation measures. In addition, USACE provided data input for the WVA worksheets based upon workgroup contributions and provided draft worksheets to workgroup members for review. USFWS-Louisiana provided assistance to ensure that WVA procedures (USFWS, 2002b) were followed properly and that WVA worksheets were being used appropriately. USACE conducted in-house quality assurance of worksheet accuracy and an independent technical review of this appendix.

## 2.5 PERIOD OF ANALYSIS

The estimated date of project completion is 2019, as the dredging of the Sabine Pass and Sabine Pass Jetty channels (the controlling channels for increased salinity intrusion) are currently scheduled for

completion that year. The year 2004 is TY 0 for the ecological modeling because field observations that support many of the WVA variables were made in that year. Since the typical USACE period of analysis for projects of this type is 50 years long, the period of analysis extends to the year 2069. FWP impacts are evaluated for the period beginning in the year 2019 (TY 15) and ending in year 2069 (TY 65).

## 2.6 WVA EMERGENT MARSH COMMUNITY MODELS

The emergent marsh models were initially developed in the early 1990s by the EnvWG for use in the Louisiana CWPPRA program. They have undergone several revisions since that time, and the 2002 version was employed in this study (USFWS, 2002c). The EMCM is used to evaluate saline, brackish, intermediate, and fresh marsh habitats in the study area as defined and described in Section 1.6.1 above. Variables included in the models were selected by the EnvWG based upon their importance in characterizing fish and wildlife habitat in coastal marsh ecosystems. As part of the variable selection process, species-specific HSI models for a variety of fish and shellfish, freshwater fish, birds, reptiles and amphibians, and mammals were reviewed by the EnvWG during initial model development (Table 3).

The following six variables represent wetland habitat quality in the model:

$V_1$ percent of the wetland covered by emergent vegetation
$V_2$ percent of the open water covered by submerged aquatic vegetation
$V_3$ marsh edge and interspersion
$V_4$ percent of the open-water area less than or equal to 1.5 feet deep
$V_5$ salinity
$V_6$ aquatic organism access

### 2.6.1 Modeling Assumptions for Suitability Indices

#### 2.6.1.1 $V_1$ Percent of the Wetland Covered by Emergent Vegetation

Persistent emergent vegetation provides foraging, resting, and breeding habitat for a variety of coastal fish and wildlife species. Detritus from coastal marshes also provides a source of mineral and organic nourishment for organisms at the base of the food chain. In this model, an area that is 100 percent shallow water is assumed to have minimal habitat suitability (SI = 0.1). For all marsh types, optimal vegetative coverage is assumed to be 100 percent (SI = 1.0). This assumption diverges from the general biological understanding that optimum cover falls in the 60 to 80 percent range. Selection of 100 percent marsh

Table 3: Species Representative of and Dependent on the Habitats Considered in the WVA

| Common name | Scientific Name |
|---|---|
| **Estuarine Fish and Shellfish** | |
| pink shrimp | *Penaeus duorarum* |
| white shrimp | *Penaeus setiferus* |
| brown shrimp | *Penaeus aztecus* |
| spotted seatrout | *Cynoscion nebulosus* |
| Gulf flounder | *Paralichthys albagutta* |
| southern flounder | *Paralichthys lethostigma* |
| Gulf menhaden | *Brevoortia patronus* |
| juvenile spot | *Leiostomus xanthurus* |
| red ear sunfish | *Lepomis microlophus* |
| juvenile Atlantic croaker | *Micropoqonias undulatus* |
| red drum | *Sciaenops ocellatus* |
| **Reptiles and Amphibians** | |
| bullfrog | *Rana catesbeiana* |
| red-eared slider | *Pseudemys scripta* |
| American alligator | *Alligator mississippiensis* |
| **Birds** | |
| great egret | *Ardea alba* |
| northern pintail | *Anas acuta* |
| mottled duck | *Anas fulvigula* |
| American coot | *Fulica americana* |
| marsh wren | *Cistothorus palustris* |
| snow goose | *Chen caerulescens* |
| clapper rail | *Rallus longirostris* |
| great blue heron | *Ardea herodias* |
| red-winged blackbird | *Agelaius phoeniceus* |
| roseate spoonbill | *Ajaia ajaja* |
| white-fronted goose | *Anser albifrons* |
| laughing gull | *Larus atricilla* |
| **Mammals** | |
| mink | *Neovison vison* |
| muskrat | *Ondatra zibethicus* |
| swamp rabbit | *Sylvilagus aquaticus* |

Allen (1984, 1985a, 1985b); Allen and Hoffman (1984); Buckley (1984); Chapman and Howard (1984); Christmas et al. (1982); Diaz and Onuf (1985); Enge and Mulholland (1985); Graves and Anderson (1987); Gutzwiller and Anderson (1987); Kaminski (1986); Kostecki (1984); Leslie and Zwank (1985); Lewis (1983); Lewis and Garrison (1983); Morreale and Gibbons (1986); Mulholland (1984); Newsom et al. (1987); Rorabaugh and Zwank (1983); Short (1985); Short and Cooper (1985); Stickney and Cuenco (1982); Suchy and Anderson (1987); Turner and Brody (1983); Twomey et al. (1984); Zale and Mulholland (1985).

cover as the optimal habitat condition is based upon several factors. Loss of emergent coastal marsh is a serious existing condition in the study area, and it is assumed that this loss will continue due to RSLR (NOAA-USDC, 2006). Salinity was one of the driving subvariables for $V_1$ because increased salinity is a cause of land loss in coastal Louisiana and Texas (Visser et al., 2004). Increasing salinities even within the optimal range for some species may be outside of the optimal range for other species. Existing and potentially accelerated marsh loss associated with channel deepening has been identified as one of the highest concerns by resource agencies and the general public. Mitigation measures should therefore maximize emergent marsh creation, maintenance, and protection.

**$V_1$ Line Formula**

All marsh types

$$SI = (0.009 \times \% V_1) + 0.1$$

2.6.1.2 $V_2$ Percent of the Open Water Covered by Submerged Aquatic Vegetation

For the purpose of this model, SAV is defined as any of the diverse array of floating-leaved and submerged aquatic plants that are typically found in the SNWW study area. Seagrasses, included in the SAV designation, are flowering plants that grow entirely underwater. SAV coverage is included as an important marsh variable because it provides important food and cover to a wide variety of fish and wildlife (Virnstein, 1987; Thomas et al., 1990; Castellanos and Rozas, 2001; Raz-Guzman and Huidobro, 2002; Wyda et al., 2002; Lazzari and Stone, 2006). SAVs provides a refuge from predation, and because of this protection, densities of many invertebrates (infaunal and epifaunal) and small fishes are greater in SAV than in nearby unvegetated areas. SAV (including seagrasses) provide additional benefits by stabilizing sediments and filtering water. SAV (including seagrasses) tolerate or require a wide range of salinities.

The species composition and primary productivity of SAV communities corresponds to the salinity regime (Haller et al., 1974; Longstreth et al., 1984; Dunton, 1990; Bonis et al., 1993; Bortone, 2002; La Peyre and Rowe, 2003; Singh and Arora, 2003; Paresh and Freedman, 2006). Fresh and intermediate marshes, in particular, often support diverse communities of submerged and floating-leaved vegetation. Open water with no aquatics within a fresh or intermediate marsh is assumed to have low suitability (SI = 0.1). Optimal conditions are assumed when 100 percent of the open water is dominated by aquatic vegetation (SI = 1.0). Brackish marshes can also support aquatic plants that provide food and cover for several species of fish and wildlife. Although amounts are generally less than that which occurs in fresh or intermediate marshes, certain species such as widgeon-grass, coontail, and milfoil, can be abundant under some conditions, and widgeon grass, in particular, is an important food source for waterfowl. The SI graph for brackish marsh is identical to the fresh/intermediate model.

Low-salinity saline marshes may also contain beds of widgeongrass, which is able to tolerate a wide range of salinities. However, open-water areas in saline marshes generally contain sparse aquatic vegetation and are primarily important as nursery areas for marine organisms. In order to reflect the

importance of saline open-water areas to marine organisms, a saline marsh with no aquatic vegetation is assigned an SI = 0.3. Optimal coverage by aquatic plants is assumed to be 100 percent.

**$V_2$ Line Formulas**

Fresh/intermediate and brackish marsh

$$SI = (0.009 \times \% V_2) + 0.1$$

Saline marsh

$$SI = (0.007 \times \% V_2) + 0.3$$

2.6.1.3 $V_3$ Marsh Edge and Interspersion

This variable takes into account the relative amount of marsh to open water, and the degree to which open water is dispersed throughout the marsh. Interspersion is an important characteristic for freshwater and estuarine fish and shellfish nursery and foraging habitat in all marsh types (Rakocinski et al., 1992; Baltz et al., 1993, 1998; Rozas and Reed, 1993; Minello et al., 1994; Peterson and Turner, 1994; Rozas and Zimmerman, 2000; Minello and Rozas, 2002; Whaley and Minello, 2002; Rozas and Minello, 2007). The marsh/open-water edge provides cover for postlarval and juvenile organisms. Smaller, isolated ponds are less turbid and contain more aquatic vegetation, thereby providing more suitable waterfowl habitat. Conversely, a large degree of interspersion is assumed indicative of marsh degradation, as solid marsh converts to ever-larger areas of open water. If the entire area is solid marsh, or marsh with natural stream courses and tidal channels, Class 1 interspersion is assigned (SI = 1.0). If the entire area is open water, Class 5 interspersion is assigned (SI = 0.1).

> The SI for $V_3$ is not calculated with a line formula. Classes 1 through 5 are assigned by comparing marsh edge and interspersion to photographic examples for each class provided in Appendix A of the EMCM (USFWS, 2002c).

Inclusion of a table or index for $V_3$ (Marsh Edge and Interspersion) variable is not possible because the classification is made by comparison to photographic examples of each class. Percentage marsh coverages for each class are not provided by model documentation. The FEIS description of the model was not intended to fully replicate the model documentation. The reader is encouraged to refer to the model documentation for a more complete understanding of model application methodology.

2.6.1.4 $V_4$ Percent of Open-Water Areas Less than or Equal to 1.5 feet deep

Deeper water is assumed to be less biologically productive than shallow water because sunlight, oxygen, and temperature are reduced as depth increases. Shallow water also provides better bottom access for waterfowl, better foraging habitat for wading birds, and more-favorable conditions for the growth of aquatic vegetation. Certain species typically use shallow water for spawning, feeding, and/or shelter during various life stages (e.g., white/brown shrimp, Gulf flounder, red drum, roseate spoonbill, and mottled duck). SIs for shallow water are calculated differently for fresh/intermediate, brackish and saline

marshes. Optimal shallow-water conditions in fresh/intermediate marsh are assumed when 80 to 90 percent of the open water is equal to or less than 1.5 feet deep. It is assumed that brackish marshes generally contain deeper open-water areas because of tidal scouring, and therefore lower percentages of shallow water receive a higher SI than in fresh/intermediate marsh. The SI for saline marsh is similar to that of brackish marsh, with one difference. The SI for 100 percent shallow water is slightly less than that for brackish marsh, reflecting the importance of deeper tidal channels for estuarine organism access into saline marshes.

**$V_4$ Line Formulas**

Fresh/intermediate marsh

If $0 \leq \% < 80$, then $SI = (0.01125 \times \% V_4) + 0.1$

If $80 \leq \% \leq 90$, then $SI = 1.0$

If $\% > 90$, then $SI = (-0.04 \times \% V_4) + 4.6$

Brackish marsh

If $0 \leq \% < 70$, then $SI = (0.01286 \times \% V_4) + 0.1$

If $70 \leq \% \leq 80$, then $SI = 1.0$

If $\% > 80$, then $SI = (-0.02 \times \% V_4) + 2.6$

Saline marsh

If $0 \leq \% < 70$, then $SI = (0.01286 \times \% V_4) + 0.1$

If $70 \leq \% \leq 80$, then $SI = 1.0$

If $\% > 80$, then $SI = (-0.025 \times \% V_4) + 3.0$

2.6.1.5 $V_5$ Salinity

This variable may appear to duplicate or overlap with $V_1$ (emergent marsh cover) because the functionality and potential land loss of the marsh vegetation are related to salinity. However, this variable was included as a separate variable in order to account for salinity impacts to fish and wildlife as well as to vegetation.

Salinity is one of the most important factors affecting coastal land loss. Salinity projections affect all of the other WVA variables with the exception of aquatic organism access. Small increases in mean salinity can adversely affect aquatic systems by reducing overall biological productivity. A recent extensive literature review (Visser et al., 2004) compiled information on the effect of salinity on the productivity of emergent tidal marsh. Productivity algorithms, based upon measurements of total biomass, stem/leaf elongation, and photosynthesis, were developed that predict changes in primary productivity for every part per thousand change in salinity. Salinity and primary productivity were found to be inversely related, as salinity increases, primary productivity decreases by different amounts dependent upon the salinity tolerance of the vegetation community.

For fresh/intermediate marshes, the mean high salinity (calculated as a roaming mean of the highest 33 percent consecutive salinity readings) during the growing season is used to assess impacts. For

brackish and saline marshes, average annual salinity is used. Optimum salinity ranges assumed by the model for the various habitat types are as follows: swamp and bottomland hardwood (≤1 ppt), fresh marsh (≤2 ppt), intermediate marsh (≤4 ppt), brackish marsh (≤10 ppt), and saline marsh (≥9 and ≤ 1 ppt). For $V_5$, salinity changes within the optimal salinity ranges of each marsh type are not considered an impact, and are assigned a maximum suitability index score of "1." But even a small salinity change outside of these optimal ranges, as shown in the formulas for the salinity variable, reduce the suitability index scores below "1."

**$V_5$ Line Formulas**

Fresh marsh

If $0 \leq ppt \leq 2$, then $SI = 1.0$

If $2 < ppt \leq 4$, then $SI = (-0.4 \times ppt) + 1.8$

If $4 < ppt \leq 5$, then $SI = (-0.1 \times ppt) + 0.6$

Intermediate marsh

If $0 \leq ppt \leq 4$, then $SI = 1.0$

If $4 < ppt \leq 8$, then $SI = (-0.2 \times ppt) + 1.8$

Brackish marsh

If $0 \leq ppt \leq 10$, then $SI = 1.0$

If $ppt > 10$, then $SI = (-0.15 \times ppt) + 2.5$

Saline marsh

If $9 \leq ppt \leq 21$, then $SI = 1.0$

If $ppt > 21$, then $SI = (-0.067 \times ppt) + 2.4$

### 2.6.1.6 $V_6$ Aquatic Organism Access

Access by estuarine-dependent fishes and shellfishes, as well as other aquatic organisms, is important in assessing the quality of marsh systems. It is assumed that a high degree of surface hydrologic connectivity with adjacent systems provides high organism access, as well as providing greater nutrient exchange. The SI is calculated by determining an Access Value that is based on an interaction between the wetland area accessible to aquatic organisms during normal tidal fluctuations and the type of man-made structures (if any) blocking access channels (USFWS, 2002c: Appendix B). Access ratings for specific structures, developed by the Louisiana EnvWG, were adopted for the SNWW application. The installation and operation of water control structures has been shown to significantly impact marine fishery access to, use of, and production on wetlands behind those structures (Rogers and Herke, 1985; Herke et al., 1992; Rogers et al., 1992; Sanzone and McElroy, 1998); therefore, optimal conditions are assumed when the entire wetland area is accessible and access points are unobstructed. Brackish and saline marshes are assumed to be more important than fresh/intermediate marshes as habitat for estuarine-dependent fish and shellfish.

**$V_6$ Line Formulas**

Fresh marsh

SI= (0.7 x Access Value) + 0.3

Intermediate marsh

SI= (0.8 x Access Value) + 0.2

Brackish and saline marsh

SI= (0.9 x Access Value) + 0.1

The Structure Rating Table for $V_6$ (Aquatic Organism Access) was not included because the appropriate application of these ratings requires additional considerations that are described in detail in the model documentation. The FEIS description of the model was not intended to fully replicate the model documentation. The reader is encouraged to refer to the model documentation for a more complete understanding of model application methodology.

### 2.6.2 Habitat Suitability Index Formulas

All of the variable suitability indices (SIV) for a specific marsh type (i.e., fresh/intermediate, brackish, or saline) are combined in a mathematical formula, the HSI, which represents the composite habitat quality of the wetland being evaluated. Within each HSI formula, specific variables can be weighted to increase the relative importance of that variable over others in the formula. The HSI formulae were the same as those used by the CWPPRA EnvWG.

The primary focus of the SNWW application of the WVA model is the preservation of vegetated wetlands, but it is also recognized that some marsh restoration or protection strategies could have an adverse effect on the access of aquatic organisms. Therefore, variables $V_1$ (Percent Emergent Vegetation), $V_2$ (Percent SAV), and $V_6$ (Aquatic Organism Access) are grouped together and weighted greater than the remaining variables. For all marsh models, $V_1$ receives the greatest weighting; however, the relative weights of $V_1$, $V_2$, and $V_6$ vary by marsh model to reflect different levels of importance between the marsh types.

WVA emergent marsh models employ a split model format to account for the value of both marsh and open-water habitats. Two HSI formulas are calculated for each marsh type—one for emergent marsh habitat and one for open-water habitat. The HSI formula for emergent marsh contains only those variables that are important for evaluating its habitat quality ($V_1$, $V_3$, $V_5$, and $V_6$). The HSI formula for open-water habitat contains only those variables important to that habitat component ($V_2$, $V_3$, $V_4$, $V_5$, and $V_6$).

**Fresh/Intermediate Marsh HSI**

$$\text{Emergent Marsh HSI} = \frac{(3.5 \times (SIV_1{}^5 \times SIV_6{}^1)^{(1/6)}) + \underline{(SIV_3 + SIV_5)}}{4.5}$$

$$\text{Open Water HSI} = \frac{(3.5 \times (SIV_2{}^3 \times SIV_6{}^1)^{(1/4)}) + \underline{(SIV_3 + SIV_4 + SIV_5)}}{4.5}$$

**Brackish Marsh HSI**

Emergent Marsh HSI = $$\frac{(3.5 \times (SIV_1^{\ 5} \times SIV_6^{\ 1.5})^{(1/6.5)}) + (SIV_3 + SIV_5)}{4.5}$$

Open Water HSI = $$\frac{(3.5 \times (SIV_2^{\ 3} \times SIV_6^{\ 2})^{(1/5)}) + (SIV_3 + SIV_4 + SIV_5)}{4.5}$$

**Saline Marsh HSI**

Emergent Marsh HSI = $$\frac{(3.5 \times (SIV_1^{\ 3} \times SIV_6^{\ 1})^{(1/4)}) + (SIV_3 + SIV_5)}{4.5}$$

Open Water HSI = $$\frac{(3.5 \times (SIV_2^{\ 1} \times SIV_6^{\ 2.5})^{(1/3.5)}) + \frac{(SIV_3 + SIV_4 + SIV_5)}{3}}{4.5}$$

Since the marsh models are split into emergent marsh and open-water components, an HSI is calculated for both. Net AAHUs, determined for both components, must be combined to determine total net benefits. In the weighted formulas for determining net AAHUs for each marsh type (below), AAHUs for emergent marsh are weighted higher than open-water AAHUs to reflect the ICT emphasis on marsh restoration/protection over open-water habitat.

Fresh/Intermediate Marsh: $$\frac{2.1\ (\text{Emergent Marsh AAHUs}) + \text{Open-water AAHUs}}{3.1}$$

Brackish Marsh: $$\frac{2.6\ (\text{Emergent Marsh AAHUs}) + \text{Open-water AAHUs}}{3.6}$$

Saline Marsh: $$\frac{3.5\ (\text{Emergent Marsh AAHUs}) + \text{Open-water AAHUs}}{4.5}$$

## 2.7 SWAMP COMMUNITY MODEL (SCM)

In 2001, the EnvWG developed the swamp community model for use in the Louisiana CWPPRA program by modifying a recent LDNR model (USFWS, 2002d). Variables included in the model were selected based upon their ability to evaluate the suitability of swamp habitat in providing resting, foraging, and nesting habitat for a wide variety of wildlife species. In general, the swamp model can be applied if woody canopy cover is at least 33 percent of the surface area, and at least 60 percent of the canopy consists of any combination of bald cypress, tupelo-gum, red maple, buttonbush (*Cephalanthus occidentalis*), and/or planertree (*Planera aquatica*). Variable selection for the original swamp model

developed by LDNR was based upon a review of USFWS HSI models for various bird and small mammal species and a USFWS community model for forest birds. Other variables were added by the EnvWG to reflect different aspects of habitat quality, landscape function, and salinity.

The following four variables represent swamp habitat quality in the model:

$V_1$ stand structure
$V_2$ stand maturity
$V_3$ water regime
$V_4$ mean high salinity during the growing season

2.7.1 Modeling Assumptions for Suitability Indices

2.7.1.1 $V_1$ Stand Structure

Wildlife foods in swamp habitats consist predominantly of soft mast, other edible seeds, invertebrates, and vegetation. Since most swamp tree species produce soft mast or edible seeds, the actual tree species composition is not considered a limiting factor. However, a variety of stand structure should be present to provide appropriate habitat for resting, foraging, breeding, nesting, and nursery activities. Three structures are evaluated: (1) overstory closure, (2) scrub-shrub midstory cover, and (3) herbaceous cover. The variable assigns the lowest suitability to sites with a limited amount of all three stand structures, and the highest suitability to sites with significant amounts of all three stand structures.

**$V_1$ SI Classes**

The SI for $V_1$ is not calculated with a line formula. Classes and associated SI are assigned according to the relative percentages of structure classes as shown below.

| | Overstory Closure (%) | | Shrub/Scrub Midstory Cover (%) | | Herbaceous Cover (%) | Suitability Index (SI) |
|---|---|---|---|---|---|---|
| Class 1 | <33 | | n/a | | n/a | 0.1 |
| Class 2 | 33 <50 | and | <33 | and | <33 | 0.2 |
| Class 3 | 33 <50 | and | >33 | or | >33 | 0.4 |
| Class 4 | 50–75 | and | >33 | or | >33 | 0.6 |
| Class 5 | 33–<50 | and | >33 | and | >33 | 0.8 |
| Class 6 | ≥50 | and | >33 | and | >33 | 1.0 |
| | | | OR | | | |
| | ≥75 | and | >33 | or | >33 | 1.0 |

2.7.1.2 $V_2$ Stand Maturity

Swamps with mature sizable trees are considered to be rare and ecologically important because of the historical loss of swamp habitat from timber harvesting, saltwater intrusion, and a reduced growth rate in the subsiding coastal zone. Two components, stand age and stand density, are combined in the SI for this variable. Stand age is included because older trees provide important wildlife requisites such as snags, nesting cavities, and the medium for invertebrate production. Additionally, as the older, stronger trees establish themselves in the canopy, weaker trees die and form additional snags that would not be present in younger stands. Stand age is determined by average trunk diameter measured at breast height (dbh). The optimal size for canopy-dominant and canopy co-dominant bald cypress is greater than 16 inches, and greater than 12 inches for tupelo-gum and other species. Stand density allows evaluation of mature swamp ecosystems that contain an overstory of a few widely scattered, mature bald cypresses but in which other stand characteristics important for nesting, foraging, and other habitat functions are absent. Basal area is used as a measure of stand density; it measures how much of the forest floor is covered by the area of standing tree trunks. Stand age and density are evaluated separately for cypress and tupelo-gum.

**$V_2$ SI Line Formulas for bald cypress**

If dbh = 0 then SI = 0

If 0 < dbh ≤1 then SI = 0.01 x dbh

If 1 < dbh ≤4 then SI = (0.013 x dbh) - 0.002

If 4 < dbh ≤7 then SI = (0.017 x dbh) - 0.019

If 7 < dbh ≤9 then SI = (0.1 x dbh) - 0.6

If 9 < dbh ≤11 then SI = (0.15 x dbh) - 1.05

If 11 < dbh ≤13 then SI = (0.1 x dbh) - 0.5

If 13 < dbh ≤16 then SI= (0.067 x dbh) - 0.071

If dbh >16 then SI = 1.0.

**$V_2$ SI Line Formulas for tupelo-gum et al.**

If dbh = 0 then SI = 0

If 0 < dbh ≤1 then SI = 0.01 x dbh

If 1 < dbh ≤2 then SI = (0.04 x dbh) - 0.03

If 2 < dbh ≤4 then SI = 0.025 x dbh

If 4 < dbh ≤6 then SI = (0.1 x dbh) - 0.3

If 6 < dbh ≤8 then SI = (0.15 x dbh) - 0.6

If 8 < dbh ≤12 then SI = (0.1 x dbh) - 0.2

If dbh >12 then SI = 1.0.

**$V_2$ SI Line Formulas for Basal Area (BA)**

If open (BA <40 $ft^2$), then SI = 0.2 x BA

If moderately open (40 $ft^2 \leq$ BA $\leq$80 $ft^2$), then SI = 0.4 x BA

If moderate (81 $ft^2 \leq$ BA $\leq$120 $ft^2$), then SI = 0.6 x BA

If moderately dense (121 $ft^2 \leq$ BA $\leq$ 60 $ft^2$), then SI = 0.8 x BA

If dense (>160 $ft^2$), then SI = 1.0 x BA

2.7.1.3 $V_3$ Water Regime

Seasonal flooding with periodic drying cycles increases nutrient cycling, vertical structure complexity, and recruitment of dominant overstory trees. The optimal water regime is assumed to be seasonal flooding with abundant and consistent riverine/tidal input and water flow-through. Optimal flow-through is assumed to be an abundant and consistent input, allowing maximum use as fish and wildlife habitat. Temporary or seasonal flooding is optimal because permanent flooding produces poor water quality during warm weather and reduces fish and invertebrate production.

The SI for $V_3$ is not calculated with a line formula. Classes and associated SI are assigned according to the various combinations of four flow/exchange and four flooding duration categories as shown below.

**$V_3$ Categories**

| | | Flow/Exchange | | | |
|---|---|---|---|---|---|
| | | High | Moderate | Low | None |
| Flooding Duration | Seasonal | 1.00 | 0.85 | 0.70 | 0.50 |
| | Temporary | 0.90 | 0.75 | 0.65 | 0.40 |
| | Semipermanent | 0.75 | 0.65 | 0.45 | 0.25 |
| | Permanent | 0.65 | 0.45 | 0.30 | 0.10 |

2.7.1.4 $V_4$ Mean High Salinity During the Growing Season

Many swamp species, especially tupelo-gum and many herbaceous species, are salinity sensitive (Conner et al., 1997; Pezeshki et al., 1989). Swamp systems may be acutely affected by the sudden addition of only a few parts per thousand of salt during an intrusion event (Reid and Wood, 1976). Primary biological productivity is lowered 8.4 percent for each 1 ppt increase in salinity, slowing growth rates for dominant overstory species such as tupelo-gum (and, to a lesser degree, bald cypress since it is more salt tolerant), reducing the overstory coverage, and reducing the percentage cover and variety of fresh, herbaceous understory vegetation. These changes would result in lower wildlife values for forage, cover, and reproduction (Palmisano, 1972).

Bald cypress is able to tolerate higher salinities than the other species. Optimal conditions are assumed to occur at salinities less than 1 ppt, and habitat suitability is assumed to decrease rapidly as mean high

salinities exceed that mark. Mean high salinity during the growing season (March 1 through October 31) is defined as the average of the highest 33 percent consecutive salinity readings.

**$V_4$ SI Line Formulas**

If $0 \leq ppt \leq 1.0$, then $SI = 1.0$

If $1.0 < ppt < 3.0$, then $SI = (-0.45 \times ppt) + 1.45$

If $ppt \geq 3.0$, then $SI = 0.1$

2.7.2 Habitat Suitability Index Formula

All of the variable SIV are combined in a mathematical formula, the HSI, which represents the composite habitat quality. Variables $V_1$ and $V_3$ (stand structure and water regime) are considered the most important variables in characterizing swamp habitat quality and therefore are weighted heavier than other variables. Variable $V_4$ (salinity) was considered to be least important.

**Swamp HSI**

$$HSI = (SI\ V_1^3 \times SI\ V_2^{2.5} \times SI\ V_3^3 \times SI\ V_4^{1.5})^{1/10}$$

2.8 BOTTOMLAND HARDWOOD MODEL

In 1993, the LDNR developed a BHM for use in quantifying impacts and mitigation for permitted activities in the coastal zone (LDNR, 1993). This model was adopted by the Habitat Workgroup for use in conjunction with ecological modeling for the SNWW Feasibility Study. It applies to forested wetlands that support a canopy of woody vegetation of which more than 40 percent of tree species consist of oaks, hickories, American elm, cedar elm (*Ulmus crassifolia*), green ash, sweetgum, sugarberry (*Celtis laevigata*), boxelder (*Acer negundo*), common persimmon (*Diospyros virginiana*), honeylocust (*Gleditsia triacanthos*), red mulberry (*Morus rubra*), eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*), and American sycamore (*Platanus occidentalis*). Variable selection for the model was based upon a review of various USFWS HSI models for bottomland hardwood wildlife.

The following variables represent bottomland hardwood habitat quality in the model:

$V_1$ Tree Species Composition
$V_2$ Stand Maturity
$V_3$ Midstory/Understory
$V_4$ Hydrology
$V_5$ Size of Contiguous Forested Area
$V_6$ Surrounding Land Uses
$V_7$ Disturbance

### 2.8.1 Modeling Assumptions for Suitability Indices

#### 2.8.1.1 $V_1$ Tree Species Composition

Bottomland hardwood wildlife depends heavily on mast, other edible seeds, and tree buds as primary sources of food. The model assumes that more production of mast and other edible seeds is better than less, and that hard mast is more critical than soft mast because it is available during late fall and winter and has high energy content. Typical hard mast producers in the SNWW study area are oaks, pecan, and other hickories. Soft mast and other edible seeds are produced by red maple, sugarberry, green ash, boxelder, common persimmon, sweetgum, honeylocust, red mulberry, bald cypress, tupelo-gum, American elm, and cedar elm. Nonmast/inedible seed producers are eastern cottonwood, black willow, and American sycamore. The model defines five classes based upon the percentage of the overstory that contains mast-producing trees, and the percentage of hard mast producers in the canopy.

The SI for $V_1$ is not calculated with a line formula. Classes and associated SI are assigned according to the various classes as shown below.

**$V_1$ Classes of Tree Species Composition**

| | Description | SI |
|---|---|---|
| Class 1 | <25% mast or other edible-seed-producing trees in overstory | 0.2 |
| Class 2 | 25% to 50% mast or other edible-seed-producing trees in overstory; hard mast producers <10 percent of canopy | 0.4 |
| Class 3 | 25% to 50% mast or other edible-seed-producing trees in overstory; hard mast producers >10 percent of canopy | 0.6 |
| Class 4 | >50% mast or other edible-seed-producing trees in overstory; hard mast producers <20 percent of canopy | 0.8 |
| Class 5 | >50% mast or other edible-seed-producing trees in overstory; hard mast producers >20 percent of canopy | 1.0 |

#### 2.8.1.2 $V_2$ Stand Maturity

Mature stands of bottomland hardwood are rare in the study area and ecologically important. Historical and ongoing timber harvesting has reduced the number of mature stands and increased the ecological importance of those that remain. These stands provide more hard and soft mast, other edible seeds, and buds than younger stands. They provide important wildlife requisites such as snags, nesting cavities, and medium for invertebrate production. Older, stronger trees in the canopy outcompete understory trees and stimulate the production of additional snags and downed treetops as younger trees die.

**$V_2$ SI Line Formulas**

If dbh = 0 then SI = 0

If 0 < dbh ≤5 then SI = 0.01 x dbh

If 5 < dbh ≤8 then SI = (0.017 x dbh) - 0.03

If 8 < dbh ≤11 then SI = (0.067 x dbh) - 0.43

If 11 < dbh ≤14 then SI = (0.1 x dbh) - 0.8

If 14 < dbh ≤20 then SI = (0.067 x dbh) - 0.33

If dbh >20 then SI = 1.0.

2.8.1.3 $V_3$ Midstory/Understory

Midstory and understory plants also provide important food sources for bottomland hardwood wildlife. Understory and midstory SIs are calculated separately and averaged for the variable SI. The model assumes that the value of understory coverages increases as the percent of understory coverage increases between 0 and 30 percent. Optimal understory coverage is assumed to be between 30 and 60 percent. The SI decreases slowly when understory coverage exceeds 60 percent, based upon the assumptions that denser understory inhibits access and is less preferable for breeding, nesting, and feeding activities.

**$V_3$ Understory Percent SI Line Formulas**

If understory % = 0 then SI = 0.01

If 0 < understory % ≤30 then SI = (0.03 x understory %) + 0.1

If 30 < understory % <60 then SI = 1.0

If understory % >60 then SI = (–0.01 x understory %) + 1.6

The value of midstory coverage increases as the percent coverage increases between 0 and 20 percent. Optimal midstory coverage is assumed to be between 20 and 50 percent. The SI decreases slowly when midstory coverage exceeds 50 percent, based upon the assumptions that denser midstory inhibits understory growth and provides less preferable habitat for breeding, nesting, and feeding activities.

**$V_3$ Midstory Percent SI Line Formulas**

If midstory % = 0, then SI = 0.01

If 0 < midstory % ≤20 then SI = (0.045 x midstory %) + 0.1

If 20 < midstory % ≤50 then SI = 1.0

If midstory % >50 then SI = (–0.01 * midstory %) + 1.5

2.8.1.4 $V_4$ Hydrology

The model assumes that the optimum hydrology for stands of bottomland hardwood is one that is essentially unaltered from natural conditions, allowing natural wetting and drying cycles that are beneficial to vegetation and associated fish and wildlife species. In addition to this unaltered class, three other classes of altered water regimes are commonly found in the study area. For areas with efficient forced drainage, the vegetation provides some habitat value, but water-dependent wildlife are excluded

and there is no fisheries production. For areas with a moderately lowered water table, the vegetation provides excellent habitat for many wildlife species and temporary habitat for water-dependent wildlife, but fisheries production is still excluded. Areas with a raised water table provide habitat for fish and water-dependent wildlife that is equivalent to an unaltered system, but vegetation and associated wildlife are adversely affected.

The SI for $V_4$ is not calculated with a line formula. Classes and associated SI are assigned according to the various classes as shown below.

**$V_4$ Hydrology Classes**

| | Description | SI |
|---|---|---|
| Class 1 | Forced drainage system – efficiently removes water from the surface year-round | 0.1 |
| Class 2 | Water table lowered relative to ground level so as to significantly reduce period of inundation<br>OR<br>Water table raised so as to cause extended inundation or impoundment | 0.5 |
| Class 3 | Hydrology essentially unaltered (with exception of small levees and/or ditches that do not significantly affect water regime) | 1.0 |

2.8.1.5 $V_5$ Size of Contiguous Forested Area

The model assumes that larger forested tracts are less common and offer higher-quality habitat than smaller tracts, and that species in greatest need of conservation are specialists in habitat use requiring large forested tracts. It is recognized that forest edge and diversity are important, but the model assumes that species that thrive in edge habitat are highly mobile and occur in substantial numbers because of the increase in forest fragmentation. Species found in "edge" habitat are generalists in habitat use but are capable of existing in larger tracts. For this model, tracts greater than 500 acres in size are considered optimal.

The SI for $V_5$ is not calculated with a line formula. Classes and associated SI are assigned according to the various classes as shown below.

**$V_5$ SI for Classes of Contiguous Forested Area**

| | Description | SI |
|---|---|---|
| Class 1 | 0 to 5 acres | 0.2 |
| Class 2 | 5.1 to 20 acres | 0.4 |
| Class 3 | 20.1 to 100 acres | 0.6 |
| Class 4 | 100.1 to 500 acres | 0.8 |
| Class 5 | >500 acres | 1.0 |

2.8.1.6 $V_6$ Surrounding Land Uses

The model assumes that surrounding land uses affect the wildlife value of specific bottomland hardwood tracts. Many wildlife species commonly use adjacent areas as temporary escape or resting cover, as seasonal or diurnal food sources, or as connecting corridors to other desirable habitats. Surrounding areas that meet these needs can make a specific bottomland hardwood area more valuable. Furthermore, some types of surrounding land use are more valuable than others in providing food sources or encouraging wildlife movement. The model defines five types of surrounding land use that are typically found in the study area, and assigns weighting factors that reflect their estimated potential in meeting specific needs. The effect of surrounding land use is measured within a 0.5-mile perimeter of the bottomland hardwood tract. The percent of this area occupied by each of the land use types is calculated and summed. If 100 percent of the Surrounding Habitat is considered nonhabitat, SI equals 0.01.

The SI for $V_6$ is not calculated with a line formula. The SI is calculated using the various classes and weighting factors shown below.

**$V_6$ SI for Surrounding Land Use**

| Land Use | Weighting Factor | | Percent of 0.5-mile Circle | | Weighted Percent |
|---|---|---|---|---|---|
| Bottomland hardwood, other forested areas, marsh habitat, etc. | 1.0 | x | | = | |
| Abandoned agriculture, overgrown fields, dense cover, etc. | 0.6 | x | | = | |
| Pasture, hayfields, etc. | 0.4 | x | | = | |
| Active agriculture | 0.2 | x | | = | |
| Nonhabitat: linear, residential, commercial, industrial development, etc. | 0.0 | x | | = | |
| | | | | | Total/100 = SI |

2.8.1.7 $V_7$ Disturbance

It is assumed that human-induced disturbance can displace individuals, modify home ranges, interfere with reproduction, cause stress, and force animals to use important energy reserves. The model measures the effect of disturbance using two components: (1) type of disturbance, and (2) distance from disturbance. The magnitude of the effect of each type of disturbance is a factor of the distance to that disturbance.

Separate suitability indices were developed for each of the type and distance factors as shown below.

| Distance Classes | | SI | Type Classes | | SI |
|---|---|---|---|---|---|
| Class 1 | 0 to 50 feet | 1 | Class 1 | Constant/Major (Major highways, industrial, commercial, major navigation) | 1 |
| Class 2 | 50.1 to 500 feet | 2 | Class 2 | Frequent/Moderate (Residential development, moderately used roads, waterways commonly used by small to mid-sized boats) | 2 |
| Class 3 | >500 feet | 3 | Class 3 | Seasonal/Intermittent (Agriculture, aquaculture) | 3 |
| | | | Class 4 | Insignificant (Lightly used roads and waterways, individual homes, levees, rights of way) | 4 |

The SI for $V_7$ is not calculated with a line formula. A combined SI for disturbance is assigned in accordance with various combinations of these factors as shown below.

**$V_7$ SI Disturbance**

| | | Type Class | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Distance Class | 1 | 0.01 | 0.26 | 0.41 | 1.0 |
| | 2 | 0.26 | 0.50 | 0.65 | 1.0 |
| | 3 | 1.0 | 1.0 | 1.0 | 1.0 |

### 2.8.2 Habitat Suitability Index Formula

The model incorporates site-specific habitat quality features (tree species composition, forest stand structure, stand maturity, and hydrology) and landscape parameters (forest size, surrounding land use, and disturbance). Because the primary application of this model is to quantify the loss of ecological values due to changes in the site-specific conditions, variables that are likely to be affected by these changes ($V_1$, $V_2$, $V_3$, and $V_4$) are considered more important than the landscape variables. Of the site-specific variables, $V_1$ (Tree Species Composition) and $V_2$ (Stand Maturity) are considered equal and of greater importance than the other variables; they are weighted to the power of four. Variables $V_3$ (Understory/Midstory) and $V_4$ (Hydrology) are weighted to the power of two. The "landscape" variables ($V_5$, $V_6$, $V_7$) are not weighted.

Additionally, the following factors influence the HSI formulas. The suitability index for $V_1$ (Tree Species Composition) and $V_3$ (Understory/Midstory) are a function of hard and soft mast production. Until the trees reach hard mast-bearing age (approximately 7 years of age), $V_1$ and $V_3$ do not affect the value of the site. Therefore, $V_1$ and $V_3$ are not incorporated into HSI formulas until the trees reach approximately 7 years of age (dbh $\geq$5 inches). $V_5$ (Forest Size) assigns a greater value to larger contiguous forested tracts than to edge and diversity. In keeping with that approach, seedlings and saplings present at a forest regeneration site are not yet part of the contiguous forested area. Therefore, $V_5$ is not incorporated into HSI formulas until dbh $\geq$5 inches.

**HSI formula for bottomland hardwood**

If dbh <5 inch, then $HSI = (SI_{V2}^{4} \times SI_{V4}^{2} \times SI_{V6} \times SI_{V7})^{1/8}$

If dbh $\geq$5 inch, then $HSI = (SI_{V1}^{4} \times SI_{V2}^{4} \times SI_{V3}^{2} \times SI_{V4}^{2} \times SI_{V5} \times SI_{V6} \times SI_{V7})^{1/15}$

## 3.0 HS MODELING

Application of the WVA EMCM and SCM relied upon a 3-dimensional (3-D) numerical HS model to provide values for salinity variables in both models. Information about the HS model, its development, and application in the SNWW WVA modeling are described below.

### 3.1 SNWW MODELING WORKGROUP

At the beginning of the study, the ICT established a Modeling Workgroup to advise and assist in development of the HS model for the SNWW study.

SNWW Modeling Workgroup
- USFWS – Clear Lake (Texas) Ecological Field Office
- USFWS – Louisiana Ecological Field Office
- NMFS – Galveston, Texas
- EPA, Region 6
- GLO
- TPWD – Federal Projects Review
- TWDB
- LDNR – Coastal Restoration Division
- LDWF
- USACE-Galveston District
- Engineer Research and Design Center (ERDC)-Coastal Hydraulics Laboratory (CHL)

Most of the agencies on the ICT were represented and several (TPWD, TWDB, and ERDC-CHL) provided individuals with experience and expertise in HS modeling. The Modeling Workgroup assisted and advised ERDC in the development of the original HS model, which was described in Brown et al. (2006). Due to changes in the recommended plan of navigation improvements and technical review recommendations, the HS model was revised in 2009 to incorporate the effects of RSLR and forecasts of future freshwater inflows into the FWOP and FWP conditions (Brown and Stokes, 2009). Due to schedule constraints, the Modeling Workgroup was not consulted during model development but the revised modeling was presented for ICT review. The model described below is the revised HS model developed in 2009.

### 3.2 DESCRIPTION OF THE HS MODEL

ERDC-CHL applied an established 3-D estuarine model (ERDC modified TABS MDS) to compute hydrodynamics and salinity transport for the SNWW study. It includes forcing due to tides, freshwater inflows, wind, Coriolis, and density gradients due to salinity variation, and accounts for precipitation and evaporation. The code uses a finite-element formulation, which gives it great flexibility in matching complex geometry. Over the last decade, the code has been extensively used for a variety of USACE field

projects, including the Houston-Galveston Navigation Channels project; New York Harbor; St. Johns River, Florida; and Atchafalaya Bay in Louisiana. Two of the special features of the code, wetting/drying and "marsh porosity," enable successful modeling of wetlands. A description of the model and its output is summarized in a draft report by ERDC-CHL (Brown and Stokes, 2009). The reader is referred to this report for a full technical explanation of the model. A description of assumptions and methods of HS model application is provided here to facilitate interpretation of salinity values applied in the WVA worksheets.

## 3.3 APPLICATION OF THE HS MODEL

The HS model was calibrated and verified using field observations collected by ERDC during a long-term data collection effort at 16 locations (stations) in the study area from May 16, 2001, through January 10, 2002 (Fagerburg, 2003). The long-term data collection effort was intended to provide adequate coverage to determine tidal velocity, magnitude, and direction, ranges of water level elevations, and changes in salinity concentration. In addition to the long-term effort, additional velocity and salinity data were collected during a short-term, intensive data collection effort at 10 transects over a 25-hour period during a spring tide event.

The model salinities were verified against salinity data from June through December 2001. An index with the location of all sampling locations and model nodes is provided in Table 4. For the baseline condition, model outputs were provided for all original sampling locations. Model nodes, or specific locations in the model mesh, were added later to obtain additional output for the FWP condition.

Future projections of freshwater inflow and accelerated rates of RSLR are likely to cause significant changes in the FWOP condition for the SNWW study's period of analysis (NRC, 1987; IPCC, 2007; Milliken et al., 2008a). It is, therefore, important that the implications of FWOP RSLR and freshwater inflows be explored relative to FWP salinity changes and related impacts to plant and animal communities in the study area. A summary of the wide range of possible future scenarios and rapidly changing scientific opinions on these issues is presented below, along with an explanation of assumptions that were used to revise the HS model runs.

### 3.3.1 RSLR Considerations

Incorporation of RSLR into HS modeling for the SNWW study was initiated in the fall of 2008 in consultation with Headquarters, USACE (HQUSACE). At that time, it was determined that the SNWW HS modeling would use Curve II from NRC (1987) to determine project impacts as it appeared to be the "most likely" eustatic sea level rise over the next 50 years. In the 1987 report, the NRC believed that the three NRC scenarios of sea level rise (i.e., 0.5, 1.0, and 1.5 meters over 100 years) would provide a useful range of possible future sea level changes for design calculations. The confidence that these scenarios will encompass actual future sea levels decreases over time, and significant deviations outside the range of these scenarios are possible, including an amelioration in the rate of rise. The NRC committee recommended that these projections be updated approximately every decade to incorporate additional data

and to provide an improved basis for planning and response to the rise. Since that time, new HQUSACE guidance on incorporating considerations of RSLR into USACE programs (EC 1165-2-211) was issued on July 1, 2009, to be effective immediately.

Table 4: SNWW HS Modeling Stations and Nodes

| H/S Sampling Station No.* | Name | Location |
|---|---|---|
| 1A | Upper Beaumont | Pine Island Bayou |
| 2 | Beaumont | Neches River opposite Rose City |
| 3 | Rainbow Bridge | Neches River downstream of lower Bessie Heights |
| 4 | Lower Sabine River | Mouth of Sabine River on GIWW |
| 5 | Orange | Sabine River at Interstate 10 |
| 6 | Port Arthur | Upstream of MLK bridge next to Pleasure Island |
| 7 | Sabine Pass | Texas Point |
| 8 | Sabine Offshore | Never deployed due to offshore conditions |
| 9 | Upper Sabine Lake | Mouth of East Pass/Black Bayou |
| 10 | Lower Sabine Lake | Blue Buck Point |
| 11 | Blacks Bayou | East of intersection with East Pass |
| 12 | GIWW East | Black Bayou at GIWW East |
| 13 | GIWW West | Star Lake at GIWW West |
| 14 | Johnson's Bayou | Inside mouth of Johnson's Bayou, southeast Sabine Lake shore |
| 15 | Keith Lake | West of Hwy 87 in Keith Lake Fish Pass |
| 16 | Willow Bayou | Inside mouth of Willow Bayou, east Sabine Lake shore |
| H/S Model Nodes** | | |
| 1B | Neches River Saltwater Barrier | New node just below saltwater barrier substituted for 1A |
| 17 | GIWW - Taylors Bayou | In GIWW near mouth of Taylor's Bayou diversion channel |
| 18 | Neches River near Beaumont | In meander south of Rose City Oil Field |
| 19 | Neches River at Port Neches | In mouth of Bessie Heights Canal |
| 20 | Upper Neches River | In mouth of Lake Bayou |
| 21 | Sabine River and Old River Confluence | Confluence of Sabine and Old River |
| 22 | Black Bayou at GIWW | At mouth of Black Bayou in GIWW East |
| 23 | Cow Bayou at Sabine River | In mouth of Cow Bayou |
| 24 | Adams Bayou at Sabine River | In mouth of Adams Bayou |
| 25 | Black Bayou at Sabine Lake | At mouth of Black Bayou at its intersection with East Pass |
| 26 | Between Black Bayou and Pines Ridge | In marsh |
| 27 | Black Bayou mid-point | In midpoint of Black Bayou |
| 28 | North of Black Bayou | In marsh between Black Bayou and GIWW East |
| 29 | Right Prong South of Black Bayou | In channel leading to NW corner of Pool 3 |
| 30 | Greens Lake | In Greens Lake west of Pool 3 |
| 31 | South of Pines Ridge | In marsh west of Greens Lake |
| 32 | Willow, Starks Central, Burton Sutton Cana | At SW corner of Pool 3 |
| 33 | Willow Bayou at Deep Bayou Canal | On canal midway between Pool 3 and Sabine Lake |
| 34 | Willow Bayou near Sabine Lake | In mouth of Willow Bayou on east shore of Sabine Lake |
| 35 | Johnson's Bayou at Sabine Lake | In mouth of Johnson's Bayou on east shore of Sabine Lake |
| 36 | Johnson's Bayou Landing | In Johnson's Bayou in marsh inland from SE corner of Sabine Lake |
| 37 | Deep Bayou Canal at Starks South Canal | In marsh east of node 35 |
| 38 | Starks South Canal at Burton Sutton Canal | In marsh south of SW corner of Pool 3 |
| * Stations are data location locations and model nodes. | | |
| ** Nodes are specific locations in the model mesh for which model output was derived. | | |
| | | |

This guidance requires that potential RSL change be considered in every USACE coastal activity. Planning studies should evaluate alternatives using three specific rates of potential future sea level change for both the FWOP and FWP conditions. The base, or low, level of potential RSL change should be the long-term historic rate of RSL change at the closest tide gage station. The intermediate and high rates of local sea level change should be evaluated using a modified NRC Curve I and Curve III, respectively. The intermediate rate falls within the range of IPCC's least and most extreme sea level rise scenarios. The high rate exceeds the upper bounds of the 2007 IPCC estimates, accommodating the potential rapid loss of ice from Antarctica and Greenland. Faster melting of these ice sheets would increase their contributions to twenty-first-century sea level rise and raise levels above those currently projected. Indeed, some recent studies of geologic terrestrial and marine records support the plausibility of higher projections of sea level rise, on the order of 1.0 ± 0.5 meters by A.D. 2100 (Rahmstorf, 2007; Rohling et al., 2007; Carlson, et al., 2008). A sensitivity analysis has been prepared to determine how sensitive the SNWW alternatives would be to the three levels of change. This analysis is presented in Section 9 of this report.

Table 5 gives the various computed future rates of RSLR in the SNWW study area that were prepared per the most recent guidance (EC 1165-2-211, July 2009). According to this guidance, the subsidence rate should be chosen based on the tidal record analysis. However, the regional scientific debate concerning the validity of these tidal records with respect to projection of future subsidence rates indicate that the basal peat rates should also be considered. The existing rate of eustatic sea level rise in the SNWW study area, and various projections as delineated in the NRC (1987) and IPCC (2007, AR4 Working Group 1:820) reports. Among all of the emission scenarios, the IPCC's A1B scenario provides the central estimate of the rate of sea level rise during the period 2090 to 2099 at 3.8 mm per year. The range provided in Table 5 for the IPCC scenarios gives the low, middle, and high ranges of the potential rise in sea level between 1980 to 1999 and 2090 to 2099 as taken from Scenarios B1, A1B, and A1F1, respectively.

Table 5: Predicted RSLR Rates for the SNWW Study Area

| Predicted Rates of Future RSLR | Observed Tide Gage Values (rapid subsidence) | Observed Basal Peat Values (moderate subsidence) |
|---|---|---|
| Low Rate (Historic) | 1.1 feet/year | 0.3 foot/year |
| Intermediate Rate (Modified NRC Curve I) | 1.5 feet/year | 0.7 foot/year |
| High rate (Modified NRC Curve III) | 2.8 feet/year | 2.2 feet/year |

In Coastal Louisiana, the local subsidence component of RSLR is at a minimum on the same order of magnitude as the eustatic component. To date, there is no scientific consensus on what this rate should be, and the estimates vary by orders of magnitude. However, it should be noted that subsidence in the Chenier Plain in western Louisiana and eastern Texas is much lower than rates found to the east. The

Chenier Plain lies beyond the limits of downloading by the deep Holocene Mississippi Delta sediments (Simms et al., 2007). Rather than hundreds of feet of silty sediment, the Pleistocene surface lies beneath 49 feet of sediment in the Chenier Plain (Penland and Ramsey, 1990). Table 6 gives several estimates of this local subsidence component.

Table 6: Estimates of Local Subsidence

| Researchers | Primary Source of Data | Subsidence Rate | Total Subsidence (50 years) |
|---|---|---|---|
| Shinkle and Dokka (2004) | National Geological Survey (NGS) survey releveling/benchmark data | 10–15 mm/year | 500–750 mm |
| Morton et al. (2006) and others | Tide data | 2–5 mm/year | 100–250 mm |
| Törnqvist et al. (2006) | Sedimentary record | 0.4–0.6 mm/year | 20–30 mm |

The highest estimates of local subsidence are attributed to the research of Shinkle and Dokka (2004). They conducted an analysis of the settling rates of established benchmarks and Global Positioning System (GPS) observations, and verified these against rates obtained from water level data from the National Ocean Service. They concluded that local subsidence at the Sabine-Neches estuary is on the order to 10 to 15 mm/year. These results are based on data representative of approximately 75 years. The authors note that the rates of subsidence vary greatly both spatially and temporally, and any attempts to project these rates forward in time should be done with this in mind.

Several other researchers have obtained values of subsidence that are much lower than those given by Shinkle and Dokka (2004). For example, Morton et al. (2006) used data from tide gages and found a rate of subsidence of 2 to 5 mm year. Törnqvist et al. (2006) conducted an analysis of basal peat layers in the Mississippi Delta area to generate a proxy record of RSLR over approximately 10,000 years. The results indicate a relative local subsidence rate of only 0.4 to 0.6 mm/year. This subsidence rate was confirmed for the Sabine estuary by a recent field study of basal peat layers, in which it was determined that, during the Holocene, sea level rose more or less continuously at rates less than 5.2 mm/year (Milliken et al., 2008a).

Currently, there is no established consensus as to which rates are most appropriate for use in generating projected rates of subsidence. Morton et al. (2006) assert that the higher rates observed by Shinkle and Dokka (2004) are likely attributable to large-scale fluid extraction from the subsurface. Milliken et al. (2008b) and Gonzalez and Törnqvist (2006) assert that these higher rates do not appear to correlate well with trends observed in the basal peat data, and therefore are likely due to some temporary or anthropogenically induced cause. However, Berman (2005) notes that the methods used by Shinkle and Dokka (2004) are sound and follow accepted guidelines, and that the results should not therefore be dismissed merely because they are anomalous. Although the Shinkle and Dokka (2004) data may indicate that local subsidence is proceeding much more rapidly than previously thought, the SNWW deepening study relied on the results of the basal peat analysis. These represent long-term trends in the subsidence

rate and seem to be the closest approximation of consensus concerning the local subsidence rate currently available.

HS modeling and environmental analyses were updated to include the effects of RSLR on the project impacts. These impacts were included by analyzing both the with- and without-project conditions for a single "most likely" future sea level rise condition that was based on NRC Curve II. Adding subsidence rates estimated using the basal peat analysis to the NRC II projections for eustatic sea level rise, the value for the RSLR in the SNWW study area over 50 years would be 245 to 255 mm (4.9 to 5.1 mm/year). The average of this range (250 mm/year) has been used for modeling purposes. Hence, the "most likely" value of RSLR to be used for the SNWW deepening study's 50-year period of analysis is 250 mm or 0.82 feet. Adjusting this to account for the period of analysis beginning in 2019 and ending in 2069, the "most likely" amount of RSLR by the year 2069 is 1.1 feet. The new guidance was released subsequent to the completion of this reanalysis. The modeled "most likely" rate is between the intermediate and high rates for the moderate subsidence case, and close to the low rate for the high subsidence case. Hence, the "most likely" rate is within the range of the rates recommended for consideration in the most recent guidance.

Inclusion of RSLR in the WVA modeling required the development of new estimates of FWOP shoreline recession rates and adjustment of FWOP land loss rates for interior marsh areas. The forecasted 1.1 feet of RSLR was used to identify shoreline areas expected to be submerged during the revised period of analysis (2019 to 2069). Project effects of RSLR to interior marsh areas are expected to be limited to an increase in salinity, and are modeled with the WVA. Assumptions and methodologies used to estimate shoreline recession and land loss rates over the period of analysis are presented below.

#### 3.3.1.1 RSLR-related Shoreline Recession

The forecasted rate of RSLR would result in the recession of Gulf and Sabine Lake shorelines in the SNWW study area. Potential problems associated with sea level change can be categorized into two classes: those of the open coast and large waterbodies where both water level and wave action are concerns, and those of inland tidal waters where wave action is usually much less severe (NRC, 1987). The NRC report discusses different approaches that can be used to model the change in shoreline configuration associated with RSLR. Two of those techniques were applied to project shoreline recession in the SNWW study area over the period of analysis (2019 thru 2069).

The first technique is recommended for areas of active wave attack and erosion and was applied to the Texas Gulf of Mexico shoreline and the eastern shoreline of Sabine Lake. It is a historical trend analysis that includes an adjustment for higher future rates of RSLR. The second method was applied to the shorelines of interior lakes and inland waterways where the wave climate is subdued, and the stable or accreting Louisiana Gulf shoreline (as described below). This method involves applying the projected change in sea level over the period of analysis to preexisting topography.

Two major factors influencing erosion and eventual shoreline profiles are fetch and exposure to predominant directions of wave approach (Wilson and Allison, 2008). In the SNWW study area,

prevailing winds and wave approach are from the southeast but northers frequently occur during winter months (Anderson, 2007). The portions of the study area most affected by these prevailing wind patterns are the Gulf shoreline and the eastern shore of Sabine Lake. In Sabine Lake, fetch and wave attack associated with prevailing southeasterly winds primarily affect the western shore; an area that is protected from erosion by riprapped levees around PAs 8 and 11. These levees are quite large and sufficiently high such that the rates of RSLR predicted here would have little to no effect. Winter northers, however, do affect the unprotected eastern shore of Sabine Lake (Greco and Clark, 2005; Parchure et al., 2005).

For the Gulf and east Sabine Lake shorelines, the historical trend analysis, modified by the projected RSLR over the period of analysis, was used to project shoreline recession (NRC, 1987:51). Historical rates of change incorporate the inherent variability of the shoreline response based upon local coastal processes, local subsidence rates, coastline exposure, the local sedimentary environment, and eustatic sea level changes. This method assumes that the amount of recession during the historical record is directly correlated with the rate of sea level rise. Therefore, an accelerated rate of RSLR is assumed to result in a commensurate accelerated increase in shoreline recession. For example, a projected fourfold rise in the rate of RSLR in the study area would result in a fourfold increase in the recession rate. For the SNWW study area, the future rate of eustatic sea level was forecast to be roughly 3.8 times the existing rate (existing 1.2 mm/year compared to the forecasted 4.5 mm/year in year 2069). With the addition of the local subsidence rate (0.4 to 0.6 mm/yr), RSLR in 2069 was forecast to be roughly 4.2 times the existing rate.

Rates of existing historical Gulf shoreline change were obtained from several recent studies (Barras et al., 2004; USACE, 2004; BEG, 2009). Most of the Texas shoreline in the study area experienced very high rates of shoreline retreat from the 1950s through 2002, ranging from –5 to –51 feet/year. However, small reaches near the SNWW west jetty and near Sea Rim State Park are stable or accreting. The BEG (2009) has developed a projected shoreline for the upper Texas coast for the year 2056, based upon historical Gulf shoreline changes. The historical rate of change includes historic rates of RSLR but not the accelerated rates expected in the future. The projected shoreline retreat was adjusted to account for the accelerated rate of future RSLR by multiplying the width of the BEG shoreline retreat by 4.2 (the projected increase in the rate of RSLR) and mapping a revised shoreline. Acreage that would be lost with the revised shoreline was then calculated with GIS.

A similar method was followed for Sabine Lake; however, in this case an existing rate of feet lost per year was calculated with a GIS analysis of aerial photographs taken between 1978 and 2004 (Greco and Clark, 2005). This analysis estimated an average shoreline retreat rate of 4.5 feet/year for the Sabine Lake shoreline between the Sabine River and Willow Bayou. For the purposes of this analysis, the 4.5 feet/year rate was applied to the entire east Sabine Lake shoreline as shoreline retreat is also a problem along the Sabine Lake shoreline between Willow Bayou and Blue Buck Point (LCWCR/WCRA, 1998). The 4.5 feet/year rate was increased by a factor of 4.2 to account for the accelerated rate of RSLR, resulting in an estimated 1,230 feet of shoreline retreat by the year 2069. The current shoreline was recessed by this

width, except where other controlling features such as levees or roadways would block retreat, and the lost acreage was calculated by GIS.

For the Louisiana Gulf shoreline in the study area, no change is projected through the year 2050 (Barras et al., 2004). The history of shoreline change for this area, developed in conjunction with the Louisiana Coastal Areas Ecosystem Restoration Report (USACE, 2004), documented that the segment of the Chenier Plain shoreline between Sabine Pass and Ocean View Beach (located 6 miles beyond the 10-mile SNWW study boundary) prograded seaward at an average rate of +12.9 feet/year between 1883 and 1994. Between 1985 and 1995, the average rate of progradation slowed to +1.2 feet/year. The shoreline in the study area is dominated primarily by the effect of the Sabine Pass jetties, which intercept the westward-moving littoral drift and tend to trap sediment, creating a more stable shoreline than that nearer to Ocean View Beach. This study assumed a stable shoreline through the period of analysis and applied the projected RSLR at the Gulf shoreline (1.1 feet in year 2069) to the preexisting topography using the GIS method described below.

For the Louisiana Gulf shoreline and the shorelines of all other major waterways and waterbodies in the study area, the second method was applied. Preexisting topography along shorelines was assumed to be fixed; current shoreline elevations were combined with the projected increase in sea level to project a new shoreline. The increase in sea level at the end of the period of analysis (year 2069) was projected by HS model to be +1.1 feet throughout the study area. Slope is a major controlling variable in the determination of shoreline changes using this method. Steep slopes would experience little shoreline displacement, while gentle slopes would show a much larger lateral change. It is assumed that man-made features such as jetties, roads and highways, dikes and levees, and bulkheads and fill would continue to be maintained at a sufficient elevation that they would block shoreline retreat, and that current beneficial use projects that use dredged material to isolate interior wetlands from large waterways would be continued.

In the WVA EMCM, hydrologic unit acreages were adjusted to remove acres lost to RSLR-related shoreline recession for the FWOP land loss projection in the WVA model. This adjustment was made in the WVA land loss tables. The rate of acreage lost due to shoreline recession was assumed to be linear. The acres lost per year were subtracted from the base acreage before the revised land loss rate for the interior marsh was applied. This adjustment results in the removal of an equivalent amount of acres (lost due to RSLR only) from both the FWOP and FWP conditions. FWOP and FWP interior land loss rates were then applied to the remaining acreage, as described below, to determine the effect of salinity changes over the period of analysis in both the FWOP and FWP conditions.

#### 3.3.1.2 RSLR-related Interior Land Loss

Land loss rates for interior marsh areas were adjusted to account for increasing salinity due to RSLR over the period of analysis using the land loss methodology of the WVA. FWOP and FWP land loss rates over the period of analysis were projected using a productivity-based land loss projection methodology that is described later in this document. Year 2069 FWOP and FWP interior land loss rates were calculated by

incorporating FWOP and FWP RSLR salinities into the respective land loss projection. Salinity increases were projected by the HS model and a linear rate of change was assumed over the period of analysis.

The deepening project would result in a minimal increase in water elevation over the majority of the project area (averaging less than half an inch). Thus, no FWP impacts due to water elevation increases are anticipated. It is, however, assumed that all tidally influenced habitats would see a gradual increase in water elevation associated with an RSLR of 13.2 inches by 2069.

The effects of the projected rate of RSLR on coastal marshes are very difficult to predict. Biomass accumulation would be expected to offset much if not all of the RSLR change in water surface elevation. However, many different climatic, physical, and biological processes could affect the rate of accumulation. Recent experimental evidence suggests that increasing atmospheric carbon dioxide concentrations could stimulate biogenic mechanisms of elevation gain in a brackish marsh, and further, that this effect could be enhanced under salinity and flooding conditions expected with future RSLR (Langley et al., 2009). Although it is recognized that changes in precipitation and temperature could also affect vegetation growth rates, there is as yet no consensus on the amount, timing, and distribution of future precipitation. Changes in climate would affect the timing and quantity of freshwater delivery to the coastal estuaries, and this would affect sediment delivery to the coastal marshes. Uncertainties related to all of these processes could result in very different predictions of future marsh conditions.

"Primary productivity of salt marsh vegetation is regulated by changes in sea level, and the vegetation, in turn, constantly modifies the elevation of its habitat toward an equilibrium with sea level" (Morris et al., 2002:2876). A rise in RSL brings an increase in production and biomass density that enhances sediment deposition by increasing the efficiency of sediment trapping. This can lead to an absolute increase in the elevation of the marsh platform and result in a landward migration of the marsh (Gardner et al., 1992; Gardner and Porter, 2001). This may change total wetland area, depending upon local geomorphology and anthropogenic barriers to migration, such as bulkheads, canals, etc.

This response is further complicated by variations in sediment supply from river discharges and variations in primary production due to changes in nutrient loading, precipitation, temperature, and other factors (Morris et al., 2002). Gulf shoreline erosion associated with accelerated rates of RSLR may increase the amount of nearshore sediment. Wilson and Allison (2008) have shown that material released by Gulf shoreline erosion remains nearshore rather than being dispersed into offshore waters, therefore remaining available for redeposition by tidal flooding or storm surge overwash. In addition to RSLR, future changes in climate would influence the quantity and timing of freshwater delivery to the coastal estuaries. At this time there is no consensus in the direction or amount of changes in precipitation in the study area (Nielsen-Gammon, 2009). Whatever the net effect of climate change on basin runoff, most climate change projections agree that more-frequent high-intensity rainfall events are likely. In most drainages, this type of event would most likely produce increased sediment runoff, and thus periodically increase sediment delivery to the coastal marshes.

Existing coastal marshes appear to have adapted to historical ranges of mean sea level and gradual changes in RSLR. FWOP projections of coastal land loss in the Louisiana portion of the SNWW study area forecast relatively stable landforms and shorelines through 2050 (Barras et al., 2004), not accounting for the effects of tropical storms and hurricanes. In general, the interior marshes in the Louisiana portion of the SNWW study area appear to have stabilized and are not undergoing rapid conversion of large areas to open-water like areas to the east in Louisiana (LCWCR/WCRA, 1998; USACE, 2004). Recent Louisiana LIDAR data show that existing marsh is higher than the projected RSLR for the period of analysis and thus should be able to withstand the gradual rise in elevation (Louisiana State University [LSU], 2009). Similar large-scale FWOP land loss projections are not available for the Texas portion of the study area. However, this study assumed that the Texas portion would also remain relatively stable with respect to the effects of RSLR because the same chenier landforms, marshes, and sediments are present throughout the study area. A GIS study of aerial photographs of the Salt Bayou/Keith Lake system confirmed that the open-water trend has slowed and possibly reversed itself in that area in recent years (TPWD, 2003). Texas interior marshes most at risk to the effects of RSLR are located just outside and to the west of the SNWW study area in the McFaddin NWR.

It must be recognized that large areas of interior marsh could quickly convert to open water under certain extraordinary events. If RSLR accelerates to the extent that the coastal plant community cannot sustain an elevation within its range of tolerance, rates of primary production would decrease, resulting in an unstable and rapidly deteriorating marsh community (Morris et al., 2002). In addition, if shoreline recession cuts existing fore dune formations, large areas of interior marsh could quickly be exposed to higher-salinity Gulf waters and wave attack. In this case, large marsh areas could quickly be lost to the Gulf.

### 3.3.2 Freshwater Inflows

Freshwater inflows for the SNWW HS model's future conditions were developed using model outputs from Run 8 of the TCEQ Water Availability Models (WAMs) for the lower Sabine and Neches rivers. For existing conditions, "Run 8 uses modified diversion amounts (maximum use for the last 10 years), year 2000 area-capacity parameters for major reservoirs, and assumed return flows. It also includes term water rights and provides the most realistic assessment of current streamflow conditions" (TWDB, 2007:363). The TWDB has projected flows for the year 2060 by modifying Run 8 "to include projected increased demand from existing water rights, expected change to return flows, projected new strategies to come online before 2060, and estimated year 2060 storage capacities for major reservoirs" (TWDB, 2007:363). For the Neches River, the flow appears to increase over existing conditions as a result of projected releases from new reservoirs to diversion points downstream during periods of dry weather.

The 2060 WAMs run was selected for use in the SNWW HS modeling because it was developed by the State's lead water planning agency, and it includes future water supply strategies approved by the 2007 Texas State Water Plan (TWDB, 2007). The SNWW study area is included in Regional Plan I for the East Texas Region. The Region I water plan takes into consideration existing flows that are dedicated to the

State of Louisiana as prescribed by the Sabine River Compact. All existing and proposed future strategies for meeting Texas's demand must be met by the Texas firm-yield share (750,000 acre-feet) of the total Sabine River flow, as appropriated under the use provision of Certificate of Adjudication No. 05-4658 (March 5, 1958). The WAMs 2060 model does not attempt to predict future demand in the Louisiana portion of the Sabine basin. This should not significantly affect future projections because the majority of the Sabine River watershed in the study area is located in Texas, and large increases in water use are not expected, given the large amount of undeveloped, coastal wetlands in the Louisiana portion of the watershed.

By 2060, the Region I population is projected to grow 36 percent, and water demands are projected to increase by 41 percent. The greatest increase (48 percent) is expected in the demand for manufacturing water. Municipal demand is expected to grow 24 percent. The existing water supply is projected to decrease slightly by 2060, due primarily to reservoir sedimentation and a small decline in groundwater supply. Although the region as a whole appears to have enough supply to meet demands through 2060, the total water supply is not readily available to all users.

The regional plan recommends the following strategies to provide the additional water supply projected to be needed by 2060: (1) the construction of the Lake Columbia reservoir in the Neches River watershed; (2) cooperation with Region C, which includes the Dallas-Fort Worth metropolitan area, in the use of surface water from Toledo Bend Reservoir and proposed Lake Fastrill; (3) expanded groundwater use by smaller communities; and (4) municipal conservation throughout the region.

The WAMs Run 8 for the year 2060 was developed using current patterns of precipitation and evaporation. USACE did not modify the WAMs model to use future projections of precipitation or evaporation for SNWW future conditions because the Texas State Climatologist has recently concluded that it is impossible to predict with confidence what precipitation trends will be in Texas over the next half century (Nielsen-Gammon, 2009). Unlike precipitation, there is more consensus for a predicted temperature increase in Texas of close to 4°F by 2060. No attempt was made to change future temperatures in the 2060 WAMs model because resulting changes in evapotranspiration would be so small as to result in a negligible change in the modeling results.

# 4.0 APPLICATION OF THE EMERGENT MARSH COMMUNITY MODELS

## 4.1 $V_1$ PERCENT EMERGENT VEGETATION

### 4.1.1 Preparation of Baseline Data Set

Since salinity and inundation are major forces in the distribution of habitats across the coastal landscape (Mitsch and Gosselink, 2000), units used to evaluate impacts were defined to the greatest extent possible on hydrologic characteristics. USGS orthophoto quadrangle maps (1995, 2000, 2005) were reviewed by the Habitat Workgroup, and all sensitive habitats hydrologically connected to waterways influenced by the proposed channel improvements were divided into hydro-units. Hydro-unit boundaries were based upon small watershed divides, or on the basis of other topographic features that serve as hydrologic separators. Uplands and developed areas were excluded from the analysis. These upland and developed areas possess no sensitive resources or habitats that could be impacted by the proposed project and are not addressed further. Care was taken to ensure that the hydro-units were scaled so that all significant environmental effects of the proposed project would be captured.

Habitat classification definitions were derived from Cowardin et al. (1979). National Wetlands Inventory (NWI) classifications and USFWS habitat maps of coastal Louisiana were collapsed into 15 land cover classifications in accordance with a protocol developed by the USGS National Wetlands Research Center and LDNR, Coastal Management Division (USGS-NWRC and LDNR, 2004) and used by the CWPPRA EnvWG in Louisiana. Cover classes were aggregated because this study did not require the level of detail inherent in the NWI classifications. Baseline habitat types within each hydro-unit were classified as marsh (fresh, intermediate, brackish, or saline), cypress-tupelo swamp, or bottomland hardwood. Habitat acreages for each habitat type were measured from satellite imagery using GIS software, and field truthed by the Habitat Workgroup during field visits on August 24 and 25 and October 13 and 21, 2004.

Acreages for baseline habitats in the Texas hydro-units were classified and mapped with the assistance of the Habitat Workgroup. TPWD provided habitat mapping for the Keith Lake/Salt Bayou hydro-unit (USFWS, 2001a; TPWD, 2004), the Lower Neches WMA (TPWD, 1992), and Cow Bayou (TPWD, 2002). USFWS (2001a, 2001b) provided habitat maps of the McFaddin and Texas Point NWRs, and also mapped habitat types on the Neches River using the NWI data (USFWS and GLO, 1992; USFWS, 2004), supplemented and revised as necessary on the basis of expert knowledge and field visits. All other Texas hydro-units were mapped by PBS&J specifically for this study, using collapsed NWI (USFWS and GLO, 1992) data, and revised as necessary by the Habitat Workgroup. Water acreages were taken from a GIS data layer provided by TxDOT (2002).

Hydro-units and habitat types for Louisiana marsh habitats were drawn directly from mapping units developed for the Louisiana CWPPRA program (Chabreck and Linscombe, 1978; Linscombe, 2001; USGS, 2002; USGS-NWRC, 2004). Nonmarsh habitats on the Sabine River were mapped by PBS&J for this study using NWI data (USFWS and GLO, 1992), reviewed and revised by the Habitat Workgroup. Water acreages were taken from a GIS data layer provided by USGS (2002).

Because habitat acreages were initially calculated using images from different years, acreages were adjusted, as described below, to reflect a common base year of 2004. All acreages that were originally measured from images predating 2004 were adjusted by applying the base land loss rate to the acreage and subtracting acres of emergent marsh lost for each year between the imagery date and 2004. An index map of all HUs is provided on Figure 2, and overview habitat maps are provided as figures 4 through 9. Tables 7 and 8 provide a breakdown of habitat acreages within each hydro-unit for Texas and Louisiana, respectively. The acreages presented in these tables present acreages that have been adjusted, as necessary, to the 2004 base year.

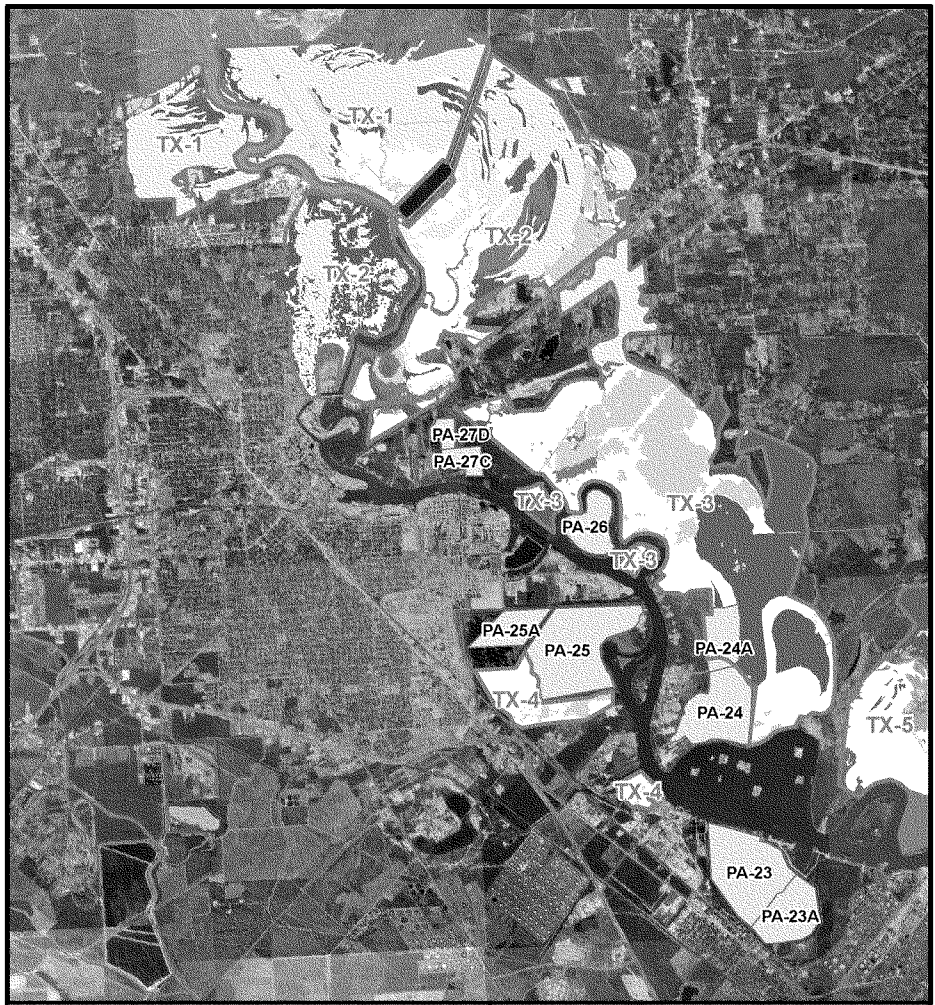
### 4.1.2 Land Change Projection Methodology

Variable $V_1$ (Percent Emergent Marsh) of the WVA Emergent Marsh models requires a projection of FWOP and FWP acres of emergent marsh. To make this projection, a methodology that has been applied in numerous Louisiana CWPPRA projects was utilized in this study, with some modifications, as described below.

A number of factors currently contribute to existing land loss in the study area, and the Habitat Workgroup assumed that the same trends will continue in the FWOP condition. FWOP projections of land loss were developed as a baseline against which project-induced changes could be measured. The Habitat Workgroup employed historical data to assess recent trends in land loss or land gain, and then used these historical rates to project changes into the future. Base land loss rates were determined by measuring changes of emergent marsh and open-water areas using GIS software between images from 2 or more years. The time between images generally spanned the most recent 15- to 20-year time period for which reliable data were available. This time period generally fell between the years 1978 and 2001.

The time span over which base land loss rates were calculated postdates the mid-twentieth-century decades in which the greatest volumes of oil and gas were extracted in this region. These base rates thus exclude subsidence related to the most extensive period of oil and gas extraction, which has waned significantly in recent decades. The base land loss rates do include chronic, regional effects of subsidence, altered sediment delivery, sea level rise, and tropical storms or hurricanes that occurred during the period of observation.

The Habitat Workgroup applied the most recent reliable data available for each hydro-unit. For Louisiana marshes, the Habitat Workgroup generally applied land loss rates between 1983 and 1990 (Dunbar et al., 1992; Britsch and Dunbar, 1993) and 1978–1990 (USGS-LDNR, 1993). In Texas, a land loss rate developed for 1987 to 2001 (TPWD, 2004) was applied to all marshes adjacent to the GIWW and south through Texas Point. On the Neches River, a land loss rate for the period from 1978 to 1994, measured for a BEG study, was applied to the Old River Cove marshes (White et al., 1996). For Bessie Heights marsh, the most recent data available were from a period between 1956 and 1978 (White et al., 1987).




Hydrologic Unit
Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Placement Areas
Upland/Impoundment/Other
Shrub/Scrub
Swamp
Water

0 0.5 1 2
Miles

**Figure 4**
**Habitats in Hydrologic Units TX-1 through TX-4**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1:102,000 |
| Prepared by:EM/AChristiansen | Date: 09/02/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Figures/TX_PAs4_Hbtat_vr3.mxd

Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water

Hydrologic Unit
Placement Areas

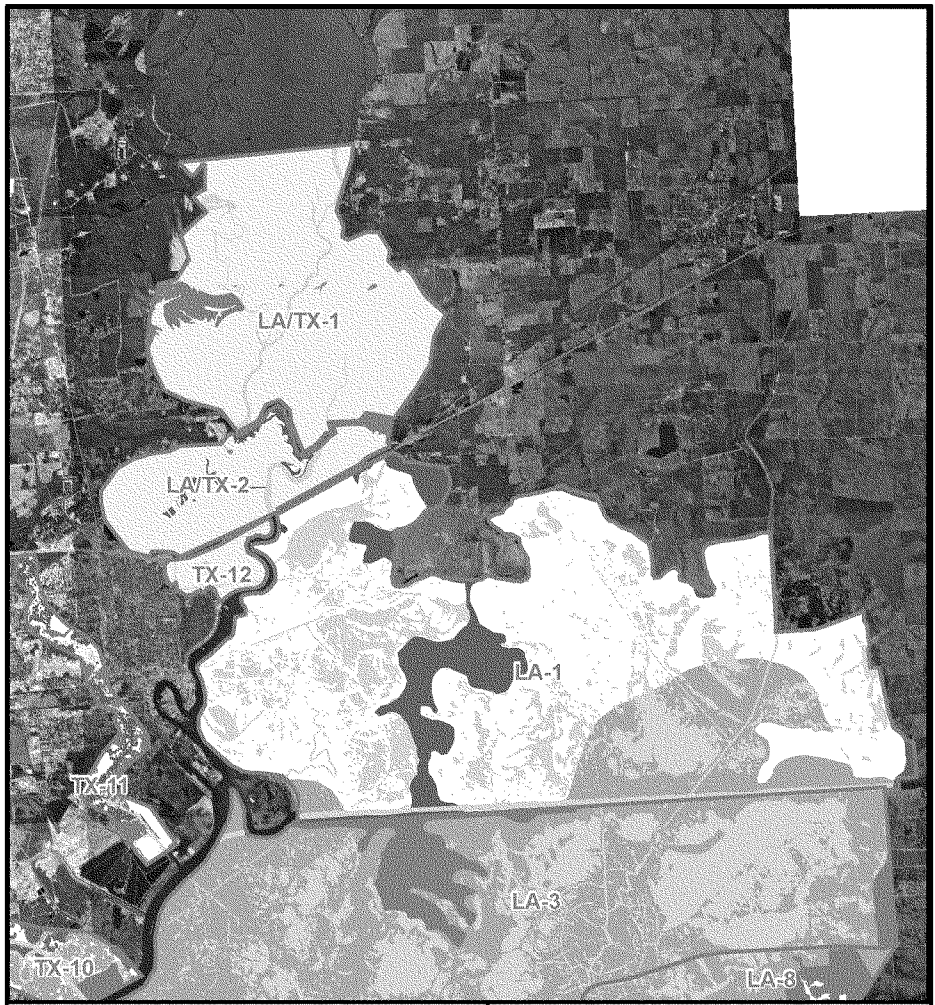
0 0.75 1.5 3 Miles

**Figure 5**

**Habitats in Hydrologic Units TX-5, TX-6, TX-10, and TX-13**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1:148,000 |
| Prepared by:EM/AChristiansen | Date: 09/10/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/TX_PAs5_Hbtat_vr4.mxd




Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water
Hydrologic Unit
0 0.5 1 2 Miles

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 329-8342 Fax: (512) 327-2453

**Figure 6**

**Habitats in Hydrologic Units TX-11, TX-12, LA/TX-1, LA/TX-2, and LA-1**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1:133,000 |
| Prepared by:EM/ Christiansen | Date: 09/02/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/TXLA_PAs6_Hbtat_vr4.mxd

Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water

Hydrologic Unit

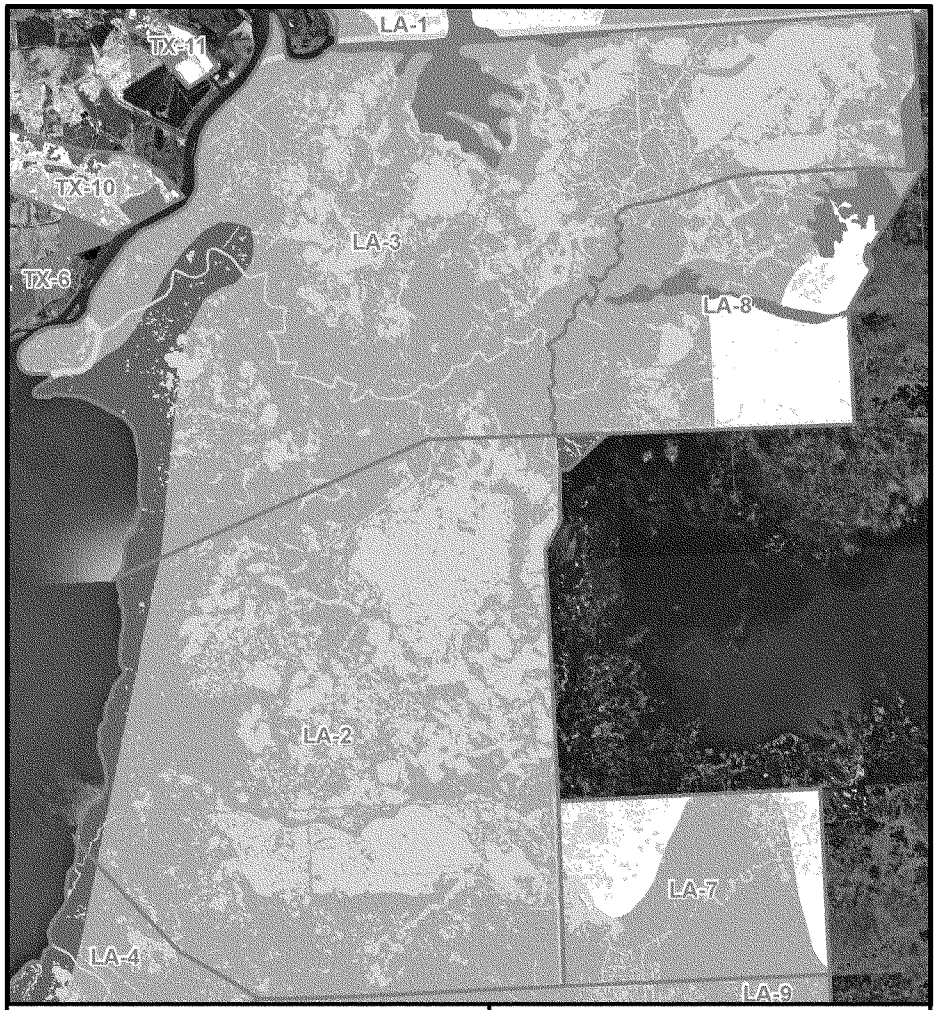
2 1 0 2 Miles

**Figure 7**

**Habitats in Hydrologic Units TX-7 through TX-9**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1:180,000 |
| Prepared by: AC/GC | Date: 12/10/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/TXLA_PAs7_Hbtat_v/3.mxd




Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water
Hydrologic Unit

0 0.75 1.5 3 Miles

**Figure 8**

**Habitats in Hydrologic Units LA-2, LA-3, LA-7, and LA-8**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1:136,000 |
| Prepared by:EM/ Christiansen | Date: 09/03/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/TXLA_PAs8_Hbtat_vr3.mxd

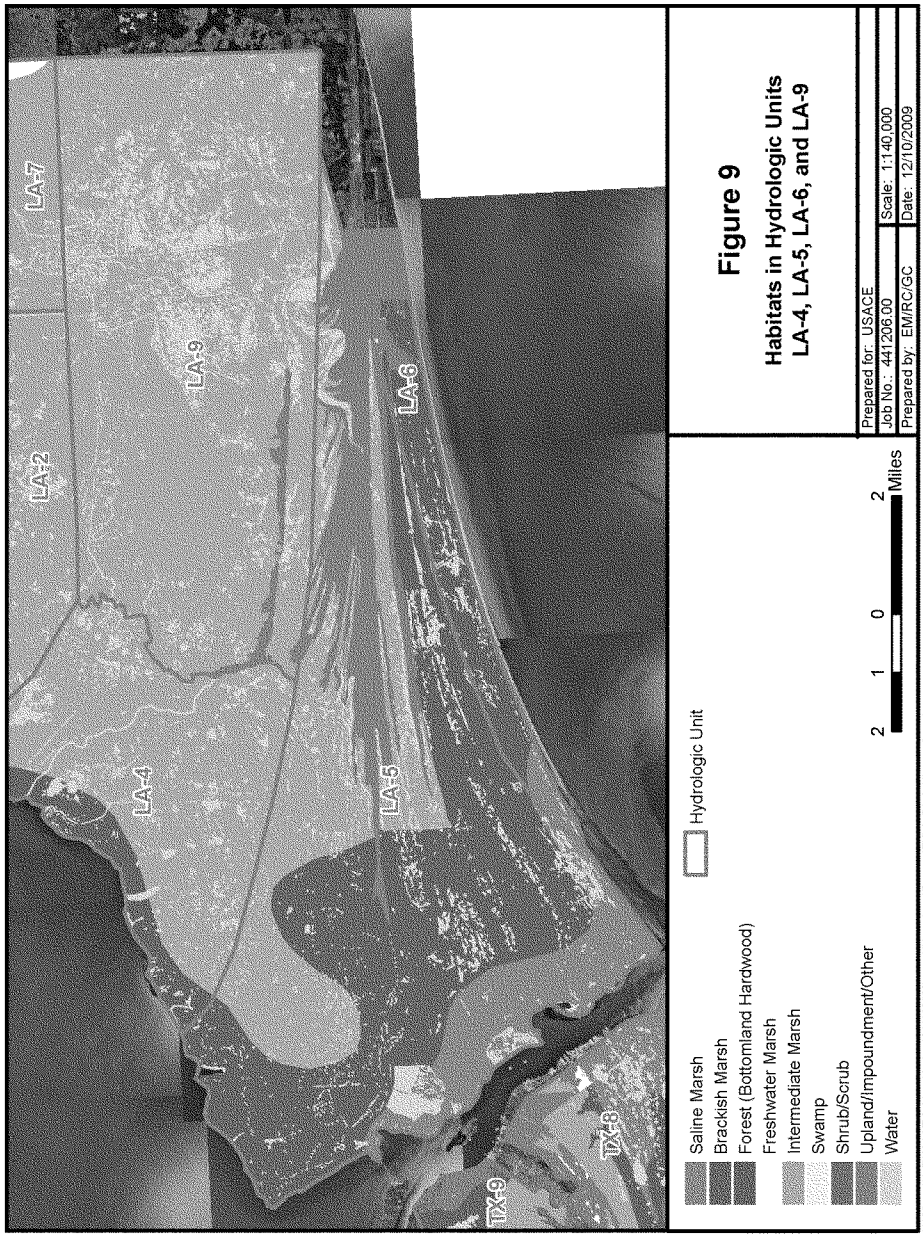

LA-7
LA-2
LA-9
LA-4
LA-5
LA-6
TX-9
TX-8
Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water
Hydrologic Unit
2 1 0 2
Miles
Figure 9
Habitats in Hydrologic Units
LA-4, LA-5, LA-6, and LA-9
Prepared for: USACE
Job No.: 441206.00
Scale: 1:140,000
Prepared by: EM/RC/GC
Date: 12/10/2009
N:\Clients\U_Z\USACE\Sabine_Neches\0441206\0\post_HU_projects\Projects\TXLA_PAs9_Habat_v13.mxd

Table 7: Texas Hydrologic Unit Habitat Acreage (2004)

| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TX 1 - North Neches River** | | | | | | | | | | | | |
| Acreage | 2,760 | 384 | 0 | 0 | 53 | 0 | 412 | 384 | 3,609 | 0 | 407 | 4,016 |
| Water | n/a | 52 | 0 | 0 | 0 | 0 | n/a | 52 | 52 | 0 | 75 | 127 |
| Totals | 2,760 | 436 | 0 | 0 | 53 | 0 | 412 | 436 | 3,661 | 0 | 482 | 4,143 |
| **TX 2 - Neches River/Lake Bayou** | | | | | | | | | | | | |
| Acreage | 2,277 | 1,270 | 0 | 0 | 108 | 0 | 1,040 | 1,270 | 4,695 | 0 | 684 | 5,379 |
| Water | n/a | 266 | 0 | 0 | 0 | 0 | n/a | 266 | 266 | 0 | 63 | 329 |
| Totals | 2,277 | 1,535 | 0 | 0 | 108 | 0 | 1,040 | 1,535 | 4,960 | 0 | 747 | 5,707 |
| **TX 3 - Rose City** | | | | | | | | | | | | |
| Acreage | 464 | 2,323 | 0 | 0 | 0 | 0 | 1,775 | 2,323 | 4,562 | 0 | 152 | 4,714 |
| Water | n/a | 1,004 | 0 | 0 | 0 | 0 | n/a | 1,004 | 1,004 | 0 | 87 | 1,091 |
| Totals | 464 | 3,327 | 0 | 0 | 0 | 0 | 1,775 | 3,327 | 5,566 | 0 | 239 | 5,805 |
| **TX 4 - West of Rose City** | | | | | | | | | | | | |
| Acreage | 0 | 395 | 0 | 0 | 0 | 0 | 0 | 395 | 395 | 0 | 1 | 396 |
| Water | n/a | 97 | 0 | 0 | 0 | 0 | n/a | 97 | 97 | 0 | 0 | 97 |
| Totals | 0 | 492 | 0 | 0 | 0 | 0 | 0 | 492 | 492 | 0 | 1 | 493 |
| **TX 5 - Bessie Heights** | | | | | | | | | | | | |
| Acreage | 0 | 2,018 | 1,932 | 20 | 40 | 0 | 293 | 3,970 | 4,303 | 769 | 743 | 5,815 |
| Water | n/a | 129 | 4,981 | 0 | 77 | 0 | n/a | 5,110 | 5,187 | 0 | 361 | 5,548 |
| Totals | 0 | 2,147 | 6,913 | 20 | 117 | 0 | 293 | 9,080 | 9,490 | 769 | 1,104 | 11,363 |
| **TX 6 - Old River Cove** | | | | | | | | | | | | |
| Acreage | 0 | 31 | 199 | 5,240 | 0 | 0 | 197 | 5,470 | 5,667 | 399 | 2,165 | 8,231 |
| Water | n/a | 0 | 0 | 3,290 | 0 | 0 | n/a | 3,290 | 3,290 | 0 | 330 | 3,620 |
| Totals | 0 | 31 | 199 | 8,530 | 0 | 0 | 197 | 8,760 | 8,957 | 399 | 2,495 | 11,851 |
| **TX 7 - GIWW North** | | | | | | | | | | | | |
| Acreage | 0 | 4,541 | 129 | 588 | 0 | 0 | 0 | 5,258 | 5,258 | 0 | 454 | 5,712 |
| Water | n/a | 136 | 0 | 59 | 0 | 0 | n/a | 195 | 195 | 0 | 0 | 195 |
| Totals | 0 | 4,677 | 129 | 647 | 0 | 0 | 0 | 5,453 | 5,453 | 0 | 454 | 5,907 |

Table 7 (Cont'd)

| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TX 8 - Texas Point** | | | | | | | | | | | | |
| Acreage | 0 | 100 | 1,605 | 2,398 | 0 | 4,898 | 0 | 9,001 | 9,001 | 0 | 1,413 | 10,414 |
| Water | n/a | 11 | 26 | 148 | 0 | 810 | n/a | 995 | 995 | 0 | 13 | 1,008 |
| Totals | 0 | 111 | 1,631 | 2,546 | 0 | 5,708 | 0 | 9,996 | 9,996 | 0 | 1,426 | 11,422 |
| **TX 9 - Salt Bayou** | | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
| Acreage | 0 | 567 | 24,942 | 15,801 | 0 | 0 | 0 | 41,310 | 41,310 | 0 | 4,392 | 45,702 |
| Water | n/a | 0 | 4,181 | 4,757 | 0 | 0 | n/a | 8,938 | 8,938 | 0 | 404 | 9,342 |
| Totals | 0 | 567 | 29,123 | 20,558 | 0 | 0 | 0 | 50,248 | 50,248 | 0 | 4,796 | 55,044 |
| **TX 10 - Cow Bayou** | | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
| Acreage | 110 | 1,436 | 1,144 | 0 | 0 | 0 | 388 | 2,580 | 3,078 | 173 | 1,060 | 4,311 |
| Water | n/a | 339 | 0 | 0 | 0 | 0 | n/a | 339 | 339 | 0 | 340 | 679 |
| Totals | 110 | 1,775 | 1,144 | 0 | 0 | 0 | 388 | 2,919 | 3,417 | 173 | 1,400 | 4,990 |
| **TX 11 - Adams Bayou** | | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
| Acreage | 115 | 516 | 0 | 0 | 0 | 0 | 640 | 516 | 1,271 | 6 | 316 | 1,593 |
| Water | n/a | 83 | 0 | 0 | 0 | 0 | n/a | 83 | 83 | 0 | 3 | 86 |
| Totals | 115 | 599 | 0 | 0 | 0 | 0 | 640 | 599 | 1,354 | 6 | 319 | 1,679 |
| **TX 12 - South of Blue Elbow** | | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
| Acreage | 689 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 689 | 0 | 0 | 689 |
| Water | n/a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals | 689 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 689 | 0 | 0 | 689 |
| **TX 13 - Groves** | | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
| Acreage | 0 | 0 | 385 | 0 | 0 | 0 | 0 | 385 | 385 | 0 | 0 | 385 |
| Water | 0 | 0 | 52 | 0 | 0 | 0 | 0 | 52 | 52 | 0 | 0 | 52 |
| Totals | | | 437 | | | | | 437 | 437 | 0 | 0 | 437 |
| **LA-TX 1 - SABINE ISLAND (TEXAS PORTION)** | | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
| Acreage | 1,194 | 0 | 0 | 0 | 0 | 0 | 524 | 0 | 1,718 | 0 | 559 | 2,277 |
| Water | n/a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals | 1,194 | 0 | 0 | 0 | 0 | 0 | 524 | 0 | 1,718 | 0 | 559 | 2,277 |
| **LA-TX 2 - BLUE ELBOW (TEXAS PORTION)** | | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Placement Areas | Other | Total Hydro Unit Acreage |
| Acreage | 2,548 | 0 | 0 | 0 | 0 | 0 | 189 | 0 | 2,737 | 0 | 0 | 2,737 |
| Water | n/a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals | 2,548 | 0 | 0 | 0 | 0 | 0 | 189 | 0 | 2,737 | 0 | 0 | 2,737 |
| **Acreage** | 10,157 | 13,580 | 30,336 | 24,047 | 201 | 4,898 | 5,458 | 73,062 | 88,677 | 1,347 | 12,346 | 102,370 |
| **Water** | 0 | 2,117 | 9,240 | 8,254 | 77 | 810 | 0 | 20,498 | 20,498 | 0 | 1,676 | 22,174 |
| **TOTAL** | 10,157 | 15,697 | 39,576 | 32,301 | 278 | 5,708 | 5,458 | 93,560 | 109,175 | 1,347 | 14,022 | 124,544 |

Table 8: Louisiana Hydrologic Unit Habitat Acreage (2004)

| | LA 1 - PERRY RIDGE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 14,810 | 3,074 | 0 | 0 | 0 | 2,158 | 17,884 | 20,042 | 0 | 2,373 | 22,415 |
| Water | n/a | 4,049 | 1,630 | 0 | 0 | 0 | n/a | 5,679 | 5,679 | 0 | 0 | 5,679 |
| Totals | 0 | 18,859 | 4,704 | 0 | 0 | 0 | 2,158 | 23,563 | 25,721 | 0 | 2,373 | 28,094 |
| | LA 2 - WILLOW BAYOU | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 0 | 22,470 | 1,133 | 0 | 0 | 0 | 23,603 | 23,603 | 0 | 0 | 23,603 |
| Water | n/a | 0 | 12,639 | 49 | 0 | 0 | n/a | 12,688 | 12,688 | 0 | 0 | 12,688 |
| Totals | 0 | 0 | 35,109 | 1,182 | 0 | 0 | 0 | 36,291 | 36,291 | 0 | 0 | 36,291 |
| | LA 3 - BLACK BAYOU | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 0 | 24,633 | 2,964 | 0 | 0 | 0 | 27,597 | 27,597 | 0 | 1,717 | 29,314 |
| Water | n/a | 0 | 10,308 | 231 | 0 | 0 | n/a | 10,539 | 10,539 | 0 | 0 | 10,539 |
| Totals | 0 | 0 | 34,941 | 3,195 | 0 | 0 | 0 | 38,136 | 38,136 | 0 | 1,717 | 39,853 |
| | LA 4 - WEST JOHNSON'S BAYOU | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 0 | 10,031 | 1,837 | 0 | 0 | 0 | 11,868 | 11,868 | 0 | 2 | 11,870 |
| Water | n/a | 0 | 1,079 | 241 | 0 | 0 | n/a | 1,320 | 1,320 | 0 | 0 | 1,320 |
| Totals | 0 | 0 | 11,110 | 2,078 | 0 | 0 | 0 | 13,188 | 13,188 | 0 | 2 | 13,190 |
| | LA 5 - SABINE LAKE RIDGES | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 0 | 8,232 | 14,673 | 0 | 3,198 | 0 | 26,103 | 26,103 | 0 | 4,473 | 30,576 |
| Water | n/a | 0 | 1,038 | 1,289 | 0 | 569 | n/a | 2,896 | 2,896 | 0 | 0 | 2,896 |
| Totals | 0 | 0 | 9,270 | 15,962 | 0 | 3,767 | 0 | 28,999 | 28,999 | 0 | 4,473 | 33,472 |
| | LA 6 - JOHNSON'S BAYOU RIDGES | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 0 | 0 | 2,505 | 0 | 353 | 0 | 2,858 | 2,858 | 0 | 975 | 3,833 |
| Water | n/a | 0 | 0 | 239 | 0 | 17 | n/a | 256 | 256 | 0 | 0 | 256 |
| Totals | 0 | 0 | 0 | 2,744 | 0 | 370 | 0 | 3,114 | 3,114 | 0 | 975 | 4,089 |
| | LA 7 - SOUTHEAST SABINE | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 2,023 | 4,925 | 0 | 0 | 0 | 0 | 6,948 | 6,948 | 0 | 0 | 6,948 |
| Water | n/a | 611 | 475 | 0 | 0 | 0 | n/a | 1,086 | 1,086 | 0 | 0 | 1,086 |
| Totals | 0 | 2,634 | 5,400 | 0 | 0 | 0 | 0 | 8,034 | 8,034 | 0 | 0 | 8,034 |

Table 8 (Cont'd)

| | LA 8 - SOUTHWEST GUM COVE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 3,503 | 5,346 | 0 | 0 | 0 | 0 | 8,849 | 8,849 | 0 | 1,166 | 10,015 |
| Water | n/a | 112 | 1,259 | 0 | 0 | 0 | n/a | 1,371 | 1,371 | 0 | 0 | 1,371 |
| Totals | 0 | 3,615 | 6,605 | 0 | 0 | 0 | 0 | 10,220 | 10,220 | 0 | 1,166 | 11,386 |
| | LA 9 - EAST JOHNSON'S BAYOU | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other Upland | Total Hydro Unit Acreage |
| Acreage | 0 | 0 | 22,694 | 0 | 0 | 0 | 0 | 22,694 | 22,694 | 0 | 581 | 23,275 |
| Water | n/a | 0 | 3,444 | 0 | 0 | 0 | n/a | 3,444 | 3,444 | 0 | 0 | 3,444 |
| Totals | 0 | 0 | 26,138 | 0 | 0 | 0 | 0 | 26,138 | 26,138 | 0 | 581 | 26,719 |
| | LA-TX 1 - SABINE ISLAND (LOUISIANA PORTION) | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other | Total Hydro Unit Acreage |
| Acreage | 5,998 | 0 | 0 | 0 | 0 | 0 | 1,041 | 0 | 7,039 | 0 | 21 | 7,060 |
| Water | n/a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals | 5,998 | 0 | 0 | 0 | 0 | 0 | 1,041 | 0 | 7,039 | 0 | 21 | 7,060 |
| | LA-TX 2 - BLUE ELBOW (LOUISIANA PORTION) | | | | | | | | | | | |
| | Swamp | Fresh | Intermediate | Brackish | Shrub/ Scrub | Saline | Bottomland hardwood | Total Marsh | Total Wetlands | Place-ment areas | Other | Total Hydro Unit Acreage |
| Acreage | 643 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 650 | 0 | 0 | 650 |
| Water | n/a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals | 643 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 650 | 0 | 0 | 650 |
| Acreage | 6,641 | 20,336 | 101,405 | 23,112 | 0 | 3,551 | 3,206 | 148,404 | 158,251 | 0 | 11,308 | 169,559 |
| Water | 0 | 4,772 | 31,872 | 2,049 | 0 | 586 | 0 | 39,279 | 39,279 | 0 | 0 | 39,279 |
| TOTAL | 6,641 | 25,108 | 133,277 | 25,161 | 0 | 4,137 | 3,206 | 187,683 | 197,530 | 0 | 11,308 | 208,838 |

The Habitat Workgroup believed this rate was preferable since it reflects a higher rate of change than has occurred in recent years, and it is difficult to measure land loss in an area in which most marsh has already been lost. The Habitat Workgroup applied land loss rates from adjacent areas to the marshes in the Rose City and Lake Bayou areas on the Neches River, adjusting them for local conditions. The loss rate from the adjacent Black Bayou marsh was applied to marshes along Cow and Adams bayous.

After changes in acreages were calculated, the amount of emergent marsh that converted to open water was expressed as a percentage loss per year. Adjustments to FWOP land loss projections were made to account for shoreline recession, constructed or funded CWPPRA projects in the east Sabine Lake marshes (Clark et al., 2000; USFWS and NRCS, 2003), at Black Bayou (LDNR, 1993), and at Perry Ridge (USGS-NWRC, 2002a, 2002b) and RSLR. FWP projections added projected increases to coastal shore erosion (Gravens and King, 2003) and interior marsh loss. A spreadsheet that calculates land loss annually was used for all projections. It was assumed that TY 0 was 2004 (the WVA planning year), that TY 1 was 2019 (the year project construction would be completed), and TY 51 was 2069 (the end of the period of analysis).

#### 4.1.2.1 Productivity-based Land Loss Projection

In order to provide a systematic evaluation of future land loss changes for the SNWW WVA application, the Habitat Workgroup developed a productivity-based method of land loss projection based upon a salinity-productivity relationship developed for the Habitat Switching Module in the Louisiana Coastal Areas Ecosystem Restoration Study (Visser et al., 2004). For $V_1$, any change in salinity is reflected in the projected land loss rate through the productivity-based method described below. Even small changes within the optimal salinity range of a marsh type result in a small change to the land loss rate, either positive or negative. This is intended to capture effects to fish and wildlife species that are sensitive to even small changes in salinity.

In the Louisiana Coastal Area study, productivity algorithms were developed for all herbaceous and forested wetlands based on available published and unpublished data. Supporting references for salinity-related productivity changes in vegetation include:

- **Swamp** – co-dominant species bald cypress (*Taxodium distichum*) (Conner et al., 1997; Megonigal et al., 1997; Mitsch et al., 1991; Pezeshki et al., 1987a, 1990)

- **Fresh marsh** – co-dominant species maidencane (*Panicum hemitomon)* and bulltongue (*Sagittaria lancifolia)* (Greiner LaPeyre et al., 2001; Hester et al., 2001; Howard and Mendelssohn, 1999; McKee and Mendelssohn, 1989; Pezeshki et al., 1987b, 1987c; Willis and Hester, 2004; Spalding and Hester, 2007)

- **Intermediate marsh** – co-dominant species bulltongue and marshhay cordgrass (*Spartina patens)* (Baldwin and Mendelssohn, 1998; Greiner La Peyre et al., 2001; Howard and Mendelssohn, 1999, 2000; Pezeshki et al., 1987b; Spalding and Hester, 2007; Webb and Mendelssohn, 1996)

- **Brackish marsh** – co-dominant species marshhay cordgrass and seashore saltgrass (*Distichlis spicata*) (Bertness et al., 1992; Broome et al., 1995; Ewing et al., 1995; Greiner LaPeyre et al., 2001; Hester et al., 2001; Kemp and Cunningham, 1981; Parrondo et al., 1978; Warren and Brockelman, 1989)

- **Saline marsh** – Smooth cordgrass (*Spartina alterniflora)* and blackrush (*Juncus romerianus*) (Bradley and Morris, 1992; Eleuterius, 1989; Gosselink, 1970; Linthurst and Seneca, 1981; Parrondo et al., 1978; Pezeshki and DeLaune, 1995)

These studies used various measurements of productivity including total biomass, stem/leaf elongation, and photosynthesis, which were gathered using greenhouse experiments on saturated soils. To better illustrate the relationship of salinity and productivity, linear regression equations were fitted to these data. The equations can be used to predict percentage changes in habitat productivity per 1 ppt salinity for each major coastal habitat type, regardless of inundation. Table 9 relates the predicted changes in primary productivity for every 1 ppt increase in salinity (Visser et al., 2004) to land loss rate changes applied in the current study.

Table 9: Productivity-based Land Loss Projection

| Habitat Type | Percent Productivity Lowered and Land Loss Rates Increased per ppt Increase in Salinity |
|---|---|
| Swamp | 8.4 |
| Fresh marsh | 11.1 |
| Intermediate marsh | 11.4 (*Sagittaria*)<br>2.3 (*Spartina patens*)<br>mean = 6.8 |
| Brackish marsh | 2.6 |
| Saline marsh | 2.1 |

Relating changes in salinity to specific amounts of land loss is problematic. While extensive literature relates increases in salinity to decreased productivity, vegetation stress, and eventual wetland loss (see list above), USACE and the ICT are not aware of any studies that have documented specifically how much land loss is associated with specific increases in salinity. Similarly, no data are currently available that relate salinity reduction with a reduction in land loss (Visser et al., 2004). Therefore, the Habitat Workgroup assumed a direct linear correlation between decreased primary productivity due to salinity increases and increased land loss rates due to the project. The Habitat Workgroup considered increasing land loss rates for salinities that changed from optimal to suboptimal conditions and, conversely, also considered decreasing land loss rates in target years 20 to 50. The latter consideration is based upon historical observations that land loss rates generally stabilize and lessen a few decades after channel-deepening projects are completed. Since the effects of these considerations would generally offset one another, the Habitat Workgroup opted for the simpler 1:1 relationship.

The relationship between productivity decreases and land loss rate increases is assumed to be linear, thus a 1 percent decrease in productivity translates to a 1 percent increase in the land loss rate. For example, in Table 9, the productivity of fresh marsh decreases by 11.1 percent with every salinity increase of 1 ppt for fresh marshes. This translates to an 11.1 percent increase in the land loss rate for every 1 ppt increase in salinity. The following standard formula was applied to calculate FWP rates used in the land loss spreadsheets.

FWP land loss rate = (((FWP salinity ppt – FWOP salinity ppt) x % productivity decrease per habitat type) + 1) x baseline land loss rate)

#### 4.1.2.2 FWOP Land Loss

##### *4.1.2.2.1 Consideration of RSLR in Interior Marsh Loss*

To make the interior land loss projection for the FWOP conditions, the baseline land loss rates adopted by the ICT were applied as the baseline rate (TY 0). The baseline rates include chronic, regional effects of

subsidence, altered sediment delivery, historical rates of sea level rise, and tropical storms or hurricanes that occurred during the period of observation. FWOP effects of RSLR to interior marsh areas are expected to be limited to an increase in salinity. It is assumed that interior marshes throughout the tidally influenced portions of the study area would see a gradual increase in water elevation associated with an RSLR of 1.1 feet by 2069 and that biomass accumulation would offset much, if not all, of this RSLR effect. The SNWW HS model predicts that RSLR would result in higher salinity levels throughout the tidally influenced areas by 2069. Gradually rising salinities resulted in gradually increasing land loss rates, as rates were adjusted for the higher with-RSLR salinity using the productivity-based land loss projection methodology. Resulting changes in the biological productivity were forecast with the WVA worksheets.

*4.1.2.2.2 Shoreline Recession Due to RSLR*

The predicted FWOP acres lost to RSLR-related shoreline recession in each affected hydro-unit through TY 65 are presented in Table 10. The total acres of marsh lost for each marsh type was divided by 65 years, and the acres lost per year were subtracted from the FWOP marsh (acres) columns in the Land Loss Spreadsheets of the affected hydro-units for TYs 1 to 65.

*4.1.2.2.3 Adjustments for CWPPRA Restoration Projects*

FWOP adjustments to acreages for constructed CWPPRA projects in the east Sabine Lake marshes (Clark et al., 2000; USFWS and NRCS, 2003), at Black Bayou (LDNR and NRCS, 1993), and at Perry Ridge (USGS-NWRC, 2002a, 2002b) were applied in the WVA Land Loss Spreadsheets. Acres of restored marsh were added in the FWOP marsh (acres) column in the target year in which they were completed.

4.1.2.3 FWP Land Change Projection

FWP projections address the changes that would be expected to occur as a result of channel deepening. Although the SNWW channel is located primarily in Texas, large indirect impacts may occur in both Texas and Louisiana due to small increases in salinity levels causing an increase in wetland loss rates and a decrease in biological productivity in aquatic habitats of the study area. Only a negligible increase in water surface elevation is expected, but a small increase in coastal shore erosion is forecast for up to 4 miles from each jetty. Beneficial use features and mitigation measures would reduce FWP land loss by restoring marshes on the Neches River and in the marshes east of Sabine Lake, respectively, and with periodic Gulf shoreline nourishment.

Table 10: Projected Acres Lost to Shoreline Recession

| HU # | HU name | Marsh Type | Marsh | Water | Total |
|---|---|---|---|---|---|
| **Louisiana** | | | | | |
| LA 2 | Willow Bayou | Brackish | 627.4 | 20.2 | 647.6 |
| LA 3 | Black Bayou | Brackish | 621.4 | 8.7 | 630.1 |
| LA 4 | West Johnsons Bayou | Brackish | 956.5 | 130 | 1086.5 |
| LA 5 | Sabine Lake Ridges | Brackish | 685.1 | 48.8 | 733.9 |
| | | Saline | 105.7 | 32.5 | 138.2 |
| | LA Subtotal | | 2996.1 | 240.2 | 3236.3 |
| **Texas** | | | | | |
| TX 7 | GIWW North | Fresh | 7.9 | 0 | 7.9 |
| | | Intermediate | 3.6 | 0 | 3.6 |
| TX 8 | Texas Point | Fresh | 0.6 | 0 | 0.6 |
| | | Intermediate | 67.8 | 1.9 | 69.7 |
| | | Brackish | 812.5 | 39.8 | 852.3 |
| | | Saline | 2043.1 | 150.6 | 2193.7 |
| TX 9 | Salt Bayou | Fresh | 0.1 | 0 | 0.1 |
| | | Brackish | 26.6 | 3.4 | 30 |
| | TX Subtotal | | 2962.2 | 195.7 | 3157.9 |

FWP land changes are applied to the net FWOP acreage after all FWOP land loss adjustments have been made. The same productivity-based land loss formula applied for the FWOP land loss projection is used for the FWP land change projection. HS Model salinity outputs are used in the land loss formula to forecast FWP land loss rates.

*4.1.2.3.1 Productivity-based Interior Marsh Loss*

An increase in interior marsh loss would likely result when increased FWP salinities interact with FWOP submergence, causing a marginally higher land loss rate. Associating higher land loss rates in marsh interiors with salinity increases is based upon documented biological responses of inundated vegetation to salinity. Salinity predominantly drives the change among marsh habitats, and extreme salinities may lead to the conversion of marsh to open water, but small changes in salinity can also affect the primary productivity of marsh grasses, and this stress is worsened with inundation stress (Baldwin and Mendelssohn, 1998; Broome et al., 1995; Ewing et al., 1995; Flynn et al., 1995; Hester et al., 2001; Howard and Mendelssohn, 1999, 2000; Kemp and Cunningham, 1981; McKee and Mendelssohn, 1989; Pezeshki and DeLaune, 1995; Pezeshki et al., 1987a, 1987b; Spalding and Hester, 2007; Willis and Hester, 2004).

RSLR would increase tidal flows, water surface elevations, and salinities in all areas affected by tidal influence. Decreased plant productivity has been demonstrated to result from the interaction of excessive

submergence and salinity. This interaction leads to a decrease in organic matter accumulation, which, in turn, results in greater submergence because the rate of increase in marsh elevation cannot keep up with the rate of submergence due to RSLR (Mendelssohn and McKee, 1988; Day and Templet, 1989; Koch and Mendelssohn, 1989; Koch et al., 1990; Nyman et al., 1993; DeLaune et al., 1994; Day et al., 1995; Webb et al., 1995; Spalding and Hester, 2007). The death of wetland vegetation often results, followed by peat collapse, erosion, and wetland loss (Salinas et al., 1986; DeLaune et al., 1994; Webb and Mendelssohn, 1996; Gough and Grace, 1999; Visser et al., 1999).

Impacts to primary productivity resulting from this process have been well documented for maidencane and marshhay cordgrass, two widespread species in the study area (Pezeshki et al., 1987c; Ewing et al., 1995; Hester et al., 1996, 2001, 2002; Baldwin and Mendelssohn, 1998; Willis and Hester, 2004). Marshhay cordgrass is the most prevalent marsh grass throughout the large intermediate marshes around Sabine Lake, and it is also common in brackish and fresh marsh communities. Maindencane is a co-dominant marsh plant in the area's freshwater marshes. Freshwater marshes are much more sensitive to sudden changes in hydrology like those predicted in the with-project condition than are saline marshes, which have no negative response to occasional freshets and are not sensitive to salinities in the predicted range. Fresh systems are less able to respond to sudden and permanent increases in salinity and/or water depth (i.e., subsidence/RSLR), especially if those changes cross a critical threshold. Saltwater intrusion and related sulfide formation kill fresh and intermediate vegetation, and exposes bare soils to increased erosion. Substrate elevation is reduced to the point that open-water areas form before the succession to salt-tolerant vegetation can take place. In some cases, fresh and intermediate grasses are replaced by more-salt-tolerant brackish vegetation, but this can only occur in areas with the firm substrate required by these grasses and where hydrologic forces are not eroding those substrates. This is the same process that was documented by the Louisiana Coastal Areas Ecosystem study for coastal habitats, which includes the Sabine-Neches estuarine system (USACE, 2004).

#### *4.1.2.3.2 SNWW Channel Extension Effects to Gulf Shoreline*

FWP Gulf shoreline erosion impacts that could be caused by the proposed offshore channel extension were included in the FWP land loss calculations as follows. The Gravens and King study (2003) predicted a loss of 0.42 feet/year in the first 4 miles of shoreline from each jetty. This loss was converted to acres for each affected marsh type, the total acres were divided by 51 years (years of FWP impacts), and the acres lost-per-year were subtracted from the FWP Marsh (acres) column in the land loss spreadsheets of the affected hydro-units for TYs 15–65

#### *4.1.2.3.3 Land Change Projections for BU Features*

The SNWW LPP includes the Neches River and Gulf Shoreline BU Features. The benefits of these BU features were calculated in land loss spreadsheets and WVA worksheets following conventions described for other land change processes, with the exception that acres of restored marsh or shore nourishment were added in the FWP Marsh columns.

*4.1.2.3.4 Land Change Projections for Mitigation Measures*

WVA modeling was conducted only for mitigation measures that were advanced for final screening: marsh restoration in the Willow and Black Bayou areas, and Gulf shoreline nourishment at Texas and Louisiana Points. In the Willow and Black Bayou areas, mitigation measures would add new mineral soils to degraded areas of former marsh. The land loss rate for the WVA modeling of the restored marsh areas was reduced by 50 percent when dedicated dredging would be used to add denser, mineral soils and the increase in marsh elevation would create a more stable landform. Marsh restoration measures employing in situ marsh terracing and shoreline nourishment measures were modeled using a land loss rate equivalent to the FWP rate. Acreages in the land loss spreadsheets of each mitigation measure were adjusted to add acres of restored, emergent marsh, or acres were adjusted to account for effect of shoreline nourishment, which stopped or slowed existing shoreline retreat. For measures constructed with maintenance material, dredging cycles were estimated using historical information available in the Galveston District dredging database.

It was assumed that mitigation measures would be constructed and vegetated by TY 14, and therefore credit for marsh acreage was taken in TY 15. Recent experience with CWPPRA and other marsh restoration projects in the lower Sabine and Neches watersheds has shown that marsh plantings and natural vegetation rebound quickly and robustly to create a stable marsh landscape. It is recognized that the created marsh does not become functionally equivalent to natural marsh systems in such a short time (Minello and Webb, 1993, 1997; Minello, 2000) but the constructed marshes would begin providing cover and possibly food for some species soon after marsh vegetation is established (Minello and Zimmerman, 1992).

### 4.1.3 Limitations and Uncertainties

Several limitations and uncertainties are associated with this approach to land loss projections.

- Since the historical land loss rates reflect observed changes over specific time periods, they include effects of actual hurricanes, tropical storms, and droughts that occurred during the period of observation, rather than the average probability of these events.
- Uncertainties associated with future rates of RSLR are large. Future estimates of eustatic sea level rise and regional subsidence have a large range of potential outcomes. Impact evaluations have been made with best estimates of the "most likely" future scenario, while the range of possible impacts has been evaluated with a sensitivity analysis.
- Changes in land loss rates predicted for CWPPRA projects are assumed to be 100 percent effective, since all are too early in their project lives to assess actual performance.
- All of the rates are based on time periods after heaviest oil/gas extraction and after canal/levee construction. They capture the lingering effects of these activities, but not the localized high subsidence rates that occurred earlier.
- The direct, linear relationship between productivity decreases and land loss rate increases is based upon relationships between salinity and primary productivity that have been reported by a large

number of peer-reviewed studies. Most of these studies were conducted in controlled environments (i.e., greenhouse experiments) and thus can be considered only an approximation of field relationships. The salinity/productivity relationship is the underlying basis for projections of land loss impacts of this project. It is assumed that abrupt and continuing salinity increases would stress existing marsh vegetation, which would in turn cause the death of a small percentage of that vegetation, the subsequent erosion of marsh soils, and the creation of large areas of open water within formerly healthy marsh communities.

## 4.2 $V_2$ PERCENT SUBMERGED AQUATIC VEGETATION

Baseline values for this variable were based largely upon previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate, and data collected for existing CWPPRA or other restoration projects in or near the areas under evaluation. SAV species that have been reported in the SNWW hydro-units and their salinity tolerance ranges are presented in Table 11. Information on SAV species presented here is limited to presence/absence and does not include information on relative abundance. SAV species present in each hydro-unit are listed in the notes of each WVA worksheet. In hydro-units where observational data were not available, SAV species were assumed to be similar to those reported in nearby vegetation communities of the same type.

SAV species diversity is highest in the swamps and fresh-intermediate marshes of the study area. All of the SAV species reported in the SNWW study area occur in these areas (*Alternanthera philoxoides, Ceratophyllum demersum, Chara* spp., *Eichhornia crassipes, Lemna* sp., *Myrophyllum spicatum, Najas guadalupensis, Nymphaea odorata, Nymphaea mexicana, Ottelia alismoides, Pistia stratiotes, Potamogeton pectinatus, Potamogeton pusillus, Ruppia maritima, Salvinia minima, Utricularia* sp. unspecified, and *Vallisneria americana*). This list includes several noxious, invasive plants. Species reported in the fresh and intermediate marshes range in salinity tolerance from 0 to 0.5 ppt to 2 to 16 ppt. In brackish and saline marshes, far fewer SAV species occur, and cover is generally dominated by *Ruppia maritima*, a species that tolerates salinities from 2.0 to 25+ ppt.

SAV cover and species can change rapidly in response to a complex interaction of environmental conditions. Future conditions that could affect SAV growth include changes in salinity, freshwater introduction, nutrient input, turbidity, water depth, and fetch (Longstreth et al., 1984; Dunton, 1990; Livingston et al., 1998; Koch, 2001; Singh and Arora, 2003; Frazer et al., 2006; Paresh and Freedman, 2006). However, the FWP effects on SAV are limited to changes in salinity, and so comparisons of the FWOP and FWP conditions were limited to predicted salinity changes for this impact evaluation. Potential changes in the percentage of SAV cover in both the FWOP and FWP conditions were evaluated by comparing the salinity tolerance range of SAV species observed or expected in each hydro-unit to predicted TY 65 salinities.

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

| Scientific Name | Common Name | Salinity Range* | Salinity Tolerance | SNWW Occurrence | Vegetation Community | Observations | References |
|---|---|---|---|---|---|---|---|
| *Alternanthera philoxoides* | alligatorweed | fresh to mesohaline (0 to 8 ppt) | low | North Neches & Lake Bayou | Cypress-Tupelo Swamp | Observed during SNWW Habitat Workgroup field investigation (2004) | Emergent or floating-rooted invasive and noxious weed that forms thick mats that displaces native vegetation, retards water flow, lowers dissolved oxygen levels, and increases sedimentation; tolerates salinity of up to 10% by volume (Texas Invasive Org [TIO], 2009). Salinity tolerance is low (USDA, 2009). Common in slightly brackish and tidal fresh waters (Tiner, 1993). Chabreck (1972) reports it comprising 2.5% of intermediate and 5.3% of fresh Louisiana coastal marshes, with salinity range of 2 to 7.7 ppt. Stutzenbaker (1999) limits the salinity range to ~0 ppt. Provides excellent, good, and poor food value for crawfish, furbearers, and geese and ducks, respectively (Chabreck, 1972). |
| | | | | Sabine Island & Blue Elbow | Cypress-Tupelo Swamp | Observed during SNWW Habitat Workgroup field investigation (2004) | |
| | | | | Salt Bayou and Texas Point | Fresh Marsh | Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b) | |
| *Ceratophyllum demersum* | coontail, common hornwort | fresh and oligohaline (0 to 5.0 ppt) | low | Perry Ridge | Fresh and Intermediate Marsh | Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a) | Brittle, rootless, and entirely submerged aquatic plant (Wildflower Center [WC], 2009). Finely divided leaves arranged in whorled pattern around stem; similar to chara but bushier and softer (Center for Aquatic and Invasive Plants [CAIP], 2009). Fresh to slightly brackish waters (Flora of North America Editorial Committee [FNAEC], 1993+). Occurs in slightly brackish to tidal fresh waters (Tiner, 1993). Fair food value for ducks and crawfish (Chabreck, 1972). |
| | | | | Rose City | Fresh Marsh | Project Goal Summary, CEPRA Cycle 2 (GLO, 2000a) | |
| | | | | Willow Bayou | Intermediate Marsh | Observed during SAV and terrace study in Sabine NWR terraces (Caldwell, 2003). Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a). | |
| *Chara* spp. | chara, stonewort, muskgrass | fresh and oligohaline (0 to 4.0 ppt) | low | Perry Ridge | Fresh and Intermediate Marsh | Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a) | Branched multicellular algae that is entirely submerged and has a grainy texture; prefers hard or alkaline waters (Texas A&M University [TAMU], 2009). Chabreck (1972) gives salinity tolerance for *Chara vulgaris* as 0.15 to 3.9 ppt. Fair and poor food value for ducks and geese, respectively (Chabreck, 1972; TAMU, 2009). |
| | | | | Black Bayou | Intermediate Marsh | Observed in postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007) | |
| | | | | Willow Bayou | Intermediate Marsh | SAV and terrace study in Sabine NWR terraces (Caldwell, 2003) | |
| *Eichhornia crassipes* | water hyacinth | fresh and oligohaline (0 to 0.5 ppt) | low | Bessie Heights | Fresh and Intermediate Marsh | Observed during SNWW Habitat Workgroup field investigation (2004). | Floating aquatic plant with thick leaves and conspicuous flowers extending above water surface; nonnative, invasive plant that alters native vegetation and fish communities by lowering light penetration and dissolved oxygen levels; grows in a wide variety of aquatic habitat and tolerates drastic fluctuations in water level, flow, acidity, and nutrients (TIO, 2009). Dominant in tidal fresh waters (Tiner, 1993). Stutzenbaker (1999) salinity range is 0 to 0.5 ppt. Chabreck (1972) reports it comprising 1.4% of fresh Louisiana coastal marshes, with salinity range of 0.3 to 0.5 ppt; provides poor food value for crawfish. |
| | | | | Rose City | Fresh marsh | Observed during SNWW Habitat Workgroup field investigation (2004) | |
| | | | | Salt Bayou and Texas Point | Fresh and Intermediate Marsh | Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b) | |

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

| Scientific Name | Common Name | Salinity Range* | Salinity Tolerance | SNWW Occurrence | Vegetation Community | Observations | References |
|---|---|---|---|---|---|---|---|
| *Lemna L.* | common duck weed | fresh and oligohaline (0 to 2.0 ppt) | low | North Neches River | Cypress-Tupelo Swamp | Observed during SNWW Habitat Workgroup field investigation (2004) | Perennial floating plant with tiny leaves that forms a carpet-like cover on water surface (WC, 2009). Salinity tolerance is low (USDA, 2009). Occurs in slightly brackish to tidal fresh waters (Tiner, 1993). Chabreck (1972) reports it comprising 0.2% of brackish, 0.16% of intermediate and 3.3% of fresh Louisiana coastal marshes, with salinity range of 0.4 to 1.9 ppt. Stutzenbaker (1999) salinity range is 0 to 0.5 ppt. Provides good and fair food value for ducks and crawfish, respectively (Chabreck, 1972; WC, 2009). |
| | | | | Salt Bayou and Texas Point | Fresh Marsh | Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b) | |
| *Myriophyllum spicatum L.* | Eurasian watermilfoil | fresh to mesohaline (0 to 16 ppt) | medium | Perry Ridge | Fresh and Intermediate Marsh | Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a) | Submerged perennial plant with finely dissected featherlike leaves; nonnative, invasive that can form large, floating mats that prevent light penetration for native aquatic plants; thrives in areas subjected to natural and man-made disturbances; tolerates salinities up to 15 ppt (TIO, 2009). Invasive, noxious weed (USDA, 2009). Salinity range is 0 to 10 ppt (Urbatsch, 2009). Present at 0 thru 16 ppt (USGS, 1997). A brackish aquatic bed plant (Tiner, 1993). Stutzenbaker (1999) salinity range is 0 to 20 ppt. Chabreck (1972) reports it comprising 0.15% of brackish, 0.44% of intermediate and 1.56% of fresh Louisiana coastal marshes, and provides good and fair food value for ducks and crawfish, respectively. |
| | | | | Black Bayou | Intermediate Marsh | Observed in pre- and postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007) | |
| | | | | Willow Bayou | Intermediate Marsh | Observed in pre- and postconstruction monitoring of Willow Bayou reference area for Black Bayou Project CS-27 (Castellanos and Juneau, 2007). Observed during SAV and terraces study (Caldwell, 2003). Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a). | |
| | | | | Rose City | Fresh Marsh | Project Goal Summary, CEPRA Cycle 2 (GLO, 2000) | |
| *Najas guadalupensis* | Southern waternymph, Southern naiad | fresh to mesohaline (0 to 15 ppt) | medium | Perry Ridge | Fresh and Intermediate Marsh | Observed in postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a) | Annual, submerged aquatic plant with very long branches and short, narrow leaves (CAIP, 2009). Salinity range is 0 to 15 ppt (Urbatsch, 2009); medium salinity tolerance is reported by USDA (2009). Reported at mouth of Trinity Bay in areas where monthly mean salinities ranged from 3.0 to 18.9 ppt and 1.7 to 14.4 ppt, with overall means of 9.2 ppt and 6.0 ppt. Found in fresh and sometimes brackish water (Correll and Correll, 1972). A brackish aquatic bed plant (Tiner, 1993). Stutzenbaker (1999) salinity range is 0–0.5 ppt. Chabreck (1972) reports it comprising 1.03% of intermediate and 1.07% of fresh Louisiana coastal marshes, with salinity range of 0.23 to 1.1 ppt, and provides excellent, good, and fair food value for ducks, geese, and crawfish, respectively. |
| | | | | Black Bayou | Intermediate Marsh | Observed in pre- and postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007) | |
| | | | | Willow Bayou | Intermediate Marsh | Observed in pre- and postconstruction monitoring of Willow Bayou reference area for Black Bayou Project CS-27 (Castellanos and Juneau, 2007). Observed during SAV and terraces study (Caldwell, 2003). Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a). | |
| | | | | Rose City | Fresh Marsh | Project Goal Summary, CEPRA Cycle 2 (GLO, 2000) | |
| | | | | Salt Bayou and Texas Point | Fresh and Intermediate Marsh | Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b) | |

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

| Scientific Name | Common Name | Salinity Range* | Salinity Tolerance | SNWW Occurrence | Vegetation Community | Observations | References |
|---|---|---|---|---|---|---|---|
| *Nymphaea odorata* | American white water lily | fresh (0 to 0.5 ppt) | low | Blue Elbow & Rose City | Fresh Marsh | Project Goal Summary, CEPRA Cycle 2 (GLO, 2000) | Native, perennial floating aquatic plant with large, fragrant, white or pink flowers and flat, round, floating leaves; waterfowl and mammals eat the buoyant seeds and other parts of the plant (WC, 2009). Stutzenbaker (1999) salinity range 0–0.5 ppt. Good food value for ducks (Chabreck, 1972). |
| *Nymphaea mexicana* | yellow water lily, sun lotus, banana water lily | fresh to oligohaline (0 to 3.5 ppt) | low | Rose City | Fresh Marsh | Rose City Project Goal Summary, CEPRA Cycle 2 (GLO, 2000) | A nonnative, perennial, floating aquatic plant with bright yellow flowers and floating leaves (WC, 2009). Salinity tolerance is low (USDA, 2009). Found in alkaline lakes, ponds, pools in marshes, sloughs, etc. (FNAEC, 1993+). Dominant in fresh tidal waters (Tiner, 1993). Stutzenbaker (1999) salinity range 0 to 3.5 ppt. Excellent food value for ducks (Chabreck, 1972). |
| *Ottelia alismoides* | duck lettuce | fresh and oligohaline (0 to 5.0 ppt) | low | Perry Ridge | Fresh and Intermediate Marsh | Observed in preconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a) | Invasive, annual, submerged aquatic plant native to the rice fields of southeast Asia that has naturalized in Louisiana (CAIP, 2009). Nonnative invasive (FNAEC, 1993+). |
| | | | | Black Bayou | Intermediate Marsh | Observed in postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007) | |
| | | | | Willow Bayou | Intermediate Marsh | Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a) | |
| *Pistia stratiotes* | water lettuce | fresh to oligohaline (0 to 5.0 ppt) | low | Salt Bayou and Texas Point | Fresh Marsh | Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b) | Floating perennial aquatic plant that resembles an open head of lettuce (CAIP, 2009). Native and invasive with heavy worldwide distribution (TIO, 2009). Aggressive plant that rapidly covers vast expanses of open waters in southern wetlands, especially cypress swamps (WC, 2009). |
| *Potamogeton pectinatus* | sago or fennelleaf pondweed | fresh to mesohaline (0 to 16 ppt) | medium | Perry Ridge | Fresh and Intermediate Marsh | Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a) | Perennial submerged aquatic with long, flattened, branching stems; tolerates wide range of soil types and ph; prefers brackish water (USDA, 2009); alkaline waters for flowering (FNAEC, 1993+). Salinity range is 0 to 9 ppt (Urbatsch, 2009). Present at 0 thru 16 ppt (USGS, 1997). Grows in alkaline, brackish, or saline water of ponds, marshes, and ocean shores (Correll and Correll, 1972). Occurs in brackish, slightly brackish, and tidal fresh waters (Tiner, 1993). Stutzenbaker (1999) salinity range 0 to 3.5 ppt. Excellent and fair food value for ducks and crawfish, respectively (Chabreck, 1972). |
| | | | | Salt Bayou and Texas Point | Fresh, Intermediate and Brackish Marsh | Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b) | |
| *Potamogeton pusillus* | lesser or baby pondweed | fresh to mesohaline (0 to 16 ppt) | medium | Willow Bayou | Intermediate Marsh | Observed during SAV and terraces study (Caldwell, 2003) | Chabreck (1972) reports it comprising 0.24% of intermediate and 0.62% of fresh Louisiana coastal marshes. Good and fair food value for ducks and crawfish, respectively (Chabreck, 1972). |

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

| Scientific Name | Common Name | Salinity Range* | Salinity Tolerance | SNWW Occurrence | Vegetation Community | Observations | References |
|---|---|---|---|---|---|---|---|
| *Ruppia maritima* | widgeongrass | oligohaline thru polyhaline (2.0 to 25.0+ ppt) | high | Perry Ridge | Fresh and Intermediate Marsh | Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 but frequency of occurrence dropped dramatically post-monitoring (Mouledous and Guidry, 2007a) | Stalkless seagrass with leaves arising directly from rhizome; tolerant of wide range of salinities; generally found in waters of 25.0 ppt or less (Dineen, 2001). Salinity range is 2 to 70 ppt (Urbatsch, 2009). Adapted to brackish marsh community (Penfound and Hathaway, 1938; FNAEC, 1993+); present at 0 thru 16 ppt (USGS, 1997). Reported at mouth of Trinity Bay in areas where monthly mean salinities ranged from 3.0 to 18.9 ppt and 1.7 to 14.4 ppt, with overall means of 9.2 ppt and 6.0 ppt. Stutzenbaker (1999) salinity range 0 to 10 ppt. Chabreck (1972) reported it comprised 3.84% of brackish and 0.64% of intermediate Louisiana coastal marshes, with salinity range of 2.6 to 15.3 ppt; excellent and good food value for ducks and geese, respectively . |
| | | | | Black Bayou | Intermediate Marsh | Observed in pre- and postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007) | |
| | | | | Willow Bayou | Intermediate and Brackish Marsh | Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a). Observed during SAV and terraces study (Caldwell, 2003) | |
| | | | | Old River Cove | Intermediate and Brackish Marsh | Observed during SNWW Habitat Workgroup field investigation (2004) | |
| | | | | Salt Bayou and Texas Point | Intermediate, Brackish and Saline marsh | 100% rupia most years (Personal communication - Pat Walthers, USFWS, Texas Point NWR, 4/9/09). Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008a) | |
| *Salvinia minima* | salvinia minor | fresh (0 to 2 ppt) | low | Bessie Heights | Fresh and Intermediate Marsh | Observed during SNWW Habitat Workgroup field investigation (2004) | Rootless aquatic fern, long considered native but likely introduced in 1920s; invasive, noxious plant, forms dense mats that can shade out native aquatic species and reduce dissolved oxygen levels; low tolerance to salinity (TIO, 2009). Stutzenbaker (1999) salinity range 0 to 0.5 ppt. |
| | | | | Rose City | Fresh marsh | Observed during SNWW Habitat Workgroup field investigation (2004) | |
| *Utricularia sp. unspecified* | common bladderwort | fresh to oligohaline (0 to 3.0 ppt) | low | Perry Ridge | Fresh and Intermediate Marsh | Observed in postconstruction monitoring for CS-30, Perry Ridge West Bank Stabilization (Mouledous and Guidry, 2007a) | Native, rootless, submerged aquatic plants with lacy, complex leaves and tiny carnivorous bladders and erect flower stalks that extend above the water (CAIP, 2009). Possible species include *Utricularia gibba* and *Utricularia* sp. *macrorhiza*. Normally found in quiet, shallow, acidic waters (TAMU, 2009). Observed in fresh/intermediate habitats (1 to 3 ppt) in southeast Louisiana (Penfound and Hathaway, 1938). Stutzenbaker (1999) limits the salinity range to 0–0.5 ppt. Dominant in fresh tidal waters (Tiner, 1993). Chabreck (1972) provided a salinity range of 0.0 to 1.3 ppt for horned bladderwort *(Utricularia cornuta*); fair and poor food value for crawfish and ducks, respectively. |
| | | | | Willow Bayou | Intermediate Marsh | Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a) | |
| *Vallisneria americana* | freshwater American eelgrass; wild celery | fresh thru mesohaline (0 to 16 ppt) | medium | Perry Ridge | Fresh and Intermediate Marsh | Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a) | Submerged plant that forms tall underwater meadows and is commonly found growing in lakes and streams; leaves arise in clusters from their roots and can be several feet long (CAIP, 2009). Salinity range is 0 to 9 ppt (Urbatsch, 2009). Present at 0 thru 16 ppt (USGS, 1997). Grows in fresh to brackish waters (FNAEC, 1993+). Reported at mouth of Trinity Bay in areas where monthly mean salinities ranged from 3.0 to 18.9 ppt and 1.7 to 14.4 ppt, with overall means of 9.2 ppt and 6.0 ppt, respectively (Zimmerman et al., 1990). Occurs in slightly brackish to tidal fresh waters (Tiner, 1993). Stutzenbaker (1999) salinity range 0 to 3.5 ppt. Chabreck (1972) reports that it provides excellent food value for ducks. |

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

| Scientific Name | Common Name | Salinity Range* | Salinity Tolerance | SNWW Occurrence | Vegetation Community | Observations | References |
|---|---|---|---|---|---|---|---|
| *Utricularia sp. unspecified* | common bladderwort | fresh to oligohaline (0 to 3.0 ppt) | low | Perry Ridge | Fresh and Intermediate Marsh | Observed in postconstruction monitoring for CS-30, Perry Ridge West Bank Stabilization (Mouledous and Guidry, 2007a) | Native, rootless, submerged aquatic plants with lacy, complex leaves and tiny carnivorous bladders and erect flower stalks that extend above the water (CAIP, 2009). Possible species include *Utricularia gibba* and *Utricularia* sp. *macrorhiza.* Normally found in quiet shallow, acidic waters (TAMU, 2009). Observed in fresh/ intermediate habitats (1 to 3 ppt) in southeast Louisiana (Penfound & Hathaway, 1937). Stutzenbaker (1999) limits the salinity range to 0 to 0.5 ppt. Dominant in fresh tidal waters (Tiner, 1993). Chabreck (1972) provided a salinity range of 0.0 to 1.3 ppt for horned bladderwort (*Utricularia cornuta* ); fair and poor food value for crawfish and ducks, respectively. |
| | | | | Willow Bayou | Intermediate Marsh | Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a) | |
| *Vallisneria americana* | freshwater American eelgrass; wild celery | fresh thru mesohaline (0 to 16 ppt) | medium | Perry Ridge | Fresh and Intermediate Marsh | Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a) | Submerged plant that forms tall underwater meadows and is commonly found growing in lakes and streams; leaves arise in clusters from their roots and can be several feet long (CAIP, 2009). Salinity range is 0 to 9 ppt (Urbatsch, 2009). Present at 0 thru 16 ppt (USGS, 1997). Grows in fresh to brackish waters (FNAEC, 1993+). Reported at mouth of Trinity Bay in areas where monthly mean salinities ranged from 3.0 to 18.9 ppt and 1.7 to 14.4 ppt, with overall means of 9.2 and 6.0 ppt, respectively (Zimmerman et al., 1990). Occurs in slightly brackish to tidal fresh waters (Tiner, 1993). Stutzenbaker (1999) salinity range 0 to 3.5 ppt. Chabreck (1972) reports that it provides excellent food value for ducks. |

* After Cowardin et al. (1979): polyhaline 18 to 30 ppt; mesohaline 5 to 18 ppt; and oligohaline 0.5 to 5 ppt. Salinity ranges based on areas of occurrence, and refined when more-specific salinity range data were available (see reference column).

### 4.2.1 FWOP and FWP Changes in SAV Coverage

In the majority of cases, the FWOP and FWP salinity changes to the percentage of SAV cover were similar. Table 12 presents a graphical summary of SAV salinity impacts in both future conditions. In 7 out of 11 fresh marsh communities, predicted FWOP and FWP salinity changes by TY 65 would not exceed the salinity tolerance range of SAV species reported in the units. At TX 7 (GIWW North), salinity tolerances would be exceeded for two (*Lemna* sp. and *Eichhornia crassipes*) of six species in both the FWOP and FWP conditions. At TX 10 (Cow Bayou) and TX 11 (Adams Bayou), the salinity tolerance of one (*Chara* spp.) of five SAV species would be exceeded in the FWP condition. At TX 3 (Rose City), the salinity tolerances of one (*Nymphaea odorata*) of eight species would be exceeded in the FWP condition.

The highest impacts would occur in the intermediate marsh communities. In only 4 of 12 hydro-units, predicted FWOP and FWP salinity changes did not exceed the SAV salinity tolerance ranges. However, once again, the FWOP and FWP salinity changes would be similar for the majority of hydro-units. FWOP and FWP salinities in LA 3 (Black Bayou), LA 4 (Johnson's Bayou), and TX 5 (Bessie Heights), and TX 13 (Groves) would exceed the tolerance range of one or two of five species in each hydro-unit. The species affected were *Chara* spp., *Ottelia alismoides*, and *Salvinia minima*. FWOP and FWP salinities in LA 2 (Willow Bayou) would exceed the tolerance range of three of six species in each hydro-unit. SAV species affected in these units were *Utricularia* sp. unspecified, *Ceratophyllum demersum*, *Ottelia alismoides*, *Salvinia minima*, and *Eichhornia crassipes*. At LA 1 (Perry Ridge), LA 9, (East Johnson's Bayou), and TX 10 (Cow Bayou), SAV salinity tolerances would only be exceeded in the FWP condition. In LA 1, two (*Ceratophyllum demersum* and *Ottelia alismoides*) of nine SAV species would be impacted. In LA 9 and TX 10, one (*Chara* spp.) of five SAV species would be impacted.

In the brackish and saline marsh communities, the vast majority of hydro-units were dominated by *Ruppia maritima*; the large salinity tolerance range of this species would not be exceeded by salinity changes in either the FWOP or FWP condition. At LA 4 (Johnson's Bayou), the salinity tolerance range of two (*Chara* spp. and *Ottelia alismoides*) of five species would be exceeded in both the FWOP and FWP conditions. In LA 3 (Black Bayou), the salinity tolerance of one (*Ottelia alismoides*) of four SAVs would be exceeded in the FWP condition.

### 4.2.2 FWOP and FWP SAV Impacts

In the WVA worksheets, the FWOP and FWP salinity impacts to specific SAV species were identified. In no case was all SAV species in a specific marsh community predicted to be adversely affected by the projected salinity increase; the greatest impacts would occur in the LA 2 (Willow Bayou) intermediate marsh community where the salinity tolerances of three of six species would be exceeded in both the FWOP and FWP conditions. SAV salinity impacts would be limited to the FWP condition in seven hydro-units; three in fresh marsh (TX 3, Rose City; TX 10, Cow Bayou; and TX 11 Adam Bayou), three in intermediate marsh (LA 1, Perry Ridge; LA 9, East Johnson's Bayou; and TX 10, Cow Bayou), and one in the brackish marsh community (LA 3, Black Bayou).

Table 12: SNWW 48-ft Project SAV Wildlife Impacts

| Hydro-Unit (HU) # | HU Name | Future Salinity Range in HU (ppt)[1] | Alligator Weed[2] 0 to 8 ppt[3] g, F, C[4] | Bladderwort 0 to 3.0 ppt d, c | Chara 0 to 4.0 ppt d, g | Coontail 0 to 5.0 ppt d, c | Duck Lettuce 0 to 5.0 ppt | Duck Weed 0 to 2.0 ppt D, c | Eurasian Watermilfoil 0 to 16 ppt D, c | Freshwater Eelgrass 0 to 16 ppt D | Pickerelweed 0 to 3 ppt d, f | Pondweed 0 to 16 ppt D, c | *Salvinia minor* 0 to 2.0 ppt | Southern Naiad 0 to 15 ppt D, G, c | Water Hyacinth 0 to 0.5 ppt c | Water Lettuce 0 to 5.0 ppt | White Water Lily 0 to 0.5 ppt D | Widgeon Grass 2 to 25 ppt D, G | Yellow Water Lily 0 to 3.5 ppt D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fresh Marsh** | | | | | | | | | | | | | | | | | | | |
| LA 1 | Perry Ridge | | | | | | | | | | | | | | | | | | |
| | FWOP | 1.3–1.7 | NI[5] | NI | NA | NI | NI | NA | NI | NI | NA | NI | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 1.3–2.3 | NI | NI | NA | NI | NI | NA | NI | NI | NA | NI | NA | NI | NA | NA | NA | NI | NA |
| LA 7 | SE Sabine | | | | | | | | | | | | | | | | | | |
| | FWOP | 1.7–2.1 | NA | NI | NA | NI | NA | NI | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 1.7–2.4 | NA | NI | NA | NI | NA | NI | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 8 | SW Gum Cove | | | | | | | | | | | | | | | | | | |
| | FWOP | 1.2–1.4 | NA | NI | NA | NI | NI | NA | NI | NI | NA | NI | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 1.2–2.0 | NA | NI | NA | NI | NI | NA | NI | NI | NA | NI | NA | NI | NA | NA | NA | NI | NA |
| TX 1 | North Neches River | | | | | | | | | | | | | | | | | | |
| | FWOP | 0.0–0.0 | NI | NA | NA | NA | NA | NI | NA | NA | NI | NA | NA | NA | NA | NA | NA | NA | NA |
| | FWP | 0.0–0.0 | NI | NA | NA | NA | NA | NI | NA | NA | NI | NA | NA | NA | NA | NA | NA | NA | NA |
| TX 2 | Neches - Lake Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 0.0–0.0 | NI | NA | NA | NA | NA | NI | NA | NA | NI | NA | NA | NA | NA | NA | NA | NA | NA |
| | FWP | 0.0–0.1 | NI | NA | NA | NA | NA | NI | NA | NA | NI | NA | NA | NA | NA | NA | NA | NA | NA |
| TX 3 | Rose City | | | | | | | | | | | | | | | | | | |
| | FWOP | 0.1–0.3 | NA | NA | NA | NI | NA | NA | NI | NA | NI | NA | NI | NI | NI | NA | NI | NA | NI |
| | FWP | 0.1–0.6 | NA | NA | NA | NI | NA | NA | NI | NA | NI | NA | NI | NI | NI | NA | I | NA | NI |
| TX 4 | West of Rose City | | | | | | | | | | | | | | | | | | |
| | FWOP | 0.1–0.3 | NA | NA | NA | NI | NA | NA | NI | NA | NI | NA | NI | NI | NI | NA | NA | NA | NA |
| | FWP | 0.1–0.6 | NA | NA | NA | NI | NA | NA | NI | NA | NI | NA | NI | NI | NI | NA | NA | NA | NA |
| TX 5 | Bessie Heights | | | | | | | | | | | | | | | | | | |
| | FWOP | 1.0–1.5 | NA | NA | NA | NI | NA | NA | NI | NA | NI | NA | NI | NI | NI | NA | NA | NA | NA |
| | FWP | 1.5–2.0 | NA | NA | NA | NI | NA | NA | NI | NA | NI | NA | NI | NI | NI | NA | NA | NA | NA |
| TX 7 | GIWW North | | | | | | | | | | | | | | | | | | |
| | FWOP | 0.7–2.5 | NI | NA | NA | NA | NA | I | NA | NA | NA | NI | NA | NI | I | NI | NA | NI | NA |
| | FWP | 0.7–4.1 | NI | NA | NA | NA | NA | I | NA | NA | NA | NI | NA | NI | I | NI | NA | NI | NA |
| TX 10 | Cow Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 3.5–4.0 | NA | NA | NI | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 3.5–5.0 | NA | NA | I | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| TX 11 | Adams Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 2.5–3.5 | NA | NA | NI | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 2.5–5.0 | NA | NA | I | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| **Intermediate Marsh** | | | | | | | | | | | | | | | | | | | |
| LA 1 | Perry Ridge | | | | | | | | | | | | | | | | | | |
| | FWOP | 3.8–4.5 | NI | I | NA | NI | NI | NA | NI | NI | NA | NI | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 3.8–5.6 | NI | I | NA | I | I | NA | NI | NI | NA | NI | NA | NI | NA | NA | NA | NI | NA |
| LA 2 | Willow Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 6.3–6.8 | NA | I | NA | I | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 6.3–7.7 | NA | I | NA | I | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 3 | Black Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 4.7–5.1 | NA | NA | I | NA | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 4.7–6.5 | NA | NA | I | NA | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 4 | Johnson's Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 4.4–5.5 | NA | NA | I | NA | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 4.4–7.3 | NA | NA | I | NA | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 5 | Sabine Lake Ridges | | | | | | | | | | | | | | | | | | |
| | FWOP | 4.5–5.5 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 4.5–7.3 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |

Table 12: SNWW 48-ft Project SAV Wildlife Impacts

| Hydro-Unit (HU) # | HU Name | Future Salinity Range in HU (ppt)[1] | Alligator Weed[2] 0 to 8 ppt[1] g, F, C[4] | Bladderwort 0 to 3.0 ppt d, c | Chara 0 to 4.0 ppt d, g | Coontail 0 to 5.0 ppt d, c | Duck Lettuce 0 to 5.0 ppt | Duck Weed 0 to 2.0 ppt D, c | Eurasian Watermilfoil 0 to 16 ppt D, c | Freshwater Eelgrass 0 to 16 ppt D | Pickerelweed 0 to 3 ppt d, f | Pondweed 0 to 16 ppt D, c | *Salvinia minor* 0 to 2.0 ppt | Southern Naiad 0 to 15 ppt D, G, c | Water Hyacinth 0 to 0.5 ppt c | Water Lettuce 0 to 5.0 ppt | White Water Lily 0 to 0.5 ppt D | Widgeon Grass 2 to 25 ppt D, G | Yellow Water Lily 0 to 3.5 ppt D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LA 7 | SE Sabine | | | | | | | | | | | | | | | | | | |
| | FWOP | 1.7–2.1 | NA | NI | NA | NI | NA | NI | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 1.7–2.4 | NA | NI | NA | NI | NA | NI | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 8 | SW Gum Cove | | | | | | | | | | | | | | | | | | |
| | FWOP | 2.4–2.8 | NA | NA | NI | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 2.4–3.9 | NA | NA | NI | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 9 | East Johnson's Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 3.3–3.8 | NA | NA | NI | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 3.3–4.8 | NA | NA | I | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| TX 5 | Bessie Heights | | | | | | | | | | | | | | | | | | |
| | FWOP | 4.2–4.4 | NA | NA | NA | NI | NA | NA | NI | NA | I | NA | I | NI | NA | NA | NA | NA | NA |
| | FWP | 4.2–4.7 | NA | NA | NA | NI | NA | NA | NI | NA | I | NA | I | NI | NA | NA | NA | NA | NA |
| TX 8 | Texas Point | | | | | | | | | | | | | | | | | | |
| | FWOP | 5.8–7.0 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 5.8–7.8 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| TX 10 | Cow Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 3.5–4.0 | NA | NA | NI | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 3.5–5.0 | NA | NA | I | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| TX 13 | Groves | | | | | | | | | | | | | | | | | | |
| | FWOP | 3.0–4.0 | NA | NA | NA | NI | NA | NA | NI | NA | I | NA | I | NI | I | NA | NA | NA | NA |
| | FWP | 3.0–5.0 | NA | NA | NA | NI | NA | NA | NI | NA | I | NA | I | NI | I | NA | NA | NA | NA |
| **Brackish Marsh** | | | | | | | | | | | | | | | | | | | |
| LA 2 | Willow Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 6.3–7.2 | NA | NA | NA | NA | NA | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 6.3–7.7 | NA | NA | NA | NA | NA | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 3 | Black Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 3.8–4.2 | NA | NA | NA | NA | NI | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 3.8–5.3 | NA | NA | NA | NA | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 4 | Johnson's Bayou | | | | | | | | | | | | | | | | | | |
| | FWOP | 4.4–5.3 | NA | NA | I | NA | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| | FWP | 4.4–7.0 | NA | NA | I | NA | I | NA | NI | NA | NA | NA | NA | NI | NA | NA | NA | NI | NA |
| LA 5 | Sabine Lake Ridges | | | | | | | | | | | | | | | | | | |
| | FWOP | 6.2–7.1 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 6.2–8.3 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| LA 6 | Johnson's Bayou Ridge | | | | | | | | | | | | | | | | | | |
| | FWOP | 4.4–5.3 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 4.4–7.0 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| TX 6 | Old River Cove | | | | | | | | | | | | | | | | | | |
| | FWOP | 10.0–11.2 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 10.0–13.0 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| TX 7 | GIWW North | | | | | | | | | | | | | | | | | | |
| | FWOP | 9.0–10.8 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 9.0–12.4 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| TX 8 | Texas Point | | | | | | | | | | | | | | | | | | |
| | FWOP | 8.5–9.8 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 8.5–10.6 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| **Saline Marsh** | | | | | | | | | | | | | | | | | | | |
| LA 5 | Sabine Lake Ridges | | | | | | | | | | | | | | | | | | |
| | FWOP | 15.8–16.6 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 15.8–17.3 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |

Table 12: SNWW 48-ft Project SAV Wildlife Impacts

| Hydro-Unit (HU) # | HU Name | Future Salinity Range in HU (ppt)[1] | Alligator Weed[2] 0 to 8 ppt[3] g, F, C[4] | Bladderwort 0 to 3.0 ppt d, c | Chara 0 to 4.0 ppt d, g | Coontail 0 to 5.0 ppt d, c | Duck Lettuce 0 to 5.0 ppt | Duck Weed 0 to 2.0 ppt D, c | Eurasian Watermilfoil 0 to 16 ppt D, c | Freshwater Eelgrass 0 to 16 ppt D | Pickerelweed 0 to 3 ppt d, f | Pondweed 0 to 16 ppt D, c | *Salvinia minor* 0 to 2.0 ppt | Southern Naiad 0 to 15 ppt D, G, c | Water Hyacinth 0 to 0.5 ppt c | Water Lettuce 0 to 5.0 ppt | White Water Lily 0 to 0.5 ppt D | Widgeon Grass 2 to 25 ppt D, G | Yellow Water Lily 0 to 3.5 ppt D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LA 6 | Johnson's Bayou Ridge | | | | | | | | | | | | | | | | | | |
| | FWOP | 15.8–16.6 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 15.8–17.3 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| TX 8 | Texas Point | | | | | | | | | | | | | | | | | | |
| | FWOP | 12.5–13.8 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |
| | FWP | 12.5–14.6 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NI | NA |

[1] Predicted by ERDC Hydrodynamic-salinity model (Brown and Stokes, 2009)

[2] Italicized - noxious and invasive aquatic plants

[3] See table "Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range"

[4] SAVs food value for wildlife, after Chabreck (1972). D (excellent or good for ducks), d (fair or poor for ducks); G (excellent or good for geese), g (fair or poor for geese); F (excellent or good for furbearers); f ( fair or poor for furbearers); C (excellent or good for crawfish); c (fair or poor for crawfish)

[5] NI - No Salinity Impact (salinity remains within tolerance range); I - Impact (salinity extends beyond tolerance range); NA - Not Applicable (not known or observed in HU)

The salinity change occurring with RSLR in the FWOP condition through TY 65 would be very gradual; the SAV community structure in the majority of intermediate marshes would likely change to include more salinity-tolerant species, such as *Ruppia maritima*, *Potamogeton pectinatus*, *Myrophyllum spicatum* and *Vallisneria americana* (USGS, 1997). It is expected that any SAV cover lost as a result of this change would be replaced by the salinity-tolerant SAVs continuing to grow within their tolerance range. As a result, no change in percent SAV cover was predicted for the FWOP condition through TY 65.

In the FWP condition, the project-related change in salinity would occur in TY 15 with dredging of the Sabine Pass and Sabine Pass Jetty channels. The HS model projects that the incremental salinity increase (e.g., the difference between the FWOP with RSLR salinity and the FWP with RSLR salinity) would average 1.3 ppt near the mouths of Sabine and Keith lakes, 0.8 ppt in the east Sabine Lake marshes, 0.7 ppt on the lower Neches and Sabine rivers, and less than 0.15 ppt on the upper Neches and Sabine rivers. Since salinity change is a function of the total dredging template, the time required to reach a new FWP equilibrium would likely be considerable, ranging from a conservative minimum of several months to even a year, because each wetland would be responding to salinity inputs from multiple sources (Gary Brown personal communication, 2009). The most-rapid change (on the order of 2 to 3 months) would likely occur in marshes immediately adjacent and open to tidal exchange with the navigation channel that has just been dredged. Because of the salinity effect of the existing navigation channel, wetlands adjacent to the channel are likely to contain SAVs with greater salinity tolerances, and thus would be able to adapt to the FWP change more easily. Similar to expected changes in the FWOP condition, the SAV community structure in the majority of intermediate marshes would likely change to include more salinity-tolerant species, such as *Ruppia maritima*, *Potamogeton pectinatus*, *Myrophyllum spicatum*, and *Vallisneria americana* (USGS, 1997). It is expected that any SAV cover lost as a result of this gradual change would be replaced by the salinity-tolerant SAVs continuing to grow within their tolerance range. As a result, no change in percent SAV cover was predicted for the FWP condition through TY 65.

### 4.2.3 SAV Impacts from BU Features and Mitigation Measures

Marsh restoration BU features and the mitigation measures would likely cause SAV impacts because of temporary but greatly increased turbidity associated with the hydraulic placement of dredged material for marsh restoration. It was assumed that construction would result in the die-off of SAVs in the vicinity of placement activities during the year of construction, followed by quick rebounds associated with increased nutrient input, and the creation of shallow, protected ponds within the restored marsh. Rebounds in the percentage of SAV cover were applied in the year following construction. Increases in SAV cover were predicted based upon the collective professional judgment of the Habitat Workgroup and experience with similar restoration projects in the study area.

## 4.3 $V_3$ MARSH EDGE AND INTERSPERSION

The Habitat Workgroup carefully examined enlarged orthophoto quadrangle maps for each hydro-unit and assigned interspersion classes by comparing them to the photographic examples in Appendix 1 of the emergent marsh model methodology. In most cases, the hydro-units contain more than one interspersion

class and are therefore divided into more than one class by percentage of acreage covered by each type. FWP projections were made on the basis of collective professional judgment and were generally associated with salinity changes. Significant increases in salinity, especially if salinities were passing from an optimal to suboptimal range, were assumed to stress existing marsh vegetation and lead to increasing amounts of open water or greater interspersion.

### 4.3.1 FWOP and FWP Projections

Salinity changes occurring in both the FWOP and FWP conditions would result in increases to the land loss rate for both conditions. The majority of land loss over the period of analysis would occur in the FWOP condition as a result of the baseline land loss rate, increased as described above to account for the salinity effects of RSLR. As a general rule, no change in interspersion class was predicted for minor FWOP changes in interior land loss amounting to less than 3 or 4 percent. For FWOP interior land loss totaling 5 percent or higher, at least half of the percentage loss was assumed to convert from the highest class to the next highest class.

No change in interspersion would be expected to result from water elevation increases associated with RSLR; it was assumed that biomass accumulation would offset much if not all of the RSLR change in water surface elevation (Morris et al., 2002). However, significant changes in interspersion class would occur in conjunction with shoreline recession due to RSLR. In shoreline marsh communities so affected, the percentage of marsh and water lost due to shoreline recession would convert to Class 4 in both the FWOP and FWP conditions. The incremental FWP interior land loss would be less than 1.5 percent in all cases. Because of this insignificant change between the FWOP and FWP conditions, no change in interspersion class through TY 65 would be expected for the FWP condition.

### 4.3.2 Effects of BU Features and Mitigation Measures

The restoration or protection of marshes resulting from the construction of the BU features and mitigation measures would improve the interspersion class based upon the increase in marsh edge and stable marsh elevation that would result from the construction of these measures.

## 4.4 $V_4$ PERCENT OPEN WATER ≤1.5 FEET DEEP

Baseline values for this variable were based largely upon previous observations by Habitat Workgroup members during average summer tidal conditions in the hydro-units that they manage or regulate. Values were also obtained from previous CWPPRA or other restoration projects in or near the areas under evaluation. Projections of the FWP condition considered trends in marsh loss and changes in interspersion predicted for $V_1$ and $V_3$, both of which were related to changes in salinity. It was assumed that shoreline retreat would convert an area equivalent to the land lost to water deeper than 1.5 feet. Other factors that could affect water depths, such as changes in water surface elevations, sedimentation rates, or RSLR, were not considered since they would not be affected by construction of the SNWW LPP.

### 4.4.1 FWOP and FWP Projections

No conversions of shallow water to deep water in the interior marsh would be expected from FWOP water surface elevation increases associated with RSLR; it was assumed that biomass accumulation would offset much if not all of the RSLR change in water surface elevation (Morris et al., 2002). However, shallow water would be lost in conjunction with FWOP shoreline recession due to RSLR. In Gulf and Sabine Lake shoreline marsh communities affected by shoreline recession, a narrow nearshore zone (estimated at 50 feet wide) would remain shallow thru TY 65, and the remainder of new water created from the loss of marsh would convert to deep water in both the FWOP and FWP conditions.

FWP trends in marsh loss and changes in interspersion predicted for $V_1$ and $V_3$, both of which are related to changes in salinity, would also affect the FWP percent of shallow water. However, since incremental FWP interior land loss would be generally less than 1.5 percent, no FWP changes in shallow water were assumed through TY 65.

### 4.4.2 Effects of BU Features and Mitigation Measures

FWP mitigation measures and BU features would slow shoreline retreat or restore marsh and associated shallow-water habitat. Projected increases in the percent of shallow water reflect assumptions that marsh restoration in mitigation and BU areas would convert some deep water to shallow water with the settling of fine sediment in remaining open-water areas. For in situ terracing mitigation measures, shallow-water acreage was decreased commensurate with the size of borrow areas needed for terrace construction. In situ terraces are constructed in open-water areas of degraded marshes, using in situ inundated sediments. Emergent, linear berms are constructed with these in situ sediments, but borrow trenches located parallel to the emergent berms result from the removal of in situ soils.

## 4.5 $V_5$ SALINITY

### 4.5.1 FWOP Salinity Projections

Baseline salinity values for $V_5$ in the WVA worksheets were based upon HS model output or empirical data provided by resource agencies, if available. Model values were obtained from the nearest station or averaged over a group of stations, and salinity values were adjusted by the Habitat Workgroup for the observed salinity gradient in interior marshes. The HS model incorporates the most likely effects of RSLR and future freshwater inflows for the period of analysis. On average, FWOP salinities with RSLR would be about 1.0 to 1.5 ppt higher in the southern part of Sabine Lake and the Port Arthur/Sabine-Neches canals; about 0.3 to 0.5 ppt higher around the northern edge of Sabine Lake and the Sabine and Neches rivers south of IH 10, and only negligibly higher (0.0 to 0.1 ppt) north of IH 10 on both rivers.

### 4.5.2 FWP Salinity Projections

The HS model median-flow run was used to evaluate the effects of FWP salinity changes for all vegetative communities. In accordance with the 2002 WVA procedural manuals (USFWS, 2002c, 2002d),

mean salinities were applied in saline and brackish marsh communities, and the mean high 33 percent continuous salinity was utilized for fresh and intermediate marsh communities and cypress-tupelo swamps. On average, FWP salinities with RSLR would be about 1.5 ppt higher in the southern part of Sabine Lake and the Port Arthur-Sabine-Neches canals; about 0.5 to 1.0 ppt higher around the northern edge of Sabine Lake and the Sabine and Neches rivers south of IH 10, and only negligibly higher (0.02 to 0.03 ppt) north of IH 10 on both rivers.

To facilitate evaluation of salinity impacts, the Habitat Workgroup requested that model output be obtained for numerous additional model nodes (specific locations in the model mesh). Values from the original modeling station or node nearest to specific hydro-units were employed. Values were often averaged from two or more nodes that surrounded the hydro-unit in order to obtain a salinity representative of the entire unit. If no nodes were located near a hydro-unit, isohaline maps of average salinity differences were employed to estimate salinity changes in that area.

HS modeling also provided a low-flow run to be used in a sensitivity analysis (presented in Chapter 8) that evaluates potential FWP impacts of occasional extreme drought events on the sensitive swamps and bottomland hardwood forests in the study area. The low-flow run is a hypothetical flow that was defined as the 10th percentile of historical monthly flows for 57 years of inflow data for the Neches and Sabine rivers. It actually represents an event that would have much less than a 10 percent chance of occurrence, because it simulates the effect flows remaining at 10 percent of historical levels for several months in a row.

### 4.5.3 Salinity Projections for BU and Mitigation Measures

For the preliminary screening of BU and mitigation measures, a previous version of the HS model was used to evaluate measures that could have large-scale effects on the system, and desktop models were used to evaluate effects of water control structures that would have only localized effects (Brown et al., 2006). Some measures were excluded from the modeling effort since they had no hydrologic effect or they completely blocked salinity intrusion. Measures with potential to affect the entire system included combinations of BU features on the Neches River, various designs of a submerged hard sill at the mouth of Sabine Lake, and combinations of salinity control structures. The effects of individual salinity control structures were evaluated with desktop models that used tidal amplitude from the HS model, rainfall estimates, and reductions in tidal cross sections to predict salinity and velocity changes resulting from specific control structures.

No salinity benefits were predicted for BU or mitigation measures retained for final screening. When selecting salinity values for the WVA worksheets, USACE followed the same process and assumptions that were used by the Habitat Workgroup in the initial WVA; however, in all cases mitigation and BU measure salinities were assumed to be the same as the FWP.

## 4.6 $V_6$ AQUATIC ORGANISM ACCESS

### 4.6.1 FWOP and FWP Projections

Baseline values for this variable were based largely upon previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate, and an inventory of constructed or funded CWPPRA or other restoration projects in the areas under evaluation.

The Habitat Workgroup compared specific structures affecting aquatic organism access routes in each hydro-unit to the list of structures and associated structure ratings in Appendix B of the WVA emergent marsh model manual (USFWS, 2002c). The structure ratings were multiplied by the acreage affected by them to calculate the Access Value that was entered into the WVA worksheets. FWP values were generally the same as FWOP values because most construction features of the LPP did not include structures that would inhibit aquatic organism access.

### 4.6.2 Effects of BU Features and Mitigation Measures

During the preliminary screening of water control structures, the same process described for the FWP condition was followed to calculate access values for those structures. No water control structures provided sufficient benefits to overcome aquatic organism access impacts, and thus none advanced into the final screening of mitigation measures. Containment levees constructed in conjunction with BU marsh restoration projects were rated as solid plugs for the year of construction and then rated as an open system the following year when they were breached to reestablish circulation and access.

# 5.0 APPLICATION OF THE SCM

## 5.1 $V_1$ STAND STRUCTURE

### 5.1.1 FWOP Projections

Baseline values for this variable were based upon field investigations and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. A field investigation, conducted by the Habitat Workgroup on August 24 and 25 and October 21, 2004, collected baseline data required by the WVA in each hydro-unit that contained swamp habitat. FWOP changes in stand structure were projected based upon changes in stand maturity, which in turn were associated with RSLR-related changes in salinity ($V_4$) or changes in tidal flooding duration and depth ($V_3$). Steady maturation was projected for all hydro-units; the increase in overstory coverage was generally associated with a decrease in midstory trees and shrubs and herbaceous vegetation.

### 5.1.2 FWP Projections

FWP effects to stand structure would be expected in swamp communities near the GIWW East, where a FWP increase in salinity is projected. The magnitude of projected structure changes was based upon the magnitude of the salinity increase and the amount of change in relation to the optimal range. In the Adams Bayou and Blue Elbow South swamps, a projected increase in salinity could slow the growth of all structure components, with tupelo-gum and herbaceous understory considered the most sensitive to increased salinities. Growth rates for cypress and tupelo, expressed as dbh, could be slightly lower than FWOP conditions, averaging 0.03 inch less per year. The Neches River BU Feature would restore the marsh buffer and protect an existing swamp community on the fringe of Rose City; mitigation measures would have no effect on swamp communities in the study area.

## 5.2 $V_2$ STAND MATURITY

### 5.2.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above, and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. The dbh measurements were taken from randomly selected canopy dominant and co-dominant trees in the hydro-unit sample sites, and averages were calculated for the cypress and tupelo-gum et al. subgroups. Basal area was estimated using the density ranges provided in category descriptions. FWOP rates of tree growth were based on data for relevant species from the USDA Silvics of North America (USDA, 1990), and other forest research literature (USDA, 1983; Brown and Montz, 1986) that generally reflect optimum growth conditions on managed lands. Growth rates were adjusted for the effects of gradually rising salinity due to RSLR, and were distributed evenly across the project life.

### 5.2.2 FWP Projections

FWP effects would be related solely to incremental changes in salinity that could occur as a result of the deepened channel. Effects of the salinity increases were related to their magnitude and changes in relation to the optimal range. In the Adams Bayou and Blue Elbow South swamps, higher salinity would be expected to slow the growth of both tupelo-gum and bald cypress, with greater effects on tupelo-gum because of its greater salinity sensitivity. The magnitude of projected structure changes was based upon the magnitude of the salinity increase and the amount of change in relation to the optimal range.

## 5.3 $V_3$ WATER REGIME

### 5.3.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above, and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. Knowledge of conditions outside of the specific area was also considered in this determination. For example, hydrology may have been altered by nearby navigation channels and highway roadbeds or placement area levees that block through-flow.

The FWOP values consider the effects of gradual RSLR on water surface elevation and tidal circulation. The increase in water surface elevation was forecast by the HS model, which in addition to RSLR, also incorporated forecasted changes in freshwater inflow. The effects of higher FWOP water surface elevations on hydrologic conditions were estimated by comparing FWOP water surface elevations over the period of analysis to existing land elevations within the swamp and bottomland hardwood areas. The range of existing water surface elevations in the Sabine and Neches rivers adjacent to these communities was determined by field sampling in 2001 (Fagerburg, 2003). Water surface elevations associated with diurnal tides and extremes associated with normal seasonal wind variations were measured at that time. The 1.1-foot increase in water surface elevation predicted by the HS model was added to existing average and extreme water surface elevations, and then compared to the land surface elevations taken from recent LIDAR survey data (CADGIS, 2009; NOAA Coastal Service Center, 2009). While some of the lower-lying areas could see a marginal increase in the depth and duration of tidal flooding by the end of the period of analysis, the gradual change in water surface elevation due to RSLR would not permanently inundate swamp substrate throughout the year. Ultimately, FWOP increases in the duration and depth of tidal flooding associated with RSLR would adversely affect these communities, but this is most likely to occur after the period of analysis of this study.

### 5.3.2 FWP Projections

FWP effects to the water regime would be related to projected changes in velocity and water surface elevations that could be associated with a larger tidal inflow through the deeper channel. The HS model determined that both would be slightly higher under FWP conditions, but these minor increases would not be sufficient to cause changes in flooding duration or water exchange (Brown and Stokes, 2009). No

landscape or structural changes are planned for the project that would affect flow/exchange or flooding duration in the swamps or their general vicinity.

## 5.4 $V_4$ MEAN HIGH SALINITY DURING THE GROWING SEASON

### 5.4.1 FWOP Projections

Baseline salinity values were based upon HS model output or empirical data provided by resource agencies, if available. Model values were obtained from the nearest station or averaged over a group of stations, and salinity values were adjusted by the Habitat Workgroup for the observed salinity gradient in interior marshes. The HS model incorporates the most likely effects of RSLR and future freshwater inflows for the period of analysis. On average, FWOP salinities with RSLR would be only negligibly higher (0.0 to 0.1 ppt) north of IH 10 on both rivers, where the majority of the swamp communities are located. However, FWOP salinities would be expected to increase an average of 0.5 ppt in the swamp communities near the GIWW East.

### 5.4.2 FWP Projections

The HS model median-flow run was used to evaluate the effects of FWP salinity changes for all vegetative communities. In accordance with the 2002 WVA procedural manuals (USFWS, 2002c, 2002d), the mean high of 33 percent continuous salinity was utilized for fresh and intermediate marsh communities and cypress-tupelo swamps. On average, FWP salinities with RSLR would be only negligibly higher (0.02 to 0.03 ppt) north of IH 10 on both rivers, but about 1.0 to 1.4 ppt higher in the swamp communities near the GIWW East. The Neches River BU Feature would restore the marsh buffer and help protect an existing swamp community on the fringe of Rose City from FWP increases in salinity; mitigation measures would have no effect on swamp communities in the study area.

A sensitivity analysis is presented in Chapter 8 that evaluates potential FWP impacts of occasional extreme drought events on swamp communities in the study area. The analysis considers potential impacts associated with a rare low-flow event that simulates the effect flows remaining at 10 percent of historical levels for several months in a row.

# 6.0 APPLICATION OF THE BHM

## 6.1 $V_1$ TREE SPECIES COMPOSITION

### 6.1.1 FWOP Projections

Baseline values for this variable were based upon field investigations and previous observations by Workgroup members in the hydro-units that they manage or regulate. A field investigation, conducted by the Habitat Workgroup on August 24 and 25 and October 21, 2004, collected baseline data required by the WVA in each of the hydro-units that contained bottomland hardwood habitat. Changes in tree species composition were projected based upon changes in stand maturity, which in turn were associated with RSLR-related changes in hydrology ($V_4$). With steady maturation, an increase in mast producers in the overstory was generally associated with a decrease in midstory trees and shrubs and a decrease in understory vegetation.

### 6.1.2 FWP Projections

FWP effects to tree species composition would be related solely to projected changes in salinity. However, the bottomland hardwood communities are located on upland terrace margins or higher ridges in the floodplain, and are protected from salinity increases by their elevation or buffering marsh. Therefore, no changes to tree species class association would be expected to occur. The Neches River BU Feature would restore marsh buffers for existing bottomland hardwood communities on the upland margins; mitigation measures would have no effect on bottomland hardwood communities in the study area.

## 6.2 $V_2$ STAND MATURITY

### 6.2.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. The dbh measurements were taken from randomly selected canopy trees in the hydro-unit sample sites, and averages were calculated for the variable. FWOP rates of tree growth were based on data for relevant species from the USDA's *Silvics of North America* (1990), and other forest research literature (USDA, 1983; Brown and Montz, 1986) that generally reflect optimum growth conditions on managed lands. Growth rates were adjusted for the effects of gradually rising salinity due to RSLR and were distributed evenly across the project life.

### 6.2.2 FWP Projections

FWP effects would be related solely to incremental changes in salinity that could occur as a result of the deepened channel. Effects of the salinity increases were related to their magnitude and changes in relation to the optimal range. In the Adams Bayou community, salinity increasing further into the sub optimal range would be expected to slow the growth of all tree species. The magnitude of projected structure

changes was based upon the magnitude of the salinity increase and the amount of change in relation to the optimal range.

## 6.3 $V_3$ UNDERSTORY/MIDSTORY

### 6.3.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above, and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. Percentage coverage of understory and midstory was estimated by visual observation. FWOP changes were associated with projected growth and maturation of the overstory canopy, taking into account the effects of gradual RSLR. No conditions were forecast to interfere with steady growth, and therefore the projected increase in overstory coverage was generally associated with a decrease in midstory trees and shrubs and a decrease in herbaceous understory.

### 6.3.2 FWP Projections

FWP effects would be related solely to projected increases in salinity. However, projected reductions in understory/midstory growth were small to nonexistent because the magnitude of the salinity increase was small.

## 6.4 $V_4$ HYDROLOGY

### 6.4.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above. Conditions outside of the specific hydro-unit were also considered, especially highway roadbeds or placement area levees that block through-flow and result in an elevated water table. Potential effects related to changes in the duration or depth of tidal flooding resulting from RSLR were considered as is described for the SCM.

### 6.4.2 FWP Projections

FWP effects to hydrology would be related to projected changes in water surface elevations, but the minor increase predicted by the HS model was not sufficient to cause changes in the water table or drainage efficiency (Brown and Stokes, 2009). No landscape or structural changes are planned in conjunction with navigation improvements or mitigation that would affect drainage or water table elevations in the hydro-units or their general vicinities.

## 6.5 $V_5$ SIZE OF CONTIGUOUS FORESTED AREA

Baseline values for this variable were taken from GIS measurements. The size of bottomland hardwood stands and other contiguous forests was used to determine which class of forest size was applicable. Navigation improvements do not require the removal of any bottomland hardwoods, and salinity changes

would not be expected to affect the size of these forested wetlands. Therefore, there are no FWP impacts, and no mitigation measures were designed to increase bottomland forest acreage.

## 6.6 $V_6$ SURROUNDING LAND USES

A GIS analysis of USGS orthophoto quadrangle maps was used to determine baseline acreages of surrounding land use classes. A 0.5-mile-wide buffer zone was established around each hydro-unit, the different land use types were classified within this buffer zone, and the percent occupied by each of the land use types was calculated. FWOP changes were predicted for the nonhabitat class (residential, commercial, and industrial development) and the relative percentage of adjacent classes most likely to be lost to development was reduced proportionately. FWOP increases in the nonhabitat classes were estimated based upon the 2000 U.S. Census projected population growth rate of the surrounding county. No FWP changes in this variable would be expected.

## 6.7 $V_7$ DISTURBANCE

GIS measurements and observations from USGS orthophoto quadrangle maps were used to measure distances and determine appropriate disturbance classes for this variable. Distance to disturbance was measured from the perimeter of major stands of bottomland hardwood, and the shortest distance to disturbance was applied. No FWOP change in disturbance class was projected based upon assumption that most upland perimeters amenable to development are already developed. No FWP changes in this variable would be expected.

# 7.0 HYDRO-UNITS SUMMARY

## 7.1 TEXAS HYDRO-UNITS

Table 13 summarizes the results of the WVA modeling of the comparison of the FWOP and FWP condition for Texas. In Texas, negative impacts occur over approximately 39,000 acres with a projected total loss of 412 AAHUs. The majority of these impacts (380 AAHUs) are indirect impacts occurring to approximately 33,500 acres of intertidal marsh and swamp due to small increases in salinity from the proposed channel deepening. Direct impacts (32 AAHUs) are associated with the conversion of 86 acres of fresh marsh to upland PA 24A. After benefits of proposed DMMP BU features are taken into account, the net change in Texas is an increase in 656 AAHUs. A brief verbal summary of baseline, FWOP and FWP conditions is presented below for each hydro-unit. Salinity levels referenced in the hydro-unit descriptions were taken from the HS modeling report (Brown and Stokes, 2009).

### 7.1.1 TX 1 – North Neches River

This 4,143-acre hydro-unit contains 67 percent (2,760 acres) cypress-tupelo swamp, 9 percent (384 acres) fresh marsh, 10 percent (412 acres) bottomland hardwood forest, 1 percent (53 acres) shrub/scrub, and 10 percent (407 acres) other upland habitat. Open water covers only 3 percent (127 acres) of the unit. Although dominated by cypress-tupelo swamp, the swamp is interspersed with a series of relict meander riverbanks that are dry except during floods and that support bottomland hardwood forest. In addition to bald cypress and tupelo-gum, the swamp supports a diverse assortment of aquatic vegetation, including pickerelweed, alligator weed, duckweed, spider lilies, crinum, and several species of fern along the water's edge. Most of the open water in the wetland forests consists of deeper streams and bayous; SAVs cover less than half of open-water area. The relict riverbank ridges support a relatively mature growth of bottomland hardwoods composed of several species of oaks, hickory, hackberry, sweet gum, maple, and willow, with greater than 50 percent of the overstory canopy consisting of hard mast or other edible seed-producing trees. Because of the thick canopy cover, understory coverage of palmetto, yaupon, lizard's tail, smartweed, and invading tallow trees is generally 50 percent or less. The relatively scarce (on a regional and national scale) swamp and bottomland hardwood habitats have medium to high wildlife values. Mammals adapted to the area's wetland habitats include opossum, armadillo, raccoon, swamp and cottontail rabbit, gray and red fox, coyote, bobcat, and white-tailed deer. Reptiles and amphibians, including the American alligator, are abundant. A prolific and wide array of resident and migratory birds utilizes the area because of the quality and diversity of habitat and its location in the Central Flyway. The influence of the salinity wedge in the navigation channel extends into the adjacent reach of the Neches River, raising salinities during times of low freshwater inflow. However, there is relatively little mixing, and salinity stratification within the river remains strong in this reach, resulting in predominantly fresh water in the upper layer and backwater areas (Academy of Natural Sciences, 1998).

Table 13: Texas SNWW CIP - Net Impacts and Benefits
by Acres and AAHUs

| HU # | Hydrologic Unit (HU) Name | Offset Impacts by Acres and Habitat Type (acres) | | | Total Impacts/Benefits by Habitat Type (AAHUs) | | |
|---|---|---|---|---|---|---|---|
| | | No Effect | Impacts Offset by BU Plan | Acres Impacted | Total Loss | Offsetting Benefits of BU Plan | Net FWP Benefit |
| **Bottomland Hardwood** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 412 | | | 0 | | 0 |
| TX 2 | Neches-Lake Bayou | 1,040 | | | 0 | | 0 |
| TX 3 | Rose City | 1,775 | | | 0 | | 0 |
| TX 5 | Bessie Heights | 293 | | | 0 | | 0 |
| TX 6 | Old River Cove | 197 | | | 0 | | 0 |
| **Subtotal - Neches River** | | **3,717** | **0** | **0** | **0** | **0** | **0** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | 388 | | | 0 | | 0 |
| TX 11 | Adams Bayou | 640 | | | 0 | | 0 |
| LA/TX 1 | Sabine Island | 524 | | | 0 | | 0 |
| **Subtotal - Sabine River** | | **1,552** | **0** | **0** | **0** | **0** | **0** |
| **Total Bottomland Hardwood** | | **5,269** | **0** | **0** | **0** | **0** | **0** |
| **Cypress/Tupelo Swamp** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 2,760 | | | 0 | | 0 |
| TX 2 | Neches-Lake Bayou | 2,277 | | | 0 | | 0 |
| TX 3 | Rose City | 464 | | | 0 | | 0 |
| **Subtotal - Neches River** | | **5,501** | **0** | **0** | **0** | **0** | **0** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | 110 | | | 0 | | 0 |
| TX 11 | Adams Bayou | | | 115 | -4 | | -4 |
| TX 12 | Blue Elbow South | | | 689 | -18 | | -18 |
| LA/TX 1 | Sabine Island | 1,194 | | | 0 | | 0 |
| LA/TX 2 | Blue Elbow | 2,737 | | | 0 | | 0 |
| **Subtotal - Sabine River** | | **4,041** | **0** | **804** | **-22** | **0** | **-22** |
| **Total Cypress/Tupelo Swamp** | | **9,542** | **0** | **804** | **-22** | **0** | **-22** |
| **Fresh Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 1 | North Neches River | 436 | | | 0 | | 0 |
| TX 2 | Neches-Lake Bayou | 1,535 | | | 0 | | 0 |
| TX 3 | *Rose City PA24A** | | | 86 | -32 | | -32 |
| TX 3 | Rose City | | | 3,241 | -1 | 178 | 177 |
| TX 4 | West of Rose City | 492 | | | 0 | | 0 |
| TX 5 | Bessie Heights | 2,147 | | | 0 | | 0 |
| TX 7 | GIWW North | | | 4,806 | -140 | | -140 |
| **Subtotal - Neches River** | | **4,610** | **0** | **8,133** | **-173** | **178** | **5** |

**Table 13 (Cont'd)**

| HU # | Hydrologic Unit (HU) Name | Offset Impacts by Acres and Habitat | | | Total Impacts/Benefits by Habitat Type | | |
|---|---|---|---|---|---|---|---|
| | | No Effect | Impacts Offset by BU Plan | Acres Impacted | Total Loss | Offsetting Benefits of BU Plan | Net FWP Benefit |
| **Fresh Marsh (Cont'd)** | | | | | | | |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | | | 1,775 | -18 | | -18 |
| TX 11 | Adams Bayou | | | 599 | -15 | | -15 |
| **Subtotal - Sabine River** | | **0** | **0** | **2,374** | **-33** | **0** | **-33** |
| **Total Fresh Marsh** | | **4,610** | **0** | **10,507** | **-206** | **178** | **-28** |
| **Intermediate Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 5 | Bessie Heights | | | 6,933 | -14 | 433 | 419 |
| TX 8 | Texas Point | | | 1,742 | -19 | | -19 |
| TX 13 | Groves | | | 437 | -3 | | -3 |
| **Subtotal - Neches River** | | **0** | **0** | **9,112** | **-36** | **433** | **397** |
| Sabine River Watershed | | | | | | | |
| TX 10 | Cow Bayou | | | 1,144 | -12 | | -12 |
| **Subtotal - Sabine River** | | **0** | **0** | **1,144** | **-12** | **0** | **-12** |
| **Total Intermediate Marsh** | | **0** | **0** | **10,256** | **-48** | **433** | **385** |
| **Brackish Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 6 | Old River Cove | | | 8,760 | -116 | 235 | 119 |
| TX 8 | Texas Point | | | 2,546 | -7 | | -7 |
| TX 7 | GIWW North | | | 647 | -8 | | -8 |
| **Subtotal - Neches River** | | **0** | **0** | **11,953** | **-131** | **235** | **104** |
| **Total Brackish Marsh** | | **0** | **0** | **11,953** | **-131** | **235** | **104** |
| **Saline Marsh** | | | | | | | |
| Neches River Watershed | | | | | | | |
| TX 8 | Texas Point | | 5,708 | | -5 | 222 | 217 |
| **Subtotal - Neches River** | | 0 | 5,708 | 0 | -5 | 222 | 217 |
| **Total Saline Marsh** | | **0** | **5,708** | **0** | **-5** | **222** | **217** |
| | | | | | | | |
| **Total Neches River Impacts** | | 13,828 | 5,708 | 29,198 | -345 | 1,068 | 723 |
| | | | | | | | |
| **Total Sabine River Impacts** | | 5,593 | 0 | 4,322 | -67 | 0 | -67 |
| | | | | | | | |
| **Total - All Habitats** | | **19,421** | **5,708** | **33,520** | **-412** | **1,068** | **656** |

* Direct impact associated with conversion of wetland to upland PA 24A.

The fresh marsh, restricted primarily to an area in the southeast corner of the hydro-unit, is in good condition. Extensive wetland floodplain forests on both sides of the Neches River are generally buffered from encroaching development by their low elevation. Development is, however, beginning to encroach upon the area from the City of Beaumont to the southwest, and commercial sandpits are located in the floodplain.

Minimal FWOP changes over the 65-year period of analysis would be expected. FWOP RSLR would gradually increase tidal flooding duration, but the gradual change in the depth of tidal flooding is not expected to permanently inundate swamp substrate throughout each year. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. A small change in salinity is expected accompanied by a loss of 24 acres of fresh marsh. A new, permanent saltwater barrier has been constructed on the Neches River at Pine Island Bayou, at the upstream limit of the SNWW study area. A loss of only 8 acres of fresh marsh would be expected. The Habitat Workgroup estimated that a small percentage (5.0 percent) of the surrounding land would convert from pasture to development due to population growth and the hydro-unit's proximity to uplands along its southwestern margin. No changes in the acreages of the bottomland hardwood and swamp areas would be expected, and it is assumed that all wetland forests would continue to mature with no disturbance.

The HS model indicates that FWP salinities under the most likely flow conditions would remain predominantly fresh. Abundant riverine through-flows and seasonal flooding would continue in the FWP condition, and only a negligible increase in water surface elevation would be expected. No FWP salinity impacts and no loss of marsh, bottomland hardwood, or swamp acreage would be expected. No FWP AAHU losses are predicted for the hydro-unit.

### 7.1.2 TX 2 – Neches Lake Bayou

Located immediately downstream of TX 1, this 5,707-acre hydro-unit contains 40 percent (2,277 acres) cypress-tupelo swamp, 22 percent (1,270 acres) fresh marsh, 18 percent (1,040 acres) bottomland hardwood forest, 2 percent (108 acres) shrub/scrub and 12 percent (684 acres) other upland habitat. Approximately 6 percent (329 acres) of the unit is open water. Swamp and bottomland hardwood forests are present on both sides of the Neches River, and fresh marsh is restricted primarily to a central corridor along the river. Interspersed among the cypress-tupelo swamp is a series of relict meander riverbanks that are dry except during floods. Species of bottomland hardwoods, understory, SAVs, fish, and wildlife are similar to those present in TX 1. However, tupelo-gum is more abundant than bald cypress in this hydro-unit, and the percentage of hard mast or other edible seed-producing trees is somewhat lower, between 25 and 50 percent. Like TX 1, the relatively scarce (on a regional and national scale) swamp and bottomland hardwood habitats have medium to high wildlife values. The influence of the salinity wedge extending up the navigation channel is greater here than upstream. The hydrology of the area is essentially unaltered, with abundant riverine through-flows. Semipermanent flooding is associated with IH 10, which forms the

southern border of the hydro-unit and serves to block overland flow to the south. The fresh marsh, located primarily on the east bank of the Neches River, is in good condition and is experiencing a low rate of land loss.

Minimal FWOP changes over the 65-year period of analysis would be expected. FWOP RSLR would gradually increase tidal flooding duration, but the gradual change in the depth of tidal flooding is not expected to permanently inundate swamp substrate throughout each year. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. Essentially no change in salinity and no marsh loss would be expected. The Habitat Workgroup estimated that 10 percent of the bottomland forest would be lost to development over the project life due to population growth and the area's proximity to existing development. A part of the City of Beaumont lies along the western boundary, and development is also encroaching from the east. No changes in swamp acreage were forecast because of its location in the lower, flood-prone floodplain. Swamp species would continue to mature with no disturbance.

The HS model indicates that FWP salinities under the most likely flow conditions would remain fresh. Abundant riverine through-flows and seasonal flooding would continue in the FWP condition, and only a negligible increase in water surface elevation would be expected. No FWP salinity impacts and no loss of marsh, bottomland hardwood, or swamp acreage would be expected. No FWP AAHU losses are predicted for the hydro-unit.

### 7.1.3 TX 3 – Rose City

Located on the east bank of the Neches River downstream of IH 10, this 5,805-acre hydro-unit contains 40 percent (2,323 acres) fresh marsh, 31 percent (1,775 acres) bottomland hardwood forest, 8 percent (464 acres) cypress-tupelo swamp, and 2 percent (152 acres) other upland habitat. The unit is 19 percent (1,091 acres) open water. A centrally located expanse of tidally influenced mud flats is the site of eroded wetlands that were formerly fresh marsh and cypress/tupelo swamp (GLO, 2000a). This change is associated with a combination of factors, including subsidence linked to subsurface fluid extraction, timber cutting, reduced sediment supply, and exposure to higher salinities introduced through the adjacent ship channel and internal oil field canals. The hydro-unit contains the Rose City Oil and Gas Field, which ceased production in 2003. Cypress-tupelo swamp is largely confined to the Tiger Creek watershed, which drains a rapidly developing upland area into the northern portion of the hydro-unit. Vestiges of swamp vegetation are also present along the Neches River perimeter and along levees bordering canals. Bottomland hardwoods, largely confined to the southern half of the hydro-unit, grade into developed uplands along the eastern margin. The bottomland hardwoods, comprised primarily of various oaks, maple, honey locust, pecan, and tallow, occupy relict meander ridges, interspersed with fingers of fresh marsh. A 1,000-acre area in the center of the hydro-unit that was formerly marsh and wetland forest has subsided and eroded into a tidally influenced, clay-pan dotted with cypress stumps (Figure 10). Remaining fresh marsh around the rim of the eroded area is gradually being lost. Natural streams and areas that are partially confined by oil field roads and levees are covered with water averaging 2 to 3 feet

in depth. These areas support a lush growth of aquatic vegetation including coontail, southern naiad, Eurasian milfoil, common salvinia, water hyacinth, smartweed, cattails, bulrush, and pickerelweed. Baseline salinities are essentially predominantly fresh, but the hydrology of the area has been altered by oil field canals and levees, subsidence, with run-off from developed uplands to the northeast. Parts of the area are completely open to tidal flow, while other areas are restricted by levees and roads to the extent that water is permanently impounded. Access for marine organisms is unrestricted for most of the area; however, access to a 200-acre impounded area is maintained only through culverts.

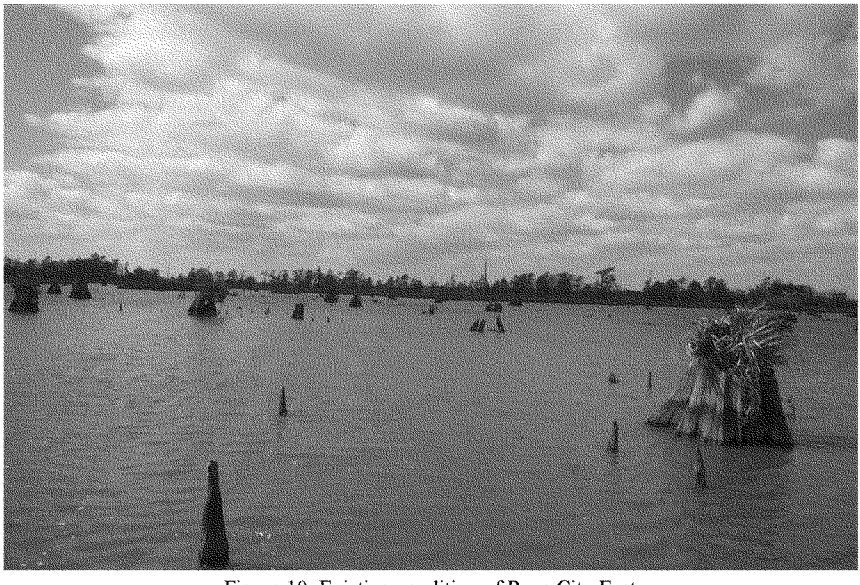


Figure 10: Existing condition of Rose City East

It is expected that FWOP changes would be limited to the fresh marsh with the loss of 93 acres (4.2 percent) of fresh marsh over the period of analysis. The FWOP salinity would remain fresh, and no impacts would be expected for the swamp and bottomland hardwood communities. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. The Habitat Workgroup estimated that 10 percent of pasturelands currently buffering the hydro-unit would be lost to development due to population growth in Vidor and the area's proximity to existing development.

FWP project impacts would be limited to those associated with about a 0.5 ppt increase in salinity. The productivity-based land loss projection indicates that this increase would result in the loss of 3 additional acres of fresh marsh (–1 AAHUs), but no losses in bottomland hardwood or swamp acreage. The small increase in salinity will cause no reduction in the general health and productivity of the cypress-tupelo swamp and bottomland hardwood habitats. The SNWW DMMP proposes the expansion of existing

PA 24, which is located at the southern tip of the unit. New PA 24A would convert 85 acres of fresh marsh and 1 acre of open water to a confined, upland placement area, resulting in a loss of –32 AAHUs. The footprint of the acreage converted to PA 24A was coordinated with the Habitat Workgroup to minimize impacts to adjacent bottomland hardwood forest and higher quality fresh marsh. One component of the Neches River BU Feature (Rose City East) would be constructed in this hydro-unit, resulting in a net increase of 249 acres of fresh marsh and a net benefit of 177 AAHUs.

### 7.1.4 TX 4 – West of Rose City

This 493-acre hydro-unit consists of two separate areas, totaling 80 percent (395 acres) fresh marsh and 20 percent (97 acres) associated open-water areas on the west bank of the Neches River, opposite the Rose City marsh area. The marshes are remnants interspersed among industrial facilities and USACE PAs. The largest remnant marsh lies along the southern and southwestern edge of PA 25. It lies on both sides of a natural drainage and an industrial canal that extends from the Neches River to developed uplands in the City of Beaumont. The southern area is bordered by a large docking slip on the north and the Neches River on the east and is surrounded by industrial facilities. Salinity in the Neches River adjacent to these sites is predominantly fresh.

FWOP land loss of 24 acres (6.4 percent) would be expected over the 65-year period of analysis. FWP project impacts would be associated with a minimal change in salinity (approximately 0.5 ppt) and the loss of 1 acre of fresh marsh (0 AAHUs). It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level.

### 7.1.5 TX 5 – Bessie Heights

The 11,363-acre Bessie Heights hydro-unit is the site of the most extensive, contiguous coastal marsh loss in Texas (GLO, 2000b). Located on the east bank of the Neches River downstream from the Rose City marsh, this unit contains 18 percent (2,018 acres) fresh marsh, 17 percent (1,932 acres) intermediate marsh, 2 percent (293 acres) bottomland hardwood, less than 1 percent combined (60 acres) brackish marsh and shrub/scrub, and 13 percent (1,512 acres) PAs and other upland habitat. It is dominated by 5,548 acres (49 percent) of open water that was historically a large, mostly emergent, intermediate marsh. Existing fresh marsh rims the edge of the large submerged wetland area, grading into developed uplands to the north and east. Pockets of bottomland hardwood are present in the fresh marsh and at the upland edge. The submerged wetland, now a vast open-water area averaging 2 to 3 feet in depth, is the site of the large Port Neches oil and gas field. This field is still active; however, production levels have been low and steady over the last 25 years. The oil field is connected to the Neches River by the Bessie Heights canal, and a grid of low levees protects active and closed well locations (Figure 11). Wetland loss in this area began during the 1930s, and the most significant losses occurred between 1956 and 1978 (White et al, 1996). The rate of marsh loss dropped during the last 25 years, averaging 0.03 percent per year. This slowing in the land loss rate appears to be due in part to changes in oil production rates and practices. Factors believed to contribute to this marsh loss include subsidence related to the removal of

groundwater, oil, and gas reserves, salt water intrusion, petroleum production brine disposal, altered hydrology, and altered sediment deposition patterns. PAs for the SNWW navigation channel line the Neches River and form the western boundary of the marsh system. They serve as artificial levees that prevent overbank flows and sediment deposition. The Nelda Stark Unit of the Lower Neches WMA is located in the northeast quadrant of the hydro-unit. TPWD data indicate that salinity in the Nelda Stark Unit intermediate marsh averages 4.2 ppt during the growing season. The HS model indicates a predominant baseline salinity of about 1.0 ppt in the fresh marsh.

Figure 11: Bessie Heights Oil Field

A FWOP land loss in the fresh marsh of 40 acres (2.0 percent) and 31 acres (1.6 percent) of intermediate marsh would be expected over the period of analysis. No change in bottomland forest acreage is forecast. The salinity increase associated with RSLR would be about 0.25 to 0.5 ppt. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level.

FWP project impacts would be associated with a small increase in salinity of about 0.5 ppt and the loss of about 2 additional acres of fresh marsh (0 AAHUs), and about 1 acre of intermediate marsh (−14 AAHUs). The small increase in salinity would cause no reduction in the general health and productivity of the bottomland hardwood habitats. One component of the Neches River BU feature (Bessie Heights East) would be constructed in this hydro-unit, resulting in a net increase of 1,189 acres of intermediate marsh and 679 acres of brackish marsh, and a net benefit of 419 AAHUs.

### 7.1.6 TX 6 – Old River Cove

The 11,851-acre Old River Cove hydro-unit is located on the east bank of the Neches River where its mouth opens onto Sabine Lake. It contains 44 percent (5,240 acres) brackish marsh with minor pockets of fresh and intermediate marsh (2 percent; 230 acres) on its periphery. One 197-acre (2 percent) area of bottomland hardwood is preserved in the northwest corner of the unit. Approximately 30 percent (3,620 acres) of the unit is open water. The submerged brackish wetland is primarily located in the western half, west of Highway 87. Much of this area is managed by TPWD as the Old River Unit of the Neches River WMA. The hydro-unit also contains 2,564 acres (22 percent) that were excluded from the analysis because they are the location of three small PAs and a 2,500-acre area of controlled, isolated wetlands that is owned and managed by a hunt club as intermediate marsh. The intake and outfall canals for a large power plant draw higher-saline waters from Old River Cove and discharge them into the Neches River just upstream of the Rainbow Bridge. Salinities west of the outfall canal tend to be lower because this area is buffered by the bank of the canal and receives lower-salinity overland flow from the Bessie Heights area. TPWD sampling indicates baseline salinities average 10.0 ppt. The Old River Cove area has lost a large amount of marsh due to subsidence, faulting (White et al., 1996), and saltwater intrusion. The most significant losses occurred between 1956 and 1978 when the rate of marsh loss averaged 27.5 acres/year. The rate of marsh loss dropped during the last 25 years, when it averaged 4.8 acres/year. Widgeon grass is abundant in shallow waters west of Highway 87, but SAVs are not common east of the highway. Access for marine organisms is fully open through roadside ditches and the utility canals. Wildlife diversity is high, and it is a key nesting and brooding area for several species of ducks. It is also an important stopover and staging area for waterfowl in the Central Flyway, and it provides high-quality winter waterfowl habitat.

A FWOP land loss of 1,518 acres (28 percent) of brackish marsh would be expected given the high background land loss rate documented in the area (White et al., 1996). Salinity would increase from about 10.0 ppt to about 11.0 ppt over the period of analysis, moving further into the suboptimal range. Gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. It was estimated that 10 percent of the bottomland hardwoods will be lost to development over the project life due to population growth in Bridge City and the area's proximity to existing development.

FWP project impacts would be associated with an increase in salinity to about 13.0 ppt and the loss of 46 acres (1 percent) of brackish marsh (–116 AAHUs). The bottomland hardwood community is buffered from salinity increases by marsh and development; no impacts would be expected. One component of the Neches River BU Feature (Old River Cove) would be constructed in this hydro-unit, resulting in a net increase of 593 acres of brackish marsh, and a net benefit of 119 AAHUs.

### 7.1.7 TX 7 – GIWW North

The 5,907-acre GIWW North hydro-unit comprises three separate areas on the north side of the GIWW. All are located within the largest remaining coastal freshwater marsh in Texas (USFWS, 2005a). The unit

consists of 77 percent (4,541 acres) fresh marsh, 10 percent (588 acres) brackish marsh, 2 percent (129 acres) intermediate marsh, and 8 percent (454 acres) of PAs and upland areas. Approximately 3 percent (195 acres) of the unit is open water. Most of this area is not hydrologically connected to the waterways that form its southern and eastern boundary, the GIWW and the Taylor Bayou Diversion Channel, respectively. TPWD data indicate that baseline salinities in the fresh and brackish marshes average 0.7 and 9.0 ppt, respectively, during the growing season. PAs along the GIWW and levees, created when the waterways were originally dredged, serve as barriers along the banks of the waterways that protect the marshes from bank overwash. Areas selected for inclusion in the hydro-unit are likely to be affected by salinity increases associated with SNWW channel improvements. They are influenced by breaks in the levees and PAs, or through natural bayous that allow higher-salinity waters to enter the marsh system. The easternmost area is 647 acres of brackish marsh on the west bank of the Taylor Bayou Diversion Channel. The central area is 2,533 acres of fresh marsh located within the McFaddin NWR's North Unit and bordered on the south by the GIWW. The westernmost area is 2,273 acres of fresh and intermediate marsh centered on the drowned valley of Salt Bayou where it is cut by the GIWW. Wildlife diversity is high, and the general locale serves as a key nesting and brooding area for several species of ducks. It is also an important stopover and staging area for waterfowl in the Central Flyway and it provides high-quality winter waterfowl habitat. SAVs are abundant in the small, shallow, open-water ponds in the unit. Fisheries access is restricted by box culverts and fixed-crest weirs in the eastern and central areas, but unrestricted through Salt Bayou in the westernmost area.

FWOP land loss of 539 acres (11.6 percent) of fresh marsh and 62 acres (10.6 percent) of brackish marsh would be expected over the 65-year period of analysis. Included in this land loss are estimated losses due to RSLR-related shoreline recession along the GIWW (about 8 acres of fresh and 3.5 acres of intermediate marsh). It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. Salinities would be expected to increase to about 2.5 ppt in the fresh marsh and about 11 ppt in the brackish marsh. In both marsh communities, the FWOP salinity would rise into the suboptimal range. No other changes in land use or hydrology would be expected.

FWP project impacts would be associated with an increase in salinity to about 4.0 ppt and 12.5 ppt in the fresh and brackish marshes, respectively, and land loss of 63 acres (1.5 percent) of fresh and 2 acres (0.4 percent) of brackish marsh for a total loss of 148 AAHUs. In both cases, salinity would be moving further into the suboptimal range. No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.1.8 TX 8 – Texas Point

This 11,422-acre hydro-unit is located adjacent to the SNWW waterway at Sabine Pass; its southern boundary extends for 13.5 miles along the Gulf of Mexico. The unit encompasses the entire 8,950-acre Texas Point NWR (USFWS, 2005a). Located within the Chenier Plain Complex of southwestern Louisiana and southeast Texas, the unit contains 4,898 acres (43 percent) of saline marsh, 2,398 acres

(21 percent) brackish marsh, 1,605 acres (14 percent) intermediate marsh, 100 acres (1 percent) fresh marsh, and 1,413 acres (12 percent) of other upland areas. Approximately 9 percent (1,008 acres) of the unit is open water. Chenier ridges along the northern margin of the hydro-unit were omitted from the analysis because they will not be affected by hydrologic changes associated with the LPP. Marshes in the hydro-unit are hydrologically connected to the SNWW through Texas Bayou and a large, adjoining man-made canal. Saltwater averaging 24 ppt also accesses the area by overwashing a subsided portion of the west jetty near the Gulf shoreline. The hydro-unit is crisscrossed with numerous small bayous that feed waters from the SNWW waterway into the interior, following long finger swales between ridges. The majority of the area is covered by saline marsh (5,708 acres), which front the SNWW waterway and the Gulf of Mexico. Saline marsh grades to brackish marsh (2,654 acres) toward the west, and this in turn grades into intermediate marsh and small pockets of fresh marsh (totalling 1,742 acres). USFWS sampling indicates that baseline salinities average 5.75 ppt, 8.5 ppt, and 12.5 ppt in the intermediate, brackish, and saline marshes, respectively. Salinities regularly exceed the optimal ranges for fresh and intermediate marsh. The marsh buffers inland habitats and the city of Sabine Pass from tropical storm–generated tidal surges and is biologically diverse and extremely productive (TPWD, 2005d). Systematic surveys of fish, wildlife, and plant resources have documented over 250 avian species and over 400 plant species in the NWR. The hydro-unit provides an important wintering and migration stopover for migratory birds including Central Flyway waterfowl, shorebirds, wading birds, marsh birds, and neotropical/neoarctic and temperate landbirds, in addition to providing year-round habitat for the mottled duck. The coastal marsh serves as a nursery area for many important commercial and recreational fish and shellfish species, including white and brown shrimp, blue crab, red drum, flounder, and speckled sea trout. SAVs cover half to three-quarters of open-water areas within the brackish and fresh/intermediate marshes, but are sparse in the saline marsh. Fisheries access is restricted in the intermediate and brackish marshes by low rock weirs on several channels; unrestricted access to the saline marsh is provided through Texas Bayou.

FWOP land loss of 245 acres (14.4 percent), 252 acres (10.6 percent), and 2,446 acres (50.2 percent) would be expected in the intermediate, brackish, and saline marshes. These losses include estimated losses due to RSLR-related shoreline recession of the Gulf shoreline of about 70 acres of fresh/intermediate, 852 acres of brackish, and 2,194 acres of saline marsh over the 65-year period of analysis. Land loss effects are also reflected in change in interspersion; areas converted to open Gulf waters were expected to convert to Class 4. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. Salinities would be expected to increase to about 7.0 ppt, 13.0 ppt, and 13.8 ppt in the intermediate, brackish, and saline marshes, respectively, over the period of analysis. Intermediate and brackish marshes would be impacted by salinities reaching further into the suboptimal range. No other changes in land use or hydrology would be expected.

FWP project impacts would be associated with salinity, interior land loss, and shoreline retreat increases totaling 31 AAHUs. Salinities would be expected to increase to about 7.8 ppt, 10.6 ppt, and 14.6 ppt in the intermediate, brackish, and saline marshes, respectively. Salinity in the intermediate marshes would

be expected to approach the upper limit for this community, increasing the potential for the conversion of large areas to brackish marsh. FWP land loss of 6 acres (0.4 percent), 5 acres (0.2 percent), and 17 acres (0.3 percent) of intermediate, brackish, and saline marshes, respectively, would be expected. FWP land loss trends include additional Gulf shoreline retreat of 0.42 foot/year between 0.5 and 3.5 miles from the jetty. The shoreline erosion results from increased wave heights and decreased sediment transport caused by deepening of the entrance channel (Gravens and King, 2003). No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.1.9 TX 9 – Salt Bayou

This 55,044-acre hydro-unit is located adjacent to the SNWW waterway between TX 8 and the GIWW. The western boundary is the Perkins Levee, which forms a barrier for hydrologic influences from the SNWW. The majority of the unit is located within the J.D. Murphree WMA and the McFaddin NWR. The hydrology of this Chenier Plain wetland is dominated by the Salt Bayou watershed and a chain of lakes along this bayou, which include Shell Lake, Johnson Lake, Keith Lake, and Salt Lake. Saltwater intrusion from the GIWW is controlled by water control structures at Perkins Levee and the opening of Salt Bayou to the GIWW (USACE, 1992), but the marshes remain open to the salinity influence of the SNWW through the Keith Lake Fish Pass. The unit contains 15,801 acres (29 percent) brackish marsh, 24,942 acres (45 percent) intermediate marsh, 567 acres (1 percent) fresh marsh, and 4,392 acres (8 percent) of uplands and ponded compartments that are leveed and hydrologically isolated. Approximately 17 percent (9,342 acres) of the unit is open water. The brackish marsh is located in areas most affected by salinity influence from the SNWW, along Salt Bayou, Johnson and Keith lakes, and the SNWW channel. According to TPWD salinity data, baseline salinities in the intermediate marsh average 4.7 ppt in the growing season and 6.9 ppt in the brackish marsh. The area supports a diversity of wildlife, including over 20 mammal, 80 bird, at least 11 reptile and amphibian species, and over 80 species of fishes and shellfishes (TPWD-GLO, 2001). Lying within the Central Flyway, the Salt Bayou marsh is a major component of the coastal wetland habitat utilized year-round by the mottled duck, and it provides an important wintering and migration stopover for other migratory waterfowl, shorebirds, wading birds, marsh birds, and neotropical/neoarctic and temperate landbirds. Fisheries access is unrestricted through the Keith Lake Fish Pass, but access to approximately 15 percent of the intermediate marsh is restricted by a flap-gate salinity control structure.

The Salt Bayou unit has been extensively impacted by human activities including oil exploration, cattle grazing, the construction of levees and ditches to facilitate waterfowl hunting and commercial fur trapping, and changes in hydrology caused by construction of the SNWW, the GIWW, and the Keith Lake Fish Pass. These have led to increases in the extent of open water at the expense of emergent marsh, with the most likely causative factors being saltwater intrusion, sulfide toxicity, and increased soil erosion associated with submergence associated with subsidence related to oil/gas withdrawal (Morton et al, 2001) and the loss of marsh vegetation (TPWD-USFWS, 1990). TPWD conducted a GIS study of historic patterns of the distribution of emergent marsh communities and changes in open-water areas (TPWD,

2003, 2004). This study documented a 6.15 percent decline in emergent marsh between 1967 and 2001. The rate of decline appears to have slowed between 1987 and 2001, with a loss of 2.36 percent.

FWOP changes for the 65-year period of analysis would be associated with RSLR-related land loss and salinity increases. The FWOP land loss rate assumed that the land loss trend measured between 1987 and 2001 would continue; 2,765 acres (10.8 percent) of existing fresh and intermediate marsh, and 1,697 acres (10.7 percent) of brackish marsh in the Salt Bayou hydro-unit would be lost. Land loss projections are also reflected in a change in interspersion, with 5 percent of Class 1 and 2 converting to Class 4. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. In the brackish marsh, FWOP salinity would be expected to increase from 6.9 ppt to 8.2 ppt, within the optimum range for the brackish marsh community. However, within the intermediate marsh, baseline salinity already exceeds the optimal range, averaging 4.7 ppt in the growing season. RSLR would be expected to raise salinity to 6 ppt by the end of the period of analysis, extending salinity levels further into the suboptimal range. No other changes in land use, hydrology, or salinity are expected.

FWP project impacts, totaling 658 AAHUs, would be associated with salinity and land loss increases primarily within the intermediate marsh system. Within the brackish marsh, salinity would increase from 6.9 ppt to 9.6 ppt, still within the optimum range for that community. For the intermediate marsh, however, salinity would be expected to increase to about 7.4 ppt, pushing near the upper limit of salinity tolerance for this vegetation community. Land loss of 49 acres (0.3 percent) of brackish marsh and 202 acres (0.8 percent) of intermediate marsh would be expected by 2069. Potential changes in water velocity due to a 48-foot deepening alternative were investigated with the 2009 HS model (Brown and Stokes, 2009). In the Keith Lake Fish Pass, the mean peak velocity would be slightly less than FWOP and there would be no change in mean velocity. Velocities in the Salt Bayou/Keith Lake marshes were not determined. However, a significant decrease in velocity would result when moving from the confined fish pass to the adjacent open marsh system. Little change in velocity is expected in the marsh system with the LPP. The deepening-only alternative does not include widening, but FWP velocities would be expected to be similar to the deepening and widening alternative.

It is important to note that the impacts presented here do not include all impacts of the Preferred Alternative in Texas as FWP impacts in Texas's Salt Bayou (TX 9) hydro-unit are not included. Jefferson County, Texas, and USACE, with support from the TPWD, GLO, and TWDB, have been studying ways to reduce the amount of saltwater intrusion, decrease high-energy inflows, and minimize impacts to larval fish access in an ongoing Section 1135 Continuing Authorities Project (CAP) study for the Salt Bayou hydrologic unit. When the Keith Lake Section 1135 CAP study was begun in 2003, it seemed likely that the CAP study and construction would be completed before the SNWW CIP could be authorized and constructed. The Keith Lake Section 1135 study was therefore considered separable from the SNWW CIP and for planning purposes, it was assumed that a water control structure at the Fish Pass would be part of the future without-project condition for the SNWW CIP. Incremental impacts of the SNWW CIP will be calculated for the Salt Bayou unit of the SNWW study area when WVA modeling is completed for the

Keith Lake Section 1135 study. It is possible that the excess DMMP benefits (316 AAHUs) of the SNWW CIP will cover all incremental project impacts. However, if it is determined that additional mitigation is needed, then USACE and the non-Federal sponsor of the SNWW CIP will initiate consultation with resource agencies, identify and incrementally justify additional compensatory mitigation for the Salt Bayou unit, and prepare a supplemental environmental impact statement.

### 7.1.10 TX 10 – Cow Bayou

The mouth of Cow Bayou flows into the Sabine River approximately 3 miles north of its confluence with Sabine Lake. The 4,990-acre hydro-unit comprises a narrow riparian corridor ranging from 1 mile wide at its mouth to 0.3 mile wide at its upstream extent that extends approximately 10 miles from the Sabine River. The riparian corridor is confined along most of its length by development in Bridge City, Texas. In 1946, the formerly shallow, meandering bayou was channelized and deepened to 13 x 100 feet by the USACE to provide shallow-draft access to the Orange Oil Field (Rivers and Harbors Act of July 24, 1946a). Dredged material from original construction was side cast into low mounds along the length of the channelized bayou. Two large, upland confined PAs (1,233 acres; 25 percent of the total hydro-unit acreage) are located on both sides of the bayou mouth at the Sabine River. These are used for maintenance dredging of the Channel to Orange, a segment of the SNWW waterway that is not part of this study of navigation improvements. Upstream of the PAs lie 1,436 acres (29 percent) of fresh marsh and 144 acres (23 percent) of intermediate marsh. Cypress-tupelo swamp (110 acres; 2 percent) is largely confined to the upper 3 miles. The marsh and swamp are interspersed with small pockets of bottomland hardwood (388 acres; 8 percent), which become larger along the upper bayou. Baseline salinities range from fresh in the uppermost reaches to about 3.5 ppt near the mouth. The hydrology of the hydro-unit has been altered by adjacent development. Roads and subdivisions have artificially lowered the water table in some areas and impounded water in others. TCEQ has identified water quality problems in Cow Bayou, citing impairments due to low dissolved oxygen and high fecal coliform (TCEQ, 2004a).

FWOP land losses of 75 acres (5.2 percent) and 59 acres (5.2 percent) of fresh and intermediate marsh, respectively, would be expected over the period of analysis. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. Salinities would remain fresh in the upper reaches and rise to 4.0 ppt near the mouth of the bayou. RSLR would result in an increase in both the depth and duration of tidal flooding. However, the swamp substrate would be exposed during average low tides and for longer durations seasonally. No other changes in land use or hydrology would be expected.

FWP project impacts would be expected due to an increase in salinities to about 1 ppt in the swamps and fresh marshes in the upper reaches, and 5.0 ppt in the fresh and intermediate marshes in the lower reach, moving into the suboptimal range in marshes closest to the Sabine River. Land losses of 6 acres (0.4 percent) and 3 acres (0.3 percent) in fresh and intermediate marsh, respectively, would be expected. Impacts would total 30 AAHUs. No loss of swamp or bottomland hardwood acreage is predicted. No

other changes in marsh edge, SAV coverage, land use, hydrology, or marine organism access are attributable to the project.

7.1.11 TX 11 – Adams Bayou

The mouth of Adams Bayou flows into the Sabine River approximately 5 miles north of Sabine Lake. The 1,679-acre hydro-unit comprises a narrow riparian corridor ranging from 0.5 mile wide at its mouth to 0.25 mile wide at its upstream extent, approximately 6 miles from the Sabine River. The riparian corridor is confined along most of its length by development in Orange, Texas. In 1946, the formerly shallow, meandering bayou was channelized and deepened to 12 x 100 feet by the USACE to provide shallow-draft access to the interior of Orange County (Rivers and Harbors Act of July 24, 1946b). Dredged material from original construction was side cast into low mounds along the length of the channelized bayou. One large, upland confined PA (322 acres; 19 percent of total hydro-unit acreage) is located on the west side of the bayou, near its mouth at the Sabine River. It is used for maintenance dredging of the Channel to Orange portion of the SNWW. Fresh marsh (516 acres; 31 percent) is interspersed with bottomland hardwood (640 acres; 38 percent) throughout the hydro-unit. Cypress-tupelo swamp (115 acres; 7 percent) is confined to the upper 2 miles. Open water composes 5 percent (86 acres) of the unit. Baseline salinity averages about 2.5 ppt, already edging into the suboptimal range. The hydrology of the hydro-unit has been altered by adjacent development. Roads and subdivisions have artificially lowered the water table in some areas and impounded water in others. TCEQ has identified water quality problems in Adams Bayou, citing impairments due to low dissolved oxygen and high fecal coliform (TCEQ, 2004b). The Adams Bayou Unit of the Lower Neches WMA is located in the lower 3 miles of the hydro-unit.

FWOP land loss of 28 acres (5.3 percent) of fresh marsh would be expected in conjunction with an increase in salinity to about 3.0 to 3.5 ppt, extending further into the suboptimal range for both fresh marsh and swamp communities. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. No changes in swamp or bottomland hardwood acreage are predicted. RSLR would result in an increase in both the depth and duration of tidal flooding. However, the swamp substrate would be exposed during average low tides and for longer durations seasonally. No other changes in land use or hydrology would be expected.

FWP project impacts associated with increases in salinity and land loss would total 19 AAHUs for the hydro-unit as a whole. Salinity would be expected to increase to about 3.9 ppt in the swamp community and to about 5.0 ppt in the fresh marshes, pushing at the upper limit of salinity tolerance for cypress-tupelo swamps and further into the suboptimal range for fresh marsh. The loss of 4 AAHUs in the swamp system is a conservatively high estimate of impacts since baseline growth rates were conservatively estimated assuming maximum growth in optimum conditions. Bottomland hardwoods would be buffered from the effects of most of this salinity increase by their elevation. Land loss of 3 acres (0.6 percent) of fresh marsh would be expected. No loss of swamp or bottomland hardwood acreage would be expected,

but the increased salinity would affect the general health and productivity of the cypress-tupelo swamp by slowing the rates of herbaceous coverage and tree trunk diameter growth by an average of 0.03 inch per year. This small reduction in the growth rate is a conservatively high estimate that assumes maximum growth under optimum conditions, and thus can be considered a negligible impact. Similar reductions in tree growth rates and mid/understory coverage would be expected for bottomland hardwood, but no overall reduction in habitat productivity was reflected in AAHUs. No other changes in marsh edge, SAV coverage, land use, hydrology, or marine organism access were attributable to the project.

### 7.1.12 TX 12 – South of Blue Elbow

This 689-acre hydro-unit is located on the west bank of the Sabine River, south of IH 10. The City of Orange occupies the uplands to the west. A long east-to-west canal, dug in conjunction with power line construction, passes through the hydro-unit from the upland to the Sabine River. The remnants of a radial star canal system remain from past logging operations in the northeast quadrant of the area. The hydro-unit is composed entirely of cypress-tupelo swamp in good condition. Baseline salinity in the river averages about 0.7 ppt. Overland flow and exchange with the Sabine River is high, and flooding in the area is semipermanent.

FWOP changes would be associated with the continued maturation of existing overstory and rising salinity due to RSLR. The Habitat Workgroup projected that overstory coverage would increase from 50 to 70 percent, and that understory would decrease from 70 to 50 percent due to decreased sunlight on the forest floor. Salinity would be expected to increase to about 1.1 ppt by the end of the period of analysis. RSLR would also result in an increase in both the depth and duration of tidal flooding. However, the swamp substrate would be exposed during average low tides and for longer durations seasonally. None of the area would be expected to be lost to development.

FWP project impacts, totaling 18 AAHUs, would be expected with an increase in salinity to 1.7 ppt, moving further into the suboptimal salinity range for cypress-tupelo swamp. Although no loss in swamp acreage would be expected, the increased salinity would cause a reduction in the general health and productivity of the cypress-tupelo swamp by reducing overstory coverage and slowing the rate of trunk diameter growth by an average of 0.05 inch per year. This small reduction in the growth rate is a conservatively high estimate that assumes maximum growth under optimum conditions, and thus can be considered a negligible impact.

### 7.1.13 TX 13 – Groves

This 437-acre hydro-unit is located west of the Neches River between PA 16 and the Star Lake Canal. The City of Groves and industrial development occupy the terrace margin just south of this unit. It comprises 88 percent (385 acres) intermediate marsh and 12 percent (52 acres) open water. Shallow, meandering streams cross the marsh and drain into the Star Lake Canal and Neches River. Baseline salinities are approximately 3.0 ppt.

FWOP impacts would result in land loss of 68 acres (18.3 percent) and an increase in salinity to 4.0 ppt over the period of analysis. It is assumed that the gradual rate of RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. No changes in aquatic organism access would be expected.

FWP project impacts would be associated with an increase in land loss and salinity, resulting in a total loss of 3 AAHUs. It is expected that 3 acres (0.8 percent) of intermediate marsh would be lost and that salinity would increase to about 5.0 ppt, moving into the suboptimal range. No other changes in land use, hydrology, or marine organism access would be attributable to the project.

## 7.2 LOUISIANA HYDRO-UNITS

Table 14 summarizes the results of the WVA modeling of the comparison of the FWOP and FWP condition for Louisiana. In Louisiana, negative indirect impacts occur to approximately 182,000 acres of intertidal marsh due to small increases in salinities from the proposed channel deepening. The resulting total loss is 1,709 AAHUs. After benefits of a proposed DMMP BU feature are taken into account, the net Louisiana loss is 1,499 AAHUs. A brief verbal summary of baseline, FWOP, and FWP conditions is presented below for each hydro-unit. Salinity levels referenced in the hydro-unit descriptions were taken from the hydro-dynamic salinity modeling report (Brown and Stokes, 2009).

### 7.2.1 LA 1 – Perry Ridge

The 28,094-acre Perry Ridge hydro-unit is bordered on the east by the Sabine River and on the south by the GIWW. Its north and east borders are uplands that form the Coastal Zone Boundary. It contains 53 percent (14,810 acres) fresh marsh with 11 percent (3,074 acres) intermediate marsh in smaller areas affected by the Vinton and Gray drainage ditches and the Sabine River. The north-south-trending Perry Ridge that bisects the hydro-unit is covered by 2,158 acres (8 percent) bottomland hardwood forest and 2,373 acre (8 percent) of other upland habitat. Approximately 19 percent (5,679 acres) of the unit is covered by open water.

Marsh losses in the area have been caused by water level fluctuations, saltwater intrusion, and tidal scour from the GIWW as a result of breaches in the northern bank. CWPPRA Project No. CS-24, Perry Ridge Shore Protection, completed in 1999, and Project No. CS-30, completed in 2001, are intended to prevent further erosion of the GIWW shore along a 4.3-mile reach of the north bank near the Vinton drainage ditch, a 1.8-mile reach of the GIWW from Perry Ridge to the Sabine River, and a 0.4-mile reach of the Sabine River north from its intersection with the GIWW, and reduce the salinity intrusion from the GIWW (USGS-NWRC, 2002a, 2002b). The GIWW is the dominant hydrologic influence in the area, connecting the Sabine and Calcasieu estuaries and allowing salt water to encroach into traditionally freshwater areas. The goal is to prevent impacts to fragile marsh habitats in the interior of the area. HS modeling indicates that baseline salinities during the growing season average about 1.3 ppt in the fresh

Table 14: Louisiana SNWW CIP - Net Impacts by Acres and AAHUs

| HU # | Hydrologic Unit (HU) Name | Offset Impacts by Acres and Habitat Type (acres) | | | Total Impacts/Benefits by Habitat Type (AAHUs) | | |
|---|---|---|---|---|---|---|---|
| | | No Impact | Impacts Offset by BU Plan | Acres Impacted | Total Loss | Offsetting Benefits of BU Plan | Net FWP Impact |
| All HUs in Sabine River Watershed | | | | | | | |
| **Bottomland Hardwood** | | | | | | | |
| LA 1 | Perry Ridge | 2,158 | 0 | 0 | 0 | 0 | 0 |
| LA/TX 1 | Sabine Island | 1,041 | 0 | 0 | 0 | 0 | 0 |
| | Subtotal | 3,199 | 0 | 0 | 0 | 0 | 0 |
| **Cypress/Tupelo Swamp** | | | | | | | |
| LA/TX 1 | Sabine Island | 5,998 | 0 | 0 | 0 | 0 | 0 |
| LA/TX 2 | Blue Elbow | 650 | 0 | 0 | 0 | 0 | 0 |
| | Subtotal | 6,648 | 0 | 0 | 0 | 0 | 0 |
| **Fresh Marsh** | | | | | | | |
| LA 1 | Perry Ridge | 0 | 0 | 18,859 | -65 | 0 | -65 |
| LA 7 | Southeast Sabine | 0 | 0 | 2,634 | -11 | 0 | -11 |
| LA 8 | Southwest Gum Cove | 0 | 0 | 3,615 | -2 | 0 | -2 |
| | Subtotal | 0 | 0 | 25,108 | -78 | 0 | -78 |
| **Intermediate Marsh** | | | | | | | |
| LA 1 | Perry Ridge | 0 | 0 | 4,704 | -53 | 0 | -53 |
| LA 2 | Willow Bayou | 0 | 0 | 35,109 | -328 | 0 | -328 |
| LA 3 | Black Bayou | 0 | 0 | 34,941 | -509 | 0 | -509 |
| LA 4 | West Johnson's Bayou | 0 | 0 | 11,110 | -269 | 0 | -269 |
| LA 5 | Sabine Lake Ridges | 0 | 0 | 9,270 | -218 | 0 | -218 |
| LA 7 | Southeast Sabine | 5,400 | 0 | | 0 | 0 | 0 |
| LA 8 | Southwest Gum Cove | 0 | 0 | 6,605 | -4 | 0 | -4 |
| LA 9 | East Johnson's Bayou | 0 | 0 | 26,138 | -190 | 0 | -190 |
| | Subtotal | 5,400 | 0 | 127,877 | -1,571 | 0 | -1,571 |
| **Brackish Marsh** | | | | | | | |
| LA 2 | Willow Bayou | 0 | 0 | 1,182 | -1 | 0 | -1 |
| LA 3 | Black Bayou | 0 | 0 | 3,195 | -1 | 0 | -1 |
| LA 4 | West Johnson's Bayou | 0 | 0 | 2,078 | -1 | 0 | -1 |
| LA 5 | Sabine Lake Ridges | 0 | 0 | 15,962 | -14 | 0 | -14 |
| LA 6 | Johnson's Bayou Ridge | 0 | 0 | 2,744 | -6 | 0 | -6 |
| | Subtotal | 0 | 0 | 25,161 | -23 | 0 | -23 |
| **Saline Marsh** | | | | | | | |
| LA 5 | Sabine Lake Ridges | 0 | 3,767 | 0 | -35 | 210 | 173 |
| LA 6 | Johnson's Bayou Ridge | 0 | 370 | 0 | -2 | | |
| | Subtotal | | 4,137 | 0 | -37 | 210 | 173 |
| | | | | | | | |
| Louisiana Impacts Total | | 15,247 | 4,137 | 178,146 | -1,709 | 210 | -1,499 |

marsh and 3.8 ppt in the intermediate marsh (Brown and Stokes, 2009). SAVs are abundant in the shallow open-water areas, and access for marine organisms is fully open along the Sabine River and through the Vinton Drainage Ditch.

FWOP RSLR would be expected to increase salinities in the fresh and intermediate marshes to 1.7 ppt and 4.5 ppt, respectively, by the end of the 65-year period of analysis. FWOP changes would push salinity in the intermediate marsh into the suboptimal range. Interior land loss of 921 acres (6.2 percent) in the fresh marsh and 191 acres (6.3 percent) in the intermediate marsh would be expected as a result of the higher salinities. However, RSLR would not be expected to result in marsh submergence or shoreline recession. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. CWPPRA Projects CS-24 and CS-30 would be expected to prevent the shoreline erosion and recession associated with RSLR (Mouledous and Guidry, 2005a, 2005b, 2007a, 2007b). FWOP RSLR would gradually increase tidal flooding depth and duration, but the higher water surface elevations would not be expected to inundate the majority of Perry Ridge. Lower areas of the ridge, however, could be inundated during occasional, extreme high-tide events. The brief insults of salinities between 1.0 and 2.0 ppt would not be expected to significantly impact the bottomland hardwood community that grows on the ridge. It was predicted that population growth in the upland margins would result in the conversion of 5 percent of existing bottomland hardwood to development by 2069.

FWP project losses, totaling 188 AAHUs, would be expected with an increase in interior marsh loss and salinity. Salinity would be expected to increase to 2.3 ppt in the fresh marsh and 5.6 ppt in the intermediate marsh by the end of the period of analysis. These salinities would edge into the suboptimal range in the fresh marsh, but push further into the suboptimal range for the intermediate. Interior marsh loss of 50 acres (0.3 percent) of fresh marsh (–131 AAHUs) and 12 acres (0.4 percent) of intermediate marsh would be expected. The bottomland hardwoods would be protected by the ridge's elevation and buffered from salinity increases by the surrounding marsh. No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.2.2 LA 2 – Willow Bayou

The 36,291-acre Willow Bayou hydro-unit is bordered on the west by Sabine Lake, on the north by the Sabine NWR boundary, on the east by the Burton-Sutton Canal, and on the south by Starks South Canal, which forms the Sabine NWR boundary. Gray's Ditch parallels a raised cattle walkway that runs along most of the Sabine Lake shoreline south of Pines Ridge Bayou. Access to Sabine Lake is provided by Willow Bayou Canal, Three Bayou, and Johnson's Bayou. Black Bayou influences the eastern half of the area through connections via Greens Bayou and the Right Prong of Black Bayou. The majority of the hydro-unit is located within the western half of the Sabine NWR. Except for a narrow margin of 3 percent (49 acres) brackish marsh along the lakeshore, the unit is composed primarily of 62 percent (22,470 acres) intermediate marsh. Large interior areas, especially in the vicinity of Greens Lake and the intersection of the Deep Bayou and Willow Bayou canals, are converting to shallow open water due to elevated salinity

and subsidence. In total, approximately 34 percent (12,688 acres) of the unit is open water. Marsh loss caused by wave action is also occurring along the shoreline at an average rate of 4.7 feet/year (Greco and Clark, 2005). Baseline salinities, based on data provided by the USFWS during ICT meetings, average about 6.3 ppt in the hydro-unit. Access for marine organisms is fully open through Willow, Three, and Black bayous.

The East Sabine Lake Hydrologic Restoration Project (CWPPRA Project No. CS-32) has been constructed with the intent of countering this deterioration (USGS-NWRC, 2005). Project goals include the reduction of salinities within interior marshes, encouragement of SAV development, hydrologic restoration of historic flows, reduction of turbidity in open-water areas, and the restoration and protection of marsh through earthen vegetative terraces. Construction Unit 1, completed in 2006, includes a rock weir at Pines Ridge Bayou, two flap-gate culverts at Bridge Bayou, a rock weir at Double Island Gully, a 3,000-foot-long foreshore rock dike along the Sabine Lake shore north of Willow Bayou, and approximately 45 miles of vegetated earthen terraces in large, shallow, open-water areas south of Greens Lake and south of Willow Bayou Canal (USFWS-LDNR, 2008a). Hydrodynamic modeling of proposed Construction Unit II water control structures (fixed-crest weirs with boat bays) at Right Prong, Greens, Three, and Willow bayous was completed in 2004 (USFWS-LDNR, 2008b). The modeling predicted that the proposed structures would have very little effect on reducing project area salinities, and therefore Construction Unit 2 components were deleted from the restoration plan in 2006. The Pines Bayou weir was rehabilitated in 2007 due to heavy damage from Hurricane Rita. Four 50-foot-wide gaps were also installed in 2007 in the breakwater near Willow Bayou.

The FWOP condition includes all elements of Construction Unit 1 of CWPPRA Project CS-32. Marsh acreage in both the brackish and intermediate marshes has been adjusted to add marsh protected or restored by that project. FWOP salinities would be expected to increase to 6.8 ppt and 7.2 ppt in the intermediate and brackish marshes, respectively. Higher salinity would be expected to result in the loss of 2,116 acres of intermediate marsh as new open-water areas develop within healthy marsh. Marsh loss of 695 acres would be expected in the brackish marsh, which includes 627 acres expected to be lost with recession of the East Sabine Lake shoreline due to RSLR. However, RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 329 AAHUs would be expected with increases in salinity and interior marsh loss, with nearly all of this loss occurring in the intermediate marsh. Salinities would be expected to increase to 7.7 ppt and 8.6 ppt in the intermediate and brackish marshes, respectively, increasing the potential for the conversion of large areas to brackish marsh. Interior marsh loss of 102 acres (0.5 percent) in intermediate marsh and 2 acres (0.2 percent) in brackish marsh would be expected. Open-water areas would be expected to enlarge slightly as salinity nears the maximum tolerance of the intermediate community. No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.2.3 LA 3 – Black Bayou

The 39,853-acre Black Bayou hydro-unit is bordered on the west by Sabine Lake and the Sabine River, on the north by the GIWW, on the east by Gum Cove Ridge, and on the south by the Willow Bayou hydro-unit. Black Bayou meanders through the unit, entering at the intersection of the GIWW and the Black Bayou Cut-off Canal and eventually flowing into the Sabine River near its mouth. A small triangular area on the western margin of the unit is part of the Sabine NWR. The unit is composed primarily of intermediate marsh, with brackish marsh along the Sabine Lake shore and shrub-scrub forest on the southern end of Perry Ridge. Large interior areas, especially in the Black Bayou Cut-off Canal area, are converting to shallow open water due to elevated salinity and subsidence. Intermediate marsh composes 62 percent (24,633 acres), brackish marsh 8 percent (2,964 acres), and other upland 4 percent (1,717 acres). In total, 28 percent (10,539 acres) of the unit is open water. Baseline salinity averages between 3.8 and 4.7 ppt throughout the hydro-unit. Access for marine organisms is fully open through the Black Bayou Cut-off Canal and Black Bayou at the Sabine River and Sabine Lake.

The Black Bayou Hydrologic Restoration Project (CWPPRA Project No. CS-27) was constructed in December 2001 for the purpose of restoring coastal marsh habitat and slowing the conversion of wetlands to shallow open water. The project limits the amount of saltwater intrusion into the surrounding marsh and canals from Black Bayou and the GIWW and reduces erosion caused by wave action from nearby boats and tides (USGS-NWRC, 2002c). These elements are (1) approximately 4.3 miles of rock foreshore dike along the south shore of the GIWW; (2) the Black Bayou Cut-off Canal rock weir with boat bay; (3) the Burton Canal weir with boat bay; (4) the Block's Creek rock weir with boat bay; and (5) a self-regulating tide gate for the NO-13 unit wetlands. Terracing and vegetative plantings are also planned as part of the CWPPRA project.

The FWOP condition assumes that all elements of CWPPRA Project CS-27 are in place and fully functioning. The land loss rate of 0.08 percent/year, predicted as the FWP condition for the CS-27 project, was adopted through TY 16. Beginning in TY 16, it was assumed that 50 percent of the CWPPRA project structures would not be functioning, raising the land loss rate by 50 percent to 0.12 percent/year through TY 65. FWOP salinities would be expected to increase to about 4.2 to 5.1 ppt throughout the unit, resulting in the loss of 1,713 acres (7.0 percent) of intermediate marsh as new open-water areas develop within healthy marsh. Marsh loss of 803 acres (27.3 percent) would be expected in the brackish marsh, which includes 621 acres expected to be lost with recession of the East Sabine Lake shoreline due to RSLR. However, RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 510 AAHUs would be expected with increases in salinity and interior marsh loss, with nearly all of this loss occurring in the intermediate marsh. Salinities would be expected to increase to between 5.3 and 6.5 ppt, pushing further into the suboptimal range for intermediate marsh. Interior marsh loss of 130 acres (0.5 percent) in intermediate marsh and 4 acres (0.1 percent) in brackish marsh would be

expected. Open-water areas would be expected to enlarge slightly as salinity rises further into the suboptimal range. No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.2.4 LA 4 – West Johnson's Bayou

The 13,190-acre West Johnson's Bayou hydro-unit is bordered on the west by Sabine Lake, on the north by the Sabine NWR and Willow Bayou hydro-unit, on the east by Deep Bayou, and on the south by Buck Ridge. Johnson's Bayou flows from the southeast to the northwest through the unit, eventually flowing into Sabine Lake. The unit is composed of 76 percent intermediate marsh (10,031 acres), with 14 percent brackish marsh (1,837 acres) along the Sabine Lake shore. Located just north of the Johnson's Bayou Chenier Plain, the interior of the unit is fairly stable but the shoreline is affected by wave erosion. In total, 10 percent (1,320 acres) of the unit is open water. Access for marine organisms is fully open through Johnson's Bayou. Baseline salinity averages about 4.5 ppt throughout the hydro-unit. No CWPPRA projects have been constructed in this area.

FWOP salinities would be expected to increase to between 5.3 and 5.5 ppt throughout the unit, resulting in the loss of 1,703 acres (17.1 percent) of intermediate marsh as new open-water areas develop within healthy marsh. Marsh loss of 1,189 acres (65.4 percent) would be expected in the brackish marsh, which includes about 957 acres expected to be lost with recession of the East Sabine Lake shoreline due to RSLR. However, RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 270 AAHUs would be expected with increases in salinity and interior marsh loss, with nearly all of this loss occurring in the intermediate marsh. Salinities would be expected to increase to 7.0 to 7.3 ppt, pushing further into the suboptimal range for intermediate marsh and increasing the possibility for conversion to brackish marsh. Interior marsh loss of 142 acres (1.4 percent) in intermediate marsh and 6 acres (0.3 percent) in brackish marsh would be expected. Open-water areas would be expected to enlarge slightly as salinity rises further into the suboptimal range. No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.2.5 LA 5 – Sabine Lake Ridges

The triangular, 33,472-acre, Sabine Lake Ridges hydro-unit is bordered on the west by Sabine Lake and Sabine Pass, on the north by Buck Ridge, and on the south by the Gulf of Mexico and Hackberry Ridge. Greens Bayou drains the northern part of the unit, emptying into Sabine Lake. The lower reach of Lighthouse Bayou parallels the beach and empties into Sabine Pass. Several chenier ridges run parallel to the Gulf Coast, the most prominent of which are Buck Ridge, Blue Buck Ridge, and Hackberry Ridge. The unit comprises 44 percent brackish marsh (14,673 acres), 24 percent (8,232 acres) intermediate marsh, 10 percent (3,198 acres) saline marsh, and 13 percent (4,473 acres) of upland ridges. Located within the Chenier Plain, the interior of the unit is fairly stable but the shoreline is affected by wave

erosion along Sabine Pass. In total, 9 percent (2,896 acres) of the unit is open water. Average baseline salinities range between 4.5 and 6.2 ppt in the intermediate and brackish marshes, and about 15.8 ppt in the saline marshes near the coast. The Gulf of Mexico shoreline is stable and appears to be accreting at a rate of 1.2 feet/year (USACE, 2004:Appendix D). Access for marine organisms is fully open through Greens and Lighthouse bayous.

FWOP salinities would be expected to increase to between 5.5 and 7.1 ppt in the intermediate and brackish marshes, resulting in the loss of 1,103 acres (13.5 percent) of intermediate marsh as new open-water areas develop within healthy marsh. Marsh loss of 2,567 acres (17.6 percent) would be expected in the brackish marsh, which includes about 685 acres expected to be lost with recession of the East Sabine Lake and Sabine Pass shorelines due to RSLR. FWOP salinity in the saline marsh would increase to 16.6 ppt, resulting in a net loss of 398 acres (12.6 percent). This also reflects the addition of about 22 acres by 2069 due to shoreline accretion; no shoreline recession would be expected because of the relatively high and stable Gulf shoreline in this area. RSLR would not be expected to result in the submergence of interior marsh. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. No CWPPRA projects have been constructed or were assumed as a FWOP condition for this hydro-unit.

FWP losses totaling 267 AAHUs would be expected with increases in salinity and interior marsh loss, with about 82 percent of this loss occurring in the intermediate marsh. Salinities would be expected to increase to between 7.0 to 7.3 ppt in the intermediate and brackish marshes, pushing further into the suboptimal range for intermediate marsh and increasing the possibility for conversion to brackish marsh. Interior marsh loss of 142 acres (1.4 percent) in intermediate marsh and 6 acres (0.3 percent) in brackish marsh would be expected. Open-water areas in the intermediate marsh would be expected to enlarge slightly as salinity rises further into the suboptimal range. In the saline marsh, salinity would increase to about 17.3 ppt and about 10 acres of marsh would be lost. FWP saline marsh loss includes about 6.0 acres resulting from erosion of 0.42 foot/year along the 2.3-mile Gulf shoreline that would be caused by the offshore channel extension (Gravens and King, 2003). No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.2.6 LA 6 – Johnson's Bayou Ridge

The wedge-shaped, 4,089-acre, Johnson's Bayou Ridge hydro-unit is bordered on the north by Hackberry Ridge, on the south by the Gulf of Mexico, and on the east by Johnson's Bayou. Lighthouse Bayou parallels Hackberry Ridge through much of the unit. The unit is composed of 61 percent brackish marsh (2,505 acres), 9 percent (353 acres) saline marsh, and 24 percent (975 acres) uplands located at Johnson's Bayou on the eastern edge. Only 6 percent (251 acres) of the unit is open water. The Gulf of Mexico shoreline is stable and appears to be accreting at a rate of 1.2 feet/year (USACE, 2004:Appendix D). The Coast 2050 report noted that 25 percent of the chenier ridge has eroded to marsh elevations since 1968

(LCWCR/WCRA, 1998). The baseline salinity within the brackish marsh averages 4.4 ppt and in the saline marsh is 15.8 ppt. Access for marine organisms is fully open through Lighthouse Bayou.

FWOP salinities would be expected to increase to 5.3 ppt in the brackish marsh and 16.6 ppt in the saline marshes, resulting in the loss of 707 acres (28.9 percent) of brackish marsh and 93 acres (27 percent) of saline marsh. The change in saline marsh acreage reflects the addition of about 18 acres by 2069 due to shoreline accretion; no shoreline recession would be expected because of the relatively high and stable Gulf shoreline in this area. RSLR would not be expected to result in the submergence of interior marsh. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. No CWPPRA projects have been constructed or were assumed as a FWOP condition for this hydro-unit.

FWP losses totaling 8 AAHUs would be expected with increases in salinity and interior marsh loss. The majority of this loss would occur in the brackish marsh, which is linked directly to the SNWW through Lighthouse Bayou. Salinities would be expected to increase to 7.0 ppt and 17.3 ppt in the brackish marshes and salinity marshes, respectively, remaining within the optimal range for both. Interior marsh loss of 22 acres (0.9 percent) in brackish marsh and 5 acres (1.4 percent) in saline marsh would be expected. Nearly all of the saline marsh loss (about 4.9 acres) is due to predicted erosion of 0.42 foot/year along the 1.9-mile Gulf shoreline that would be caused by the offshore channel extension (Gravens and King, 2003). No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.2.7 LA 7 – Southeast Sabine (West)

The 8,034-acre Southeast Sabine (West) hydro-unit is located in the East Sabine Lake marshes, bordered on the west by the Burton-Sutton Canal, on the north by the Starks-Central Canal, on the south by the Starks South Canal, and on the east by a line extending north from the Starks Canal. This eastern boundary arbitrarily divides the CWPPRA Southeast Sabine mapping unit roughly in half. The Habitat Workgroup concluded that only the western section was influenced by the SNWW project. Old North Bayou flows from the northeast to the southwest through the unit, but the primary hydrologic connections to Sabine Lake are through the extensive canal system. The unit is composed of 61 percent intermediate marsh (4,925 acres) and 25 percent fresh marsh (2,023 acres). In total, 14 percent (1,086 acres) of the unit is open water. Marsh loss in this unit has stabilized and there is now a low rate of land loss. Access for marine organisms is fully open through the canal system. The Sabine Structures Replacement project (CWPPRA Project CS-23) has replaced salinity control structures on Hog Island Gully, West Cove, and Headquarters canals. These structures are controlling salinity intrusion to the eastern section of the original CWPPRA unit, while the west segment remains open to the influence of the SNWW through the South, Starks-Central, and Burton-Sutton canals. Baseline salinities in the fresh and intermediate marshes average 1.7 ppt in the growing season.

FWOP salinities would be expected to increase to about 2.1 throughout the unit, edging slightly into the suboptimal range for fresh marsh. Interior land loss of 40 acres (2.0 percent) of fresh and 96 acres of intermediate marsh (2.0 percent) would be expected. The unit has no Sabine Lake shoreline, and therefore none of the land loss is attributable to shoreline recession. RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 11 AAHUs would be expected due to small increases in salinity and interior marsh loss, with all of this loss occurring in the fresh marsh. Salinities would be expected to increase to about 2.4 ppt, edging further into the suboptimal range for fresh marsh. Interior marsh loss of about 1 acre would be expected. No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.2.8 LA 8 – Southwest Gum Cove

The 11,386-acre Southwest Gum Cove (West) hydro-unit is a revised version of the CWPPRA mapping unit. A 3,865-acre area of marsh south of Gum Cove Ridge was not included in the SNWW hydro-unit because it extends into the Calcasieu watershed. Southwest Gum Cove is an interior marshland unit bordered on the north by the Bankcroft Canal, on the south by the Starks North Canal, on the west by Black Bayou and the Right Prong of Black Bayou, and on the east by Gum Cove Ridge and the watershed divide. The unit is composed of 47 percent (5,346 acres) intermediate marsh, 31 percent (3,503 acres) fresh marsh, 10 percent (1,166 acres) upland, and 12 percent (1,371 acres) open water. The majority of marsh loss in this area occurred between 1956 and 1974, and the rate of loss has been much lower in recent years (LCWCR/WCRA, 1998). Baseline salinities average 1.2 ppt and 2.4 ppt during the growing season in the fresh and intermediate marshes, respectively. Hydrology has been altered by numerous oil field canals and levees. Access for marine organisms into fresh marsh in the southeast corner of the unit is partially blocked by levees that border oil field canals; culverts provide approximately 50 percent of normal access to this area. Access to intermediate marsh in the remainder of the area is unrestricted through Black Bayou. No CWPPRA projects have been constructed within this unit.

The FWOP land loss rate was based upon the trend observed between 1983 and 1990, which is much lower than that observed earlier in this century. FWOP salinities would be expected to increase to about 1.4 ppt in the fresh marsh and 2.8 ppt in the intermediate marsh, remaining in the optimal range for both marsh types. Interior land loss of 152 acres (4.4 percent) of fresh and 233 acres (4.4 percent) of intermediate marsh would be expected. The unit has no Sabine Lake shoreline, and therefore none of the land loss is attributable to shoreline recession. RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 6 AAHUs would be expected due to small increases in salinity and interior marsh loss, with the majority of this loss occurring in the fresh marsh. Salinities would be expected to increase to about 2.0 ppt and 3.9 ppt in the fresh and intermediate marshes, respectively, reaching the high end of the optimal range for each marsh type. Low interior marsh loss of about 8 acres (0.2 percent) of fresh marsh and 15 acres (2.8 percent) of intermediate marsh would be expected, with no large areas of open water developing. No other changes in land use, hydrology, or marine organism access are attributable to the project.

### 7.2.9 LA 9 – East Johnson's Bayou

The 26,719-acre East Johnson's Bayou hydro-unit is bordered on the west by Deep Bayou, on the north by the Sabine NWR and the South Line Canal, on the east by Second Bayou, and on the south by Buck Ridge. The interior unit is 85 percent intermediate marsh (22,694 acres), 2 percent (581 acres) upland, and 13 percent open water. Baseline salinity averages 3.3 ppt during the growing season. Access for marine organisms is partially blocked by levees and roads that border oil field canals. The Habitat Workgroup estimated that culverts provide approximately 50 percent of normal marine organism access. Natural bayous have been channelized to provide oil field access. No CWPPRA projects have been constructed or were assumed as a FWOP condition for this hydro-unit.

The FWOP land loss rate was based upon the trend observed between 1983 and 1990, which is much lower than that observed earlier in this century. FWOP salinities would be expected to increase to about 3.8 ppt in the intermediate marsh, remaining within the optimal range. Interior land loss of 895 acres (3.9 percent) would be expected. The unit has no Sabine Lake shoreline and therefore none of the land loss is attributable to shoreline recession. RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 190 AAHUs would be expected due to increases in salinity and interior marsh loss. Salinity would be expected to increase to about 4.8 ppt, extending into the suboptimal range for intermediate marsh. Interior marsh loss of about 46 acres (0.2 percent) would be expected with expansion of existing areas of open water. No other changes in land use, hydrology, or marine organism access are attributable to the project.

## 7.3 LOUISIANA/TEXAS HYDRO-UNITS

### 7.3.1 LA/TX 1 – Sabine Island

This 8,756-acre hydro-unit straddles the border between Louisiana and Texas. The Sabine River and Old River flow from north to south through the unit and intersect in the southern third, placing approximately 76 percent of the acreage in Louisiana, where the southern half of Louisiana's Sabine Island WMA is located. The unit is bordered on the south by the Blue Elbow bend in the Sabine River, and on the east and west by the upland terrace margins. The northern extent of the unit coincides with the terminus of

tidal influence on the Sabine (Morgan Bluff) and Old (Nibletts Bluff) rivers. It comprises 82 percent (7,192 acres) cypress-tupelo swamp and 18 percent (1,564 acres) bottomland hardwood forest. Although dominated by cypress-tupelo swamp, the unit is interspersed with a series of relict meander riverbank ridges that are dry except during floods and that support the bottomland hardwood forest. These ridges support a relatively mature growth of bottomland hardwoods composed of several species of oaks, hickory, hackberry, sweet gum, maple, and willow, with greater than 20 percent of the overstory canopy consisting of hard mast or other edible seed-producing trees. Canopy cover is approximately 55 percent, and midstory/understory coverage of palmetto, yaupon, lizard's tail, smartweed, greenbriar, blackberries, and invading tallow trees averages 50 to 65 percent. The relatively scarce (on a regional and national scale) swamp and bottomland hardwood habitats have medium to high wildlife values. Extensive wetland floodplain forests on both sides of the Sabine River are generally buffered from encroaching development by their low elevation. Development is, however, beginning to encroach upon the area from the city of Orange to the southwest. The hydrology of this fresh wetland system is essentially unaltered, with abundant riverine through-flows and seasonal flooding providing full access to aquatic organisms.

FWOP changes would be associated with the continued maturation of existing overstory and rising salinity and tidal flooding due to RSLR. A negligible increase in salinity would be expected (about 0.1 ppt) by the year 2069. Both the duration and depth of tidal flooding would be expected to increase, but the swamp substrate would continue to be exposed at average low tides and for longer periods seasonally. The Habitat Workgroup estimated that a small percentage (5.0 percent) of the bottomland forest would be converted to development due to population growth and the hydro-unit's proximity to uplands along its southwestern margin. No changes in the acreages of the bottomland hardwood and swamp areas would be expected, and wetland forests would continue to mature with no disturbance.

No FWP project impacts would be expected. The area would be beyond the influence of the LPP; no changes in salinity or tidal flows would be expected.

### 7.3.2 LA/TX 2 – Blue Elbow

This 3,387-acre hydro-unit straddles the border between Louisiana and Texas. The Sabine River bisects the unit, placing approximately 81 percent of the acreage in Texas. The unit is bordered on the north by the Blue Elbow bend in the Sabine River, on the east and west by the upland terrace margins, and on the south by IH 10. TxDOT's Blue Elbow Mitigation Bank (2,606 acres) and the Tony Houseman WMA, a viewing site along the Great Texas Coastal Birding Trail, are located within the unit. Cypress-tupelo swamp makes up the majority of the hydro-unit (82 percent; 7,192 acres), with bottomland hardwood forest composing the remainder (18 percent; 1,564 acres). The hardwoods are restricted to a gallery along the bank of the Sabine River and a northeast-southwest-trending ridge in the center of the Texas swamp. The Habitat Workgroup chose to lump the hardwoods with the swamp for the WVA analysis. Canopy cover within the swamp is approximately 20 percent, with a dense midstory/understory coverage of palmetto, yaupon, lizard's tail, smartweed, greenbriar, blackberries, and invading tallow trees averaging 60 to 70 percent. The relatively scarce (on a regional and national scale) swamp and bottomland

hardwood habitats have medium to high wildlife values. The area is utilized by the same suite of fish and wildlife described for the Sabine Island unit. Baseline salinity averages 0.3 ppt during the growing season. This fresh wetland forest system experiences high annual flows with abundant riverine through-flows; semipermanent flooding occurs upstream of the IH 10 embankment.

FWOP changes would be associated with the continued maturation of existing overstory and rising salinity and tidal flooding due to RSLR. A small increase in salinity would be expected (to about 0.6 ppt) by the year 2069. Both the duration and depth of tidal flooding would be expected to increase, but the swamp substrate would continue to be exposed at average low tides and for longer periods seasonally. TxDOT and TPWD management of a majority of the area would be expected to provide protection from most disturbances, ensure no development, and encourage the continued maturation of the forested wetland habitat. No changes in the acreages of the bottomland hardwood and swamp areas would be expected, and wetland forests would continue to mature with no disturbance.

A small FWP increase in salinity (to 0.9 ppt) within the optimal range for the swamp community would be expected. No bottomland hardwood or swamp acreage would be expected to convert to fresh marsh with this salinity change, and no FWP changes in tidal flow would be expected. Growth of the wetland forests would be expected without disturbance and no AAHU loss is projected.

# 8.0 MODELING OF BENEFICIAL USE AND MITIGATION MEASURES

## 8.1 ECOLOGICAL MITIGATION PLAN

The FWP scenario, without consideration of BU feature benefits, would negatively impact approximately 39,000 acres in Texas and 182,000 acres in Louisiana primarily by causing a decrease in biological productivity in tidally influenced areas. This reduction in productivity would be due to a small increase in salinity causing an increase in wetland loss in aquatic habitats of the study area. The ecological value of the lost productivity is represented by 2,121 AAHUs. Of those AAHUs, the majority of the productivity losses occur in the intermediate (76 percent) and fresh (13.9 percent) marsh communities. The remaining 10 percent would occur in the brackish (7 percent) and saline (2 percent) marshes and the cypress-tupelo swamp (1 percent).

## 8.2 PRELIMINARY SCREENING OF AVOIDANCE, BENEFICIAL USE, AND MITIGATION MEASURES

Planning for the avoidance, minimization, or mitigation of channel improvement impacts began with the identification and screening of a wide array of potential measures that could reduce, avoid, or minimize salinity or land loss impacts and provide compensation for unavoidable impacts. Early in the study scoping process, the SNWW ICT created the Restoration Workgroup to develop ideas for restoration or mitigation and opportunities for the beneficial use of dredged material throughout the study area. A series of public workshops was held with environmental organizations and commercial and recreational groups in Texas and Louisiana with the goal of obtaining extensive public input and identifying a wide array of ideas that could be used in the SNWW Feasibility Study planning process. A complete list of these ideas can be found in the report that summarizes this effort (Gulf Engineers and Consultants, Inc. [GEC], 2002). The SNWW Habitat Restoration Workgroup relied heavily upon this effort in developing a preliminary list of measures. Hydrologic measures that were considered ranged from large-scale measures with the potential to affect salinities throughout the estuary to small-scale measures that would have principally localized effects. Emphasis was also placed on identifying measures that could make beneficial use of dredged new work and maintenance material. Potential BU or mitigation measures that were evaluated by the SNWW ICT and eliminated during preliminary screening are summarized in Table 15.

## 8.3 DREDGED MATERIAL MANAGEMENT PLAN FEATURES

DMMP features described below use dredged material beneficially to significantly offset predicted LPP impacts and are least-cost alternatives for dredged material placement. They are included in the base plan for navigation improvements. The benefits of each of the DMMP features were evaluated and quantified using the WVA model, and these benefits were used to offset project impacts. Table 16 provides descriptions of all DMMP features that were adopted for the project. Cost estimates, developed by USACE based upon conceptual designs described below, established that these features were more cost effective than traditional upland confined placement areas. Incremental analysis was not required because

Table 15: BU and Mitigation Measures Eliminated During Preliminary Screening

| Measure Description | Reason for Elimination |
|---|---|
| ***Hydrologic Restoration*** | |
| Lock and dam at Sabine Pass | Reduced or eliminated navigation benefits<br>Caused backwater flooding<br>High flows and velocities through Sabine Pass increase engineering design risks<br>Excessive cost |
| Purchasing water from Sabine River Authority and Neches River Authority during times of low flow | Fresh water availability likely restricted during low flows when needed most<br>Excessive cost |
| Marsh islands isolating Sabine-Neches Canal B from Sabine Lake | Increased salinities in Black Bayou and the Sabine River |
| Marshes constricting flow at mouth of Sabine Lake (north and south of bridge on Highway 82) | Ineffective at reducing salinities<br>Increases velocities through mouth of Sabine Lake |
| Marshes constricting flow along the Port Arthur Canal | Ineffective at reducing salinities |
| Construction of channel islands blocking flow from bayous emptying Neches River marshes at Rose City and Bessie Heights | Caused backwater flooding<br>Obstructed water access for private landowners<br>Safety concerns – too close to navigation channel |
| ***Habitat Restoration*** | |
| Swamp replacement on Neches River | Excessive cost<br>FWP salinities on Neches River would slow growth and lessen biological productivity<br>Long maturation period – delayed benefits |
| Marsh restoration using new work material from Neches River Channel to restore marsh in Rose City West | Area is being developed as a mitigation bank; no longer available for restoration |
| Marsh restoration using new work material from Neches River Channel to restore marsh in Bessie Heights West | Would be feasible but cost exceeds Traditional Placement Plan; preliminary estimate of incremental cost – $581K; sponsor has not been identified |
| Marshes restoration along the east shores of PAs 8 and 11 at Pleasure Island | Unacceptable location<br>Interferes with levee maintenance |
| Creation of confined saline marsh along Gulf shoreline at Texas Point | Excessive cost compared to benefits |

Table 16: DMMP Restoration and Nourishment Features

| Beneficial Use Features | No. | Description | Size of Influence Area |
|---|---|---|---|
| Rose City East (component of Neches River BU Measure) | TX 3-1 East | Restores 345 acres of fresh marsh, 72 acres of shallow water, and nourishing 151 acres of existing marsh in two construction events. New work material from Neches River Channel would be used to restore 225-acre marsh, construct hydraulic containment levees and higher-elevation features. Maintenance material from the first maintenance cycle would be used to restore an additional 120 acres of marsh. | Influence area – 568 acres |
| Bessie Heights East (component of Neches River BU Measure) | TX 5-2 | Restores 679 acres of brackish and 1,190 acres of intermediate marsh and 660 acres of shallow-water habitat, and nourishes 651 acres of existing marsh. Marsh would be constructed with maintenance material from Neches River Channel for 28 years. New work material would be used to build hydraulic containment levees. | Influence area – 3,180 acres |
| Old River Cove (component of Neches River BU Measure) | TX 6-1 | Restores 639 acres of brackish marsh and 139 acres of shallow-water habitat, and nourishes 432 acres of existing marsh with new work material from Neches River Channel. New work material would be used to construct hydraulic containment levees. | Influence area – 1,210 acres |
| Gulf Shore BU Feature (Texas and Louisiana Points) | TX 8-11 LA 5-2/ 6-2 | Nourishes 3 miles of Gulf shoreline on both sides of Sabine Pass, from 0.5 to 3.5 miles from east and west jetties, using maintenance material from Sabine Pass Channel. Unconfined placement of maintenance material along shoreline every 3 years for 50-year period of analysis (8 placement episodes). Assumes 50:50 split of material between Texas and Louisiana accomplished by alternating placement in Texas and Louisiana. | Affected shoreline 6.0 miles total |

they were determined to be the least-cost plans. Maps of the DMMP features are provided on figures 12 through 14.

### 8.3.1 DMMP Features in Texas

BU features included in the DMMP provide benefits that offset and minimize all indirect and direct impacts (–412 AAHUs) of the Preferred Alternative in Texas and partially offset impacts in Louisiana (Table 17). An evaluation of placement alternatives presented in the FEIS includes all of the features listed in Table 16 as part of the DMMP. They have been determined to be the least-cost alternatives for dredged material placement and are part of the SNWW LPP. In Texas, construction of the Neches River BU Feature and the Texas portion of the Gulf Shore BU Feature will produce benefits totaling 1,068 AAHUs. There would be a net gain of 656 AAHUs in Texas, which would more than offsets all negative impacts that could occur in that state. Impacts that would be offset include the direct loss of 32 AAHUs for the conversion of fresh marsh to upland PA 24A. The majority of the offset Texas impacts are in the Neches River watershed, but approximately 16 percent are losses that could occur to cypress-tupelo swamp (–22 AAHUs) and fresh and intermediate marsh (–45 AAHUs) in the Sabine River watershed. In Louisiana, the Gulf Shore BU Feature provides benefits totaling 210 AAHUs. Given total Louisiana impacts of 1,709 AAHUs, there is a net loss of 1,499 AAHUs remaining in Louisiana after offsetting benefits of the Louisiana portion of the Gulf Shore BU Feature are applied.

Table 17: AAHU Summary of DMMP BU Feature Benefits

| | Swamp | Bottomland Hardwood | Fresh Marsh | Intermediate Marsh | Brackish Marsh | Saline Marsh | Totals |
|---|---|---|---|---|---|---|---|
| **Texas Impacts** | –22 | 0 | –206 | –48 | –131 | –5 | –412 |
| TX 3 Rose City East | | | 178 | | | | |
| TX 5-2 Bessie Heights East | | | | 305 | 128 | | |
| TX 6-1 Old River Cove | | | | | 235 | | |
| TX 8-11 Texas Point Shoreline Nourishment | | | | | | 222 | |
| **Louisiana Impacts** | 0 | 0 | –78 | –1,571 | –23 | –37 | –1,709 |
| LA5-2/6-2 Louisiana Point Shoreline Nourishment | | | | | | 210 | |
| **Total DMMP BU Benefits** | | | | | | | 1,278 |
| **Net Benefits of DMMP Features** | –22 | 0 | –106 | –1,314 | 209 | 390 | –843 |

Rose City East
Bessie Heights East
Old River Cove
Hydrologic Unit

0 8,750 17,500
Feet

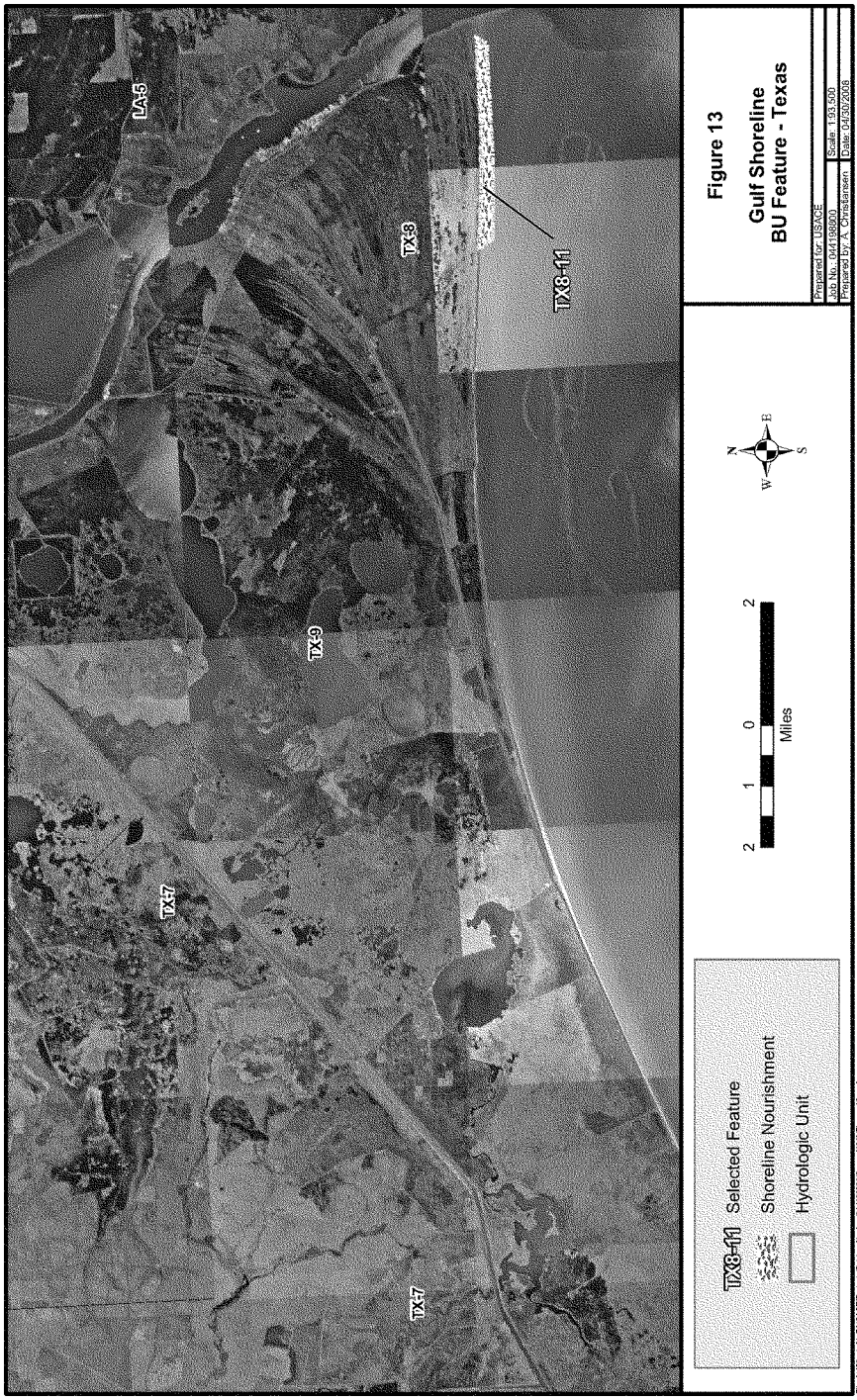
N
W E
S

**Figure 12**

**Neches River BU Feature**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1 inch equals 8,750 feet |
| Prepared by: 18827 | Date: 08/10/2009 |

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Figures/Fig_12.mxd


LA-5
TX-9
TX8-11
TX-9
TX-7
TX-7
TX8-11 Selected Feature
Shoreline Nourishment
Hydrologic Unit
2 1 0 2
Miles
N
W
E
S
Figure 13
Gulf Shoreline
BU Feature - Texas
Prepared for: USACE
Job No.: 04118820
Prepared by: A. Christensen
Scale: 1:93,500
Date: 04/30/2008

LA 5-1/6-1 Selected Mitigation Feature
LA 5-3 Non- Selected Mitigation Measures
Shoreline Nourishment
Hydrologic Unit

2 1 0 2
Miles

N
W E
S

**Figure 14**

**Gulf Shoreline**
**BU Feature - Louisiana**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1inch equals 6,600 feet |
| Prepared by: A. Christiansen | Date: 09/10/2009 |

N:\Clients\U_Z\USACE\Projects\Sabine_Neches\100007609\geo\fig\r\Gulf_BU_Feature_LA.mxd

8.3.1.1 Neches River BU Feature

Three former marsh areas on the Neches River have been combined into one large management feature, called the Neches River BU Feature, to provide flexibility in the use of new work and maintenance material from the several construction reaches of the Neches River Channel. The primary objective of this combination feature would be to beneficially utilize dredged material to restore emergent marsh in an area that has suffered dramatic, widespread loss of marsh. The BU feature would utilize new work and maintenance material that would otherwise be removed from the sediment system and stored in upland, confined placement areas.

The Neches River BU Feature would offset all indirect salinity impacts to Texas wetland habitats on the Neches and Sabine rivers (TX 3 through TX 8, and TX 10 through TX 13) by restoring 2,853 acres of emergent marsh; improving 871 acres of shallow water by creating shallower ponds and interconnecting channels; and nourishing 1,234 acres of existing fringing marsh by winnowing fine-grained material from unconfined flows of dredged material effluent (Table 18). The BU feature thus provides benefits to a total of 4,958 acres of degraded marsh on the lower Neches River, or 53 percent of the restoration target set by the Coastal Erosion Planning and Response Act (CEPRA) 2004 plan update for the lower Neches River (GLO, 2005). The BU feature also offsets the direct impact of converting 86 acres of freshwater wetland to a confined placement area (PA 24A). The size of the Neches River BU Feature components and the magnitude of their ecological benefits are made possible by the large amounts of dredged material that will be generated by the proposed project and extensive opportunities for beneficial use in the project area.

Table 18: Acreage Restored by Each Component of Neches River BU Feature

| Components of the Neches River BU Feature | Restored Emergent Marsh | Improved Shallow-water Habitat | Nourished Existing Marsh | Total Influence Area |
|---|---|---|---|---|
| Rose City East | 345 | 72 | 151 | 568 |
| Bessie Heights East | 1,869 | 660 | 651 | 3,180 |
| Old River Cove | 639 | 139 | 432 | 1,210 |
| Total | 2,853 | 871 | 1,234 | 4,958 |

*8.3.1.1.1 TX 3-1 Rose City East*

Benefits of the Neches River DMMP features in the Rose City (TX 3) hydro-unit are associated with marsh restoration measures within the footprint of this unit. A total of 225 acres of emergent fresh marsh would be constructed with new work by TY 15, and 120 more acres would be added with maintenance material from the first maintenance dredging cycle following construction. Benefits earned with this restoration total 178 AAHUs. The hydraulic placement of dredged material would restore 18 inches of topsoil over eroded mudflats and open water, creating 345 acres of emergent fresh marsh, improve 72

acres of shallow-water habitat by reducing water depths, fetch, and turbidity, and renourish 151 acres of existing fringe marsh by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved significantly, with 80 percent projected as Class 1. Conditions for SAV are expected to improve dramatically with an increase in shallow water and the creation of still-water conditions, which favor their growth. Although planned ridges of various elevations within the reconstructed marsh could, in the long run, support bottomland hardwood forest and cypress-tupelo swamp, no benefits for these habitats are being claimed because long-term management required to ensure their growth is not included in the plan.

*8.3.1.1.2 TX 5-2 Bessie Heights East*

Benefits of the Neches River DMMP features in the Bessie Heights East (TX 5-2) hydro-unit would accrue from marsh restoration of a total of 1,190 acres of emergent intermediate and 679 acres of emergent brackish marsh. New work material would be used to build a containment levee along the southern end of the BU area, and the marsh would be constructed incrementally over seven maintenance cycles. Benefits earned with this marsh restoration total 433 AAHUs. The hydraulic placement of dredged material would restore a total of 1,869 acres of emergent marsh, improve 660 acres of shallow-water habitat by reducing water depths, fetch, and turbidity, and renourish 651 acres of existing fringe marsh by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved significantly from primarily Class 3 and Class 4 to 100 percent Class 1. Channels would be constructed to allow inner marshes to drain through reconstructed stream channels into the Neches River, providing flushing to maintain moderate soil salinities, access to more of the marsh for fishery organisms, and facilitating the escape of organisms from the marsh. Conditions for SAV are expected to improve throughout the marsh restoration area, with the restoration of shallow water and the creation of still-water conditions, which favor SAV growth. Fisheries access would be fully restricted in the first construction year while containment and training levees are constructed, but access would be incrementally restored with each marsh creation episode by the placement of breaches or culverts in training and containment levees.

*8.3.1.1.3 TX 6 Old River Cove*

Benefits of the Neches River DMMP features in the Old River Cove West (TX 6-1) hydro-unit would result from marsh restoration of a total of 639 acres of emergent brackish marsh with new work material. A containment levee would be constructed along the power plant outfall canal on the western boundary of the unit. Benefits earned with this restoration total 235 AAHUs. The hydraulic placement of dredged material would restore 639 acres of emergent marsh, improve 139 acres of shallow-water habitat, and renourish 432 acres existing fringe marsh by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved significantly from 85 percent Class 2 and Class 3 to 75 percent Class 1. Channels would be constructed within the marsh to allow full circulation with the outfall canal, providing flushing to maintain moderate soil salinities and ameliorate salinities in the canal, access to more of the marsh for fishery organisms, and facilitating the escape of organisms from the

marsh. Conditions for SAV are expected to improve throughout the marsh restoration area with an increase in shallow water and the creation of still-water conditions, which favor SAV growth. Full access for marine organisms would be maintained by breaches in the containment levee. No benefits to the fringing bottomland hardwoods are projected with the hydrologic and marsh restoration plan.

8.3.1.2 Gulf Shore BU Feature

The use of dredged material was also evaluated for Gulf shoreline nourishment at Texas and Louisiana Points (see figures 13 and 14). The most cost effective plan would hydraulically pump maintenance material from Section 5 of the adjacent Sabine Pass Channel onto a total of 6 miles of shoreline on both sides of Sabine Pass. Some material would be expected to flow over existing marsh, while the remainder would flow into nearshore waters. Material placement during each 3-year Sabine Pass Channel dredging cycle would alternate between Texas and Louisiana, so that material would be placed on each state's shoreline every 6 years. This recurring action would nourish eroding marsh, minimize projected FWP shoreline impacts, and potentially create new marsh.

Texas Point is undergoing severe beach erosion, with shoreline retreat of up to 1,150 feet between 1974 and 2000 (Morang, 2006; King, 2007). This is a Texas CEPRA "critical erosion area," having the highest rate of shoreline loss on the upper Texas coast and (GLO, 2005). In Louisiana, persistent erosion along the shoreline between Ocean View and Holly Beach, on the order of –4.3 feet/year between 1985 and 1998, was recorded here prior to Hurricane Rita (USACE, 1971, 2004). Nearer to Louisiana Point, significant accretion over the last 100 years has slowed to +1.2 feet/year, and the behavior of this shoreline has become erratic, with some areas eroding and some aggrading (USACE, 2004).

Historic dredging records indicate that the maintenance material from Sabine Pass would average 51 percent silt, 31 percent clay, and 18 percent fine sand (USACE dredging database). This mix of materials does not contain typical beach-quality sand, but the material types and composition are similar to what is present on the shorelines today. Narrow beachfronts of silt or clay lie seaward of eroding overwash marsh terraces (PBS&J, 2006). Given the unusual characteristics of this sand-starved system, returning the material to the littoral system is likely to have a net beneficial effect, regardless of material type. The longshore transport in this system contains primarily fine-grained sediments, but these sediments have been shown to accumulate in the nearshore zone and result in shoreline accretion by as yet poorly understood processes (Morang, 2006; King, 2007).

The Gulf Shore BU Feature would provide a regular source of predominantly fine-grained sediment that should contribute to mudflat accretion and periodically move onshore to become shore-attached through a process described by Pacific International Engineering (PIE, 2003). On the western Louisiana and east Texas coasts, sediments accumulate as mudflats and underwater mudshoals (or "fluid mud") in the nearshore region. Nearshore, fluid mud can be trapped against the shoreline by prevailing south and southwesterly winds, and storms carry the trapped muddy ooze onto the chenier shoreline. The northwest Gulf is a microtidal, storm-dominated environment. In a typical year there are about 20 to 30 frontal

passages generating waves, surges, and wind-driven currents, with most-frequent waves from the southeast about 3 to 4.5 feet in height.

The presence of additional fine-grained sediments in the littoral system that would be regularly provided by the BU Feature should reduce the current erosion rate and minimize the small increase in shore erosion predicted with the project (Gravens and King, 2003). In systems that have an abundant supply of fine-grained sediments, the nearshore seabed can be blanketed with fluid mud. The presence of additional muddy sediment in the near shore environment may attenuate waves and lessen wave-induced erosion (Tubman and Suhayda, 1976; Hsiao and Shemdin, 1980; Wells and Kemp, 1986). There are also anecdotal reports of Gulf areas off Louisiana and Texas Points being safe havens for vessels during storms due to the near-total attenuation of waves (Block, 1984; Wells and Kemp, 1986; King, 2007).

The BU dredged material is expected to be composed largely of unconsolidated muds. These fine-grained sediments would be expected to be highly mobile initially, and some portion of the material will be rapidly lost from the vicinity of the shoreline. As demonstrated by another BU project at Texas Point (USACE, 2000), a significant percentage would also flow onshore and nourish existing marsh along the eroding beachfront. Because of the prevailing wave climate, the mobile material within the surfzone should generally migrate to the west at both Texas and Louisiana Points (Wamsley, 2008). Transport processes identified by the Sabine Pass sediment budget (Morang, 2006) indicate that the material would move toward the eroding shoreline at Texas Point. There, the additional fine-grained sediments could lower erosion rates through the mudflat accretion and wave attenuation processes described above. A small quantity of material may migrate to the east and contribute to the Sabine Fillet at the west jetty (Morang, 2006; King, 2007).

In Louisiana, the sand bar formed by BU sediments from the Cheniere LNG project may shelter the shoreline from wave energy sufficiently to allow fine-grained sediments to form a mudflat behind the sandbar (Nairn and Willis, 2002). While a significant percentage would be rapidly carried offshore, some is likely to move downcoast with the littoral current, enlarging the sand and mudflat already present at the east jetty. Potential impacts of elevated levels of total suspended solids would be expected to be similar to those that resulted from the Cheniere LNG BU project (PBS&J, 2004). A temporary increase in suspended silt/clay was expected during the first 8 to 9 months following placement. After the termination of placement activities, total suspended solids decreased gradually for about 18 months when concentrations reached background levels. Modeling conducted for the Cheniere project indicated that it would take 9 years before the silt and clay component of Cheniere BU material becomes totally suspended and is removed from the littoral zone. Since the Gulf Shore BU Feature proposes a placement episode every 6 years, all the fine-grained sediments would not have been removed before new material is added. This should result in the retention of some portion of the fine-grained sediment, and thus facilitate mudflat accretion through the processes described above. During and after each placement episode, most of the resuspended silt and clay is expected to enter the Sabine Pass Jetty Channel through the shallow boat cut, but deposition in the channel is not expected. It should remain in suspension and be transported back into the Gulf.

Although the BU sediments would be largely fine grained, approximately 18 percent of maintenance material is expected to be sand. Sands that are deposited onshore will nourish and stabilize eroding marshes; sand deposited in the nearshore zone should stay in the nearshore environment, moving back and forth across the shore face (Wamsley, 2008). Sand placed at Louisiana Point should remain on the shore face where it was deposited; no significant amounts of sand are expected to enter the Jetty Channel. On erosive mud shorelines like those in the BU area, the sand percentage should increase and form sandy lenses or a veneer over the mud shoreline substrate. As the sand lenses thicken, the sands help protect the underlying mud from further erosion (Nairn, 1992). However, in smaller quantities, sand can also accelerate erosion of a mud beach. If the consolidated mud is not covered by a sand veneer, any sand that is mobilized by wave action could act as a scouring agent (King, 2007).

The behavior of the BU sediments within this complex littoral system cannot be predicted with certainty over the period of analysis, especially given the potential for strong storms to affect the coastal environment. However, there is sufficient knowledge of general processes and baseline conditions to support evaluation of potential impacts and benefits. Furthermore, the engineering feasibility and potential environmental benefits have been demonstrated by successful recent BU projects at Texas and Louisiana Points (USACE, 2000; PBS&J, 2004). All of this information was used to establish explicit assumptions about the expected behavior of the BU material in the quantification of project impacts and benefits using the WVA model. The WVA model analysis assumed that 60 percent of the pumped quantity would remain in the existing marsh and on the shallow nearshore slope in front of the existing shorefront immediately after material placement. Since the material is unconsolidated and prone to erosion, only 50 percent of that material was assumed to remain by the end of each 6-year cycle. It was further assumed that the regular addition of material every 6 years would slow the resuspension of fine-grained sediments and result in the accumulation of some new marsh by the end of the period of analysis. No attempt was made to account for the effect of large storm systems. No long-term impacts to vegetation or benthic sediments were assumed to result from nourishment episodes. NWR personnel reported that the marsh vegetation at Texas Point rebounded quickly and with renewed vigor after being covered with up to 1 foot of material by the Texas Point BU project (Walther, 2005). Potential impacts to Critical Habitat for the wintering piping plover are expected to be beneficial in the long term, with short-term displacement during disposal activities. Benthic invertebrate fauna residing in the intertidal and tidal impact zones would be smothered, but studies have shown the impact to be similar to that resulting from natural events such as storms and hurricanes (Saloman and Naughton, 1977; Simon and Dauer, 1977). Following the burial, the resident species should recover quickly because of their short life cycle, high reproductive potential, and the rapid recruitment of larvae and motile macrofauna from nearby unaffected areas (Nelson and Pullen, 1988).

Benefits earned from the Gulf Shore BU Feature at Texas and Louisiana Points are shown in Table 18. With adoption of the DMMP, all FWP impacts in Texas would be avoided or offset and no compensating mitigation is proposed in conjunction with construction of the LPP. Included in the offset are negligible impacts (–22 AAHUs) to 804 acres of cypress-tupelo swamp, where small increases in salinity may affect the general health and productivity of the cypress-tupelo swamp system by slowing the trunk diameter

growth rate by an average of 0.03 inch per year. No impacts from the LPP were identified for the majority of cypress-tupelo swamps and all bottomland hardwoods in the study area.

Impacts in Louisiana are minimized to the greatest extent possible by the DMMP, but the unavoidable loss of 1,499 AAHUs remains. When looking at the project as a whole (Texas and Louisiana combined), the LPP would result in the loss of 843 AAHUs. However, because the ecological benefits of the DMMP BU features are primarily in Texas, additional compensatory mitigation beyond the total project loss of 843 AAHUs is proposed so that impacts in Louisiana will be compensated in Louisiana, with the exception of impacts that occur on Federal lands in Louisiana, specifically the Sabine NWR. Impacts on Federal lands in Louisiana would be offset by the excess Texas BU feature benefits as shown in Table 19. A mitigation plan, described in Section 8.6, has been developed to compensate for unavoidable impacts of the LPP.

## 8.4 FEASIBILITY SCREENING OF MITIGATION MEASURES

Unavoidable impacts of the LPP in Louisiana would remain after all benefits of the DMMP BU features have been applied. These impacts are related primarily to a decrease in the overall biological productivity of approximately 182,000 acres (284 square miles) of intertidal marsh in Louisiana. The important ecological functions of the wetlands in the affected area would decline as increases in salinity levels affect emergent marsh communities and the fish and wildlife that depend upon this habitat. Indirect adverse affects of increased salinity on marsh health and productivity could lead to the resultant loss of 691 acres of marsh, associated SAV, and shallow-water habitat, as stressed emergent marsh converts to open water.

### 8.4.1. Compensatory Mitigation Target for Louisiana

Since the Coastal Zone Management Act (CZMA) does not apply to Federal lands, then the need to provide one-to-one mitigation for all AAHU losses in Louisiana (over and above full compensation calculated for the project as a whole) can be reduced by the total number of AAHU losses to Federal lands in Louisiana. The only Federal lands in Louisiana that would be affected by this exclusion are located in the Sabine NWR. While the Texas Point and McFaddin NWRs in Texas would also be affected by salinity increases associated with the project, two DMMP BU features (the Neches River and the Gulf Shore BU features) provide benefits that offset all project impacts in Texas (including impacts to both NWRs) and provide excess benefits of 656 AAHUs. The DMMP BU features fulfill Texas's Coastal Zone Management Plan (CZMP) requirements to avoid and minimize impacts to the coastal zone, such that no compensatory mitigation for Texas state resources is needed.

Total SNWW project impacts to the Sabine NWR in Louisiana would be 340 AAHUs. When these are removed from the net project impacts in Louisiana (–1,499 AAHUs), the mitigation target proposed for compliance with Louisiana's CZMP is –1,159 AAHUs. Table 19 illustrates this calculation. Since all mitigation measures for the SNWW would be located in Louisiana, the new mitigation target would compensate for total project losses of 843 AAHUs.

### 8.4.2. Preliminary Screening of Mitigation Measures

The Habitat Restoration Workgroup met or convened by teleconference four times between December 2004 and January 2006 to develop, model, and recommend potential BU and mitigation measures for the SNWW LPP. The Habitat Workgroup and USACE developed concepts for hydrologic and marsh restoration, shoreline protection, and Gulf shoreline nourishment measures, and applied the WVA model to compute mitigation outputs. Conceptual designs and costs for these measures were completed by the USACE, Galveston District. ERDC conducted HS modeling and developed a desk-top off-channel wetlands salinity mitigation model (DOWSMM) to test the effectiveness of salinity control structures proposed within the Willow and Black Bayou watersheds in Louisiana, and the Texas Bayou watershed in Texas (Brown et al., 2006:Appendix B). These are the hydrologic restoration measures listed in Table 20.

Table 19: Compensatory Mitigation Target for Louisiana

| Units (AAHUs) | Texas | Louisiana | Project |
|---|---|---|---|
| **Net FWP Benefits/Impacts** | | | |
| Total Impacts (negative) | –412 | –1,709 | –2,121 |
| Total BU Benefits (positive) | 1,068 | 210 | 1,278 |
| Net FWP Benefits (positive) or Impacts (negative) | 656 | –1,499 | –843 |
| **Excess Texas Benefits Applied to Federal Lands** | | | |
| Excess Texas Benefits | 656 | | |
| Sabine NWR Impacts | –340 | | |
| Net Excess Texas Benefits | 316 | | |
| **Compensatory Mitigation Target** | | | |
| Net Impacts by State and Project | | –1,499 | –843 |
| Federal Impacts Compensated with Texas Excess Benefits | | 340 | |
| FWP Compensatory Mitigation Target | | –1,159 | –843 |

Developing sufficient acceptable and effective mitigation measures to compensate for predicted impacts proved to be quite a challenge. Measures developed specifically for salinity impacts in Louisiana marshes and in the Texas Point NWR proved unsuccessful. All measures designed to directly address salinity impacts in the Texas Point, Willow Bayou, and Black Bayou hydro-units were eliminated during preliminary or feasibility level screenings. Reductions in salinity proved too small to overcome reduced marine organism access in the WVA model.

Numerous measures explored by the Habitat Workgroup were eventually found not to be feasible or cost effective. Table 20 summarizes measures that were not included in the final CE/ICA. Although not discussed in detail in this report, WVA benefits were calculated for the majority of these measures.

Table 20: Eliminated Mitigation Measures

| | Measure Description | Reason for Elimination |
|---|---|---|
| | *Hydrologic Restoration Measures* | |
| TX 8-1 | Plug in old logging canal just west of Texas Bayou at Sabine Pass with new work material from Sabine Pass Channel | Ineffective at reducing salinities per DOWSMM (Brown et al., 2006)<br>Negligible marsh restoration benefits |
| TX 8-1-A | Restriction of Texas Bayou cross section with sheet pile wall at State Highway 82 bridge; armor channel sides and bridge supports and provide sloping bottom to transition between deeper Sabine Pass and existing –6-foot bottom of Texas Bayou | Ineffective at reducing salinities per HS model (Brown et al., 2006)<br>Increases velocities through mouth of Sabine Lake |
| TX 8-1-B | Combination of rock weir in Texas Bayou and plug in old logging canal; channel filling restores 13 acres of marsh | Ineffective at reducing salinities per DOWSMM (Brown et al., 2006)<br>Increases velocities through mouth of Sabine Lake<br>Negligible marsh restoration benefits<br>Not cost effective |
| TX 8-2 | Constructing dredged material berm inside west jetty south of the Pilot House, and fill behind the berm to construct 32 acres of marsh; assume that subsided portion of west jetty has been repaired and raised by O&M prior to construction of mitigation measure | Negligible marsh restoration benefits<br>Not cost effective<br>Dependent upon operation and maintenance (O&M) action |
| TX 12-1 | Earthen plug in mouth of old logging access canal on Sabine River; fill material mined from adjacent Sabine River channel | Negligible AAHU benefits |
| LA 2-7 | Large adjustable salinity control structures at Willow Bayou and Three Bayou with slide/flap gates and boat bays (20 feet wide and 4 feet deep). Assume managed by USFWS to maintain salinity of 10 ppt | Impacts from severe restriction of marine organism access did not offset salinity reduction |
| LA 2-8 | Large adjustable salinity control structures at Greens Bayou and Right Prong of Black Bayou with slide/flap gates and boat bays (20 feet wide and 4 feet deep); assume managed by USFWS to maintain salinity of 5 ppt | Impacts from severe restriction of marine organism access did not offset salinity reduction |
| LA 2-14 | Two rock weirs with boat bays (20 feet wide and 4 feet deep) at mouth of Willow Bayou at Sabine Lake and at mouth of Three Bayou at Sabine Lake | Reduction in aquatic organism access not offset by small salinity reduction |
| LA 2-15 | Rock weirs with boat bays (20 feet wide and 4 feet deep) at Greens Bayou at Sabine NWR boundary and on Right Prong of Black Bayou near refuge boundary | Reduction in aquatic organism access not offset by small salinity reduction |
| LA 3-1 | Large, adjustable salinity control structure at mouth of Black Bayou with slide/flap gates and boat bay (20 feet wide and 4 feet deep); assumed managed for specific salinity | Severe restriction of marine organism access; does not offset salinity reduction |

Table 20 (Cont'd)

| | Measure Description | Reason for Elimination |
|---|---|---|
| | *Hydrologic Restoration Measures* | |
| LA 3-2-A | (1) Rock weir with boat bay at east end of Raleigh's ditch; (2) rock weir with boat bay at small tributary opening on west Black Bayou; and (3) a plug in Raleigh's Ditch upstream of small tributary on west Black Bayou | Reduction in aquatic organism access not offset by small salinity reduction |
| LA 3-3 | Rock liner at mouth of small stream leading south from Black Bayou | Ineffective at reducing salinities per DOWSMM (Brown et al., 2006) |
| LA 3-4 | Rock weir with boat bay on small stream leading south from Black Bayou into Sterling Pond | Ineffective at reducing salinities per DOWSMM (Brown et al., 2006) |
| LA 3-5 | Rock weir at mouth of stream leading north from Black Bayou | Ineffective at reducing salinities per DOWSMM (Brown et al., 2006) |
| LA 3-6 | Water control structures (two 36-inch sluice gates) under cattlewalk between Perry Ridge and Isaacs Ridge on the north side of Black Bayou | Reduction in aquatic organism access not offset by small salinity reduction |
| LA 3-7 | Rock liners at 4 large streams leading north from Black Bayou | Ineffective at reducing salinities per DOWSMM (Brown et al., 2006) |
| LA 3-8 | Rock weir at oil field canal opening on west side of Black Bayou Cutoff Canal | Ineffective at reducing salinities per DOWSMM (Brown et al., 2006) |
| LA/TX 1-1 | Plugs in openings of pipeline ditches on Sabine River and Big Bayou in Sabine Island WMA | Ineffective at reducing salinities |
| LA/TX 2-1 | Plug of large logging canal leading into Blue Elbow Swamp just upstream of IH 10 | Canal is sole recreational access |
| LA/TX 3-1 | Underwater sill at mouth of Sabine Lake | Ineffective at reducing salinities; maximum average reduction of 0.5 ppt in southern half of Sabine Lake (Brown et al., 2006)<br>Creates unacceptably high velocities<br>Creates higher water elevations during floods upstream of sill |
| | *Marsh Restoration Measures* | |
| TX 6-1 East | Unconfined placement new work material; frequent movement of pipe to create mound field; restores 267 acres of brackish marsh by TY 1; new work material comes from Neches River Channel, sections 11 and 12 | Not cost effective |
| TX 8-3 | Filling logging canal at Texas Bayou with new work material | Negligible marsh restoration benefits<br>Not cost effective |
| TX 8-4 | Unconfined flow of maintenance material into open-water areas west of TX 8-2, via pipeline dredge | Use of pipeline dredge instead of hopper dredge determined to be infeasible because of safety and risk |
| LA 2-9 | Duck-wing earthen terraces in south part of Greens Lake with in situ material using amphibious excavator; 5.9 miles total terrace length | Ineffective measure due to small size of influence area and restored marsh |

Table 20 (Cont'd)

| | Measure Description | Reason for Elimination |
|---|---|---|
| | *Marsh Restoration Measures* | |
| LA 2-10 | Duck-wing earthen terraces in north part of Greens Lake with in situ material using amphibious excavator; 2.1 miles total terrace length | Ineffective measure due to small size of influence area and restored marsh |
| LA 2-11 | Marsh restoration in Willow Bayou Unit 7 with maintenance material from Sabine-Neches Canal Section B or from the SNWW channel | Ineffective measure due to high pumping cost and small size of influence area and restored marsh |
| LA 2-12 | Marsh restoration in Willow Bayou Unit 7 with new work material from SNWW channel construction | Ineffective measure due to high pumping cost and small size of influence area and restored marsh |
| LA 2-13 | Marsh restoration in Willow Bayou Unit 7 with material from dedicated dredging of Sabine Lake; dredging of access canal may be required since nearshore water depths are shallow; area designated as oyster seed harvesting ground | Ineffective measure due to high pumping cost and small size of influence area and restored marsh |
| LA 3-9R | Marsh restoration into area north of Black Bayou using maintenance material from another navigation project (Channel to Orange in Sabine River) | Benefits earned between TY 50 and TY 65 and longer pumping distance make it not cost effective in average annual benefits |
| LA 3-11 | Marsh restoration in area northwest of Rusty Vincent Lake using maintenance material from the Channel to Orange | Combined with LA 3-10 |
| LA 3-16 A and B | Marsh restoration in small area east of Black Bayou Cutoff Canal and south of GIWW using dedicated dredging of adjacent GIWW | Ineffective measure due to small size of influence area and restored marsh |
| LA 3-17 | Marsh restoration in very large area east of LA 3-16 and south of GIWW using dedicated dredging of adjacent GIWW | Area approved for marsh terracing project under CWPPRA CS-27 |
| | *Shoreline Protection Measures* | |
| TX 7-1/ 7-2 | Rock shoreline protection (Section 1) protects 2.4 miles of GIWW north shore between existing PAs, reducing salinity intrusion in 2,534 acres. Section 2 protects 1.5 miles shoreline on west edge of TX 7 with rock breakwater | Measure is not cost effective for amount of AAHUs earned |
| LA 2-1R | Rock foreshore dike located parallel to and 150 feet offshore of east Sabine Lake shoreline; 3-mile segment from Willow Bayou to Three Bayou; 35 acres created behind dike | Measure is not cost effective for amount of AAHUs earned; potential fisheries impacts from armored shoreline |
| LA 2-2R | Rock foreshore dike located parallel to and 150 feet offshore of east Sabine Lake shoreline; 1.4-mile segment from Three Bayou to Pine Ridge Canal; 16 acres created behind dike | Measure is not cost effective for amount of AAHUs earned; potential fisheries impacts from armored shoreline |
| LA 3-12R | Rock foreshore dike located parallel to and 150 feet offshore of east Sabine Lake shoreline; 4.2-mile segment from Pine Ridge Canal to Black Bayou; 48 acres created behind dike | Measure is not cost effective for amount of AAHUs earned; potential fisheries impacts from armored shoreline |

Table 20 (Cont'd)

| | Measure Description | Reason for Elimination |
|---|---|---|
| | *Shoreline Protection Measures* | |
| LA 2-3 | Earthen foreshore dike, east shore of Sabine Lake, 3 miles north from Willow Bayou | Less durable for 50-year project life than rock structures; cost is equivalent to or slightly higher than rock structures |
| LA 2-4 | Earthen foreshore dike, east shore of Sabine Lake, 1.4 miles north from LA 2-3 | Less durable for 50-year project life than rock structures; cost is equivalent to or slightly higher than rock structures |
| LA 2-5 | Dedicated dredging to fill behind LA 2-1 or LA 2-3 and create marsh | Dedicated dredging not needed to fill 100 feet behind breakwater; access canal dredging provided sufficient material |
| LA 2-6 | Dedicated dredging to fill behind LA 2-2 or LA 2-4 | Dedicated dredging not needed to fill 100 feet behind breakwater; access canal dredging provided sufficient material |
| LA 2-20 | Rock foreshore breakwater 3 miles north from Willow Bayou, 1,000-foot segments, 50-foot breaks between segments, located parallel to and 250 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh | Not cost effective |
| LA 2-21 | Rock foreshore breakwater 3 miles north from Willow Bayou, 1,000-foot segments, 50-foot breaks, located parallel to and 500 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh | Not cost effective |
| LA 2-22 | Rock foreshore breakwater, 1.4 miles north from LA 2-20 in 1,000-foot segments, with 50-foot breaks, located parallel to and 250 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh | Not cost effective |
| LA 2-23 | Rock foreshore breakwater 1.4 miles north from LA 2-21 in 1,000-foot segments, with 50-foot breaks, located parallel to and 500 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh | Not cost effective |
| LA 2-24 | Rock foreshore breakwater 3 miles north from Willow Bayou, 1,000-foot segments, 50-foot breaks between segments, located parallel to and 250 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh | Not cost effective |
| LA 2-25 | Rock foreshore breakwater 3 miles north from Willow Bayou, 1,000-foot segments, 50-foot breaks between segments, located parallel to and 500 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh | Not cost effective |

Table 20 (Cont'd)

| | Measure Description | Reason for Elimination |
|---|---|---|
| | *Shoreline Protection Measures* | |
| LA 2-26 | Rock foreshore breakwater 1.4 miles north from LA 2-24 in 1,000-foot segments, with 50-foot breaks, located parallel to and 250 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh | Not cost effective |
| LA 2-27 | Rock foreshore breakwater 1.4 miles north from LA 2-25 in 1,000-foot segments, with 50-foot breaks, located parallel to and 500 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh | Not cost effective |
| LA3-13 | Earthen foreshore dike, east shore of Sabine Lake, continuation of LA 2-3 | Less durable for 50-year project life than rock structures; cost is equivalent to or slightly higher than rock structures |
| LA 3-14 | Dedicated dredging to fill behind LA 3-12 or LA 3-13; assume marsh creation to shore behind all levees | Dedicated dredging not needed to fill 100 feet behind breakwater; access canal dredging provided sufficient material |
| LA 3-19 | Rock foreshore breakwater, 4.2 miles north from LA 2-20, in 1,000-foot segments, with 50-foot breaks between segments located parallel to and 250 feet offshore; dedicated dredging of Sabine Lake used to fill behind breakwater and create marsh | Not cost effective |
| LA 3-20 | Rock foreshore breakwater 4.2 miles north from LA 2-21, in 1,000-foot segments, with 50-foot breaks between segments located parallel to and 500 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh | Not cost effective |
| LA 3-21 | Rock foreshore breakwater 4.2 miles north from LA 2-25, in 1,000-foot segments, with 50-foot breaks between segments located parallel to and 500 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh | Not cost effective and not supported by LDWF |
| | *Gulf Shoreline Nourishment* | |
| TX 8-5 | Confined cell on Gulf shoreline – new work and maintenance material – 0.5 to 3.5 miles from west jetty, no booster; levees built with new work material, 1,750 feet offshore, with maintenance material fill between the levee and the shore with 0 foot mean lower low water (MLLW) elevation | Measure is not cost effective for amount of AAHUs earned |
| TX 8-6 | Shoreline nourishment – unconfined new work from Section 5; hydraulic pipeline placement of new work material, 0.5 to 3.5 miles from west jetty; assume 50:50 split of material between Texas and Louisiana | Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11 |

Table 20 (Cont'd)

| | Measure Description | Reason for Elimination |
|---|---|---|
| | *Gulf Shoreline Nourishment* | |
| TX 8-7 | Shoreline nourishment – 0.5 to 3.5 miles from west jetty – unconfined maintenance material from sections 5 and 6; hydraulic pipeline placement of maintenance material every 6 years for project life (8 placement episodes); assume 50:50 split of material between Texas and Louisiana | Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11 |
| TX 8-8 | Shoreline nourishment – unconfined placement of new work material from Section 5 from 0.5 mile to 1 mile from west jetty; nourish 27 acres of shoreline in accretion zone | Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11 |
| TX 8-9 | Shoreline nourishment – 0.5 to 2.5 miles from west jetty – one-time hydraulic pipeline placement of all maintenance material from one dredging cycle from Section 5 | Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11 |
| TX 8-10 | Shoreline nourishment – 0.5 to 3.5 miles from west jetty – new work material from sections 5 and 6; placement using pipeline dredge; assume 50:50 split of material between Texas and Louisiana | Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11 |
| LA 5-2 and 6-2 | Shoreline nourishment – 0.5 to 3.5 miles from east jetty – maintenance material from sections 5 and 6; unconfined hydraulic pipeline placement every 6 years for project life (8 placement episodes); assume 50:50 split of material between Texas and Louisiana | Superseded by least-cost alternative – optimized Gulf nourishment measure LA 5-6 |
| LA 5-4 | Shoreline nourishment – 0.5 to 2.5 miles from east jetty – one time placement of all maintenance material from one dredging cycle from Section 5; unconfined hydraulic pipeline placement | Superseded by least-cost alternative – optimized Gulf nourishment measure LA 5-1/6-1 that uses material only from Section 5 |

## 8.5 FINAL COST EFFECTIVENESS/INCREMENTAL COST ANALYSIS SCREENING OF MITIGATION MEASURES

Table 21 lists mitigation measures included in the final CE/ICA screening of the SNWW LPP; the measures ultimately selected are shown in bold. These mitigation measures are required to compensate for impacts that would remain after measures designed to avoid or minimize impacts have been applied. A concerted effort was made to use new work and maintenance material beneficially in both minimizing and mitigating environmental impacts. Mitigation measures in the Louisiana marshes would be located in the Willow Bayou and Black Bayou hydro-units because they had the highest projected FWP losses in terms of acreage and AAHUs. East and West Johnson's Bayou hydro-units had the next highest projected losses in both acreage and AAHUs, but measures were not located in these areas because no large, open-water areas existed or were expected to develop. Maps of all mitigation measures considered in the final screening are provided on figures 15 and 16.

In 2009, changes in the proposed project and HS modeling necessitated that the WVA modeling of mitigation measures retained for final screening be revised. Due to schedule constraints, USACE performed the modeling without ICT involvement, basing it as closely as possible on methods and assumptions used by the ICT in the original modeling. The results of this remodeling were coordinated with the ICT. A quality check was also performed for the revised worksheets.

### 8.5.1 Description of Evaluated Mitigation Measures

LPP impacts in Louisiana are primarily indirect impacts related to a salinity increase associated with a deeper SNWW navigation channel. As demonstrated above, extensive efforts were made to identify feasible measures that could minimize or eliminate salinity increases in the estuary as a whole, or in localized areas within the affected marsh. Since no feasible measures were identified that could minimize salinity effects, the Habitat Workgroup evaluated an array of compensation measures that utilized marsh restoration, shoreline protection, and Gulf shoreline nourishment measures. Marsh restoration measures included in situ terracing and marsh restoration using several different sources of dredged material (SNWW new work material, dedicated dredging, Channel to Orange maintenance material, and accumulated material in the Lake Charles Deepwater Channel (GIWW-East). All of the measures described below were evaluated using the CE/ICA in the USACE certified version of IWR-PLAN to identify those measures that provide the most environmental benefits for the least incremental cost. The reader is referred to FEIS Section 5.4.3 for a detailed description of the CE/ICA process.

#### 8.5.1.1 Marsh Restoration

Five areas within the Willow Bayou hydro-unit were identified as high priority areas for marsh restoration by USFWS. Different marsh restoration solutions are proposed within the same footprint of these units. Figure 15 shows all measures that were evaluated within each specific area, with the labels for the measures ultimately included in the recommended mitigation plan shown in bold.

Table 21: Mitigation Measures, Final Screening

| ***Marsh Restoration – In Situ Terracing*** | | | |
|---|---|---|---|
| Description of Alternative | | | |
| Duck-wing-shaped earthen terraces built with in situ material using amphibious excavator. Each terrace is 1,000 feet long; 100-foot gap between terraces; approximately 500 feet between each row of terraces. Terraces should have 15-foot-wide tops at +2.0' NAVD88 and 4:1 side slopes. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Willow Bayou | LA 2-16(A) | Influence area – 1,831 acres in north part of Greens Lake; located within the same footprint as LA 2-16(B) and LA 2-16(C). | 38 acres |
| | LA 2-17(A) | Influence area – 2,297 acres in southern part of Greens Lake; located within the same footprint as LA 2-17(B) and LA 2-17(C). | 45 acres |
| | LA 2-18(A) | Influence area – 680 acres in area north of Willow Bayou canal; located within the same footprint as LA 2-18(B) and LA 2-18(C). | 11 acres |
| | LA 2-19(A) | Influence area – 1,809 acres; in area west of Deep Bayou; located within the same footprint as LA 2-19(B) and LA 2-19(C). | 28 acres |
| ***Marsh Restoration – Sabine Lake Dedicated Dredging*** | | | |
| Description of Alternative | | | |
| Hydraulically dredged material from Sabine Lake (dedicated dredging) to restore marsh and shallow-water habitat in open-water areas of marsh. Borrow trench located 500 feet from shore, excavated approximately 7.5 feet deep; width and length vary for each scale. Assume unconfined flow of maintenance material, frequent movement of pipe, and few training or containment structures. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Willow Bayou | LA 2-16(B) | Influence area – 1,831 acres in north part of Greens Lake; borrow trench approximately 1,000 feet wide and 2 miles long | 822 acres |
| | LA 2-17(B) | Influence area – 2,297 acres in southern part of Greens Lake area; borrow trench approximately 1,250 feet wide and 2 miles long | 1,035 acres |
| | **LA 2-18(B)** | **Influence area – 680 acres in area north of Willow Bayou Canal; borrow trench approximately 700 feet wide and 0.8 mile long** | **251 acres** |
| | LA 2-19(B) | Influence area – 1,809 acres in area west of Deep Bayou; borrow trench approximately 1,200 feet wide and 1.8 miles long | 719 acres |
| | **LA 2-ADD B** | **Influence area – 1,285 acres in area north of Willow Bayou Canal; borrow trench approximately 1,000 feet wide and 1.25 miles long** | **436 acres** |

Table 21 (Cont'd)

| ***Marsh Restoration -SNWW New Work Material*** | | | |
|---|---|---|---|
| Description of Alternative | | | |
| Use new work material from SNWW Section 10 to restore emergent marsh and shallow-water habitat in open water in north part of Greens Lake area. Assume unconfined flow of new work material; frequent movement of pipe; few training or containment structures. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Willow Bayou | LA 2-16(C) | Influence area – 1,831 acres in north part of Greens Lake area; located within the same footprint as LA 2-16(A) and LA 2-16(B) | 822 acres |
| | LA 2-17(C) | Influence area – 2,297 acres in southern part of Greens Lake area; located within the same footprint as LA 2-17(A) and LA 2-17(B) | 1,035 acres |
| | LA 2-18(C) | Influence area – 680 acres in area north of Willow Bayou Canal; located within the same footprint as LA 2-18(A) and LA 2-18(B) | 251 acres |
| | LA 2-19(C) | Influence area – 1,809 acres in area west of Deep Bayou; located within the same footprint as LA 2-19(A) and LA 2-19(B) | 719 acres |
| | LA 2-ADD C | Influence area – 1,285 acres in area north of Willow Bayou Canal; located within the same footprint as LA 2-ADD B | 436 acres |
| ***Marsh Restoration –Channel to Orange Maintenance Material*** | | | |
| Description of Alternative | | | |
| Hydraulically pump maintenance material from the Channel to Orange (Sabine River) between East Pass and the GIWW into areas north of Black Bayou to restore emergent marsh in degraded marsh and open-water areas. Assume unconfined flow of maintenance material, frequent movement of pipe, and few training or containment structures. Material would come from maintenance dredging of the Sabine River Channel. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Black Bayou | **LA 3-10R** | **Influence area – 2,465 acres; restoring 132 acres every 5 years, TY 5 thru TY 30 (total of 6 cycles, ending TY 30)** | **792 acres** |

Table 21 (Cont'd)

| ***Marsh Restoration – GIWW Dedicated Dredging*** | | | |
|---|---|---|---|
| Description of Alternative | | | |
| Dedicated dredging of adjacent GIWW to restore emergent marsh and shallow0water habitat; percent of open water restored to emergent marsh is different in A and B scales. Assume unconfined flow of hydraulically pumped material that has accumulated in GIWW (formerly the 30-foot Deepwater Channel to Lake Charles), frequent movement of pipe, and few training or containment structures. | | | |
| Hydro-Unit | No. | Size of Influence Area | Emergent Marsh Created |
| Black Bayou | LA 3-15(A) | Influence area – 1,788 acres in area west of Black Bayou Cutoff Canal; assume 60 percent of open water restored to emergent marsh | 546 acres |
| | LA 3-18(A) | Influence area – 1,877 acres in large area of open water south of LA 3-15; assume 60 percent of open water restored to emergent marsh | 497 acres |
| | **LA 3-15(B)** | **Influence area – 1,788 acres area west of Black Bayou Cutoff Canal; assume 75 percent of open water restored to emergent marsh** | **683 acres** |
| | **LA 3-18(B)** | **Influence area – 1,877 acres in large area of open water south of LA 3-15; assume 75 percent of open water restored to emergent marsh** | **621 acres** |
| ***Gulf Shoreline Nourishment*** | | | |
| Description of Alternative | | | |
| Nourish Gulf shoreline at Louisiana Point; length of nourished shore and number of placement cycles vary. Material pumped along shoreline using hydraulic pipeline dredge. Assume 50:50 split of material between Texas and Louisiana. Assume 60 percent retention of material after initial placement; 50 percent of newly added acres remain at end of 8 years. | | | |
| Hydro-Unit | No. | Size of Influence Area | Length of Shoreline |
| Sabine Lake Ridges | LA 5-3 | Nourish 0.5 to 1.0 mile from east jetty; assume one-time unconfined placement of new work material from SNWW Section 5; all added acres eroded away by TY 51 | 0.5 mile |
| | LAs 5-1 and 6-1 | Nourish 0.5 to 3.5 miles from east jetty; assume one-time unconfined placement of new work material from SNWW Section 5; all added acres eroded away by TY 51 | 3.0 miles |
| | LA 5-5 | Nourish 0.5 to 3.5 miles from east jetty; assume one-time unconfined placement of new work material from SNWW sections 5 and 6; all added acres eroded away by TY 51 | 3.0 miles |

**Figure 15**

**LA 2 Mitigation Potential and Selected Mitigation Measures**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 044198800 | Scale: 1:65,000 |
| Prepared by: A.Christiansen | Date: 9/01/2008 |

File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/044198000/figures/WVA/Figure_18.mxd

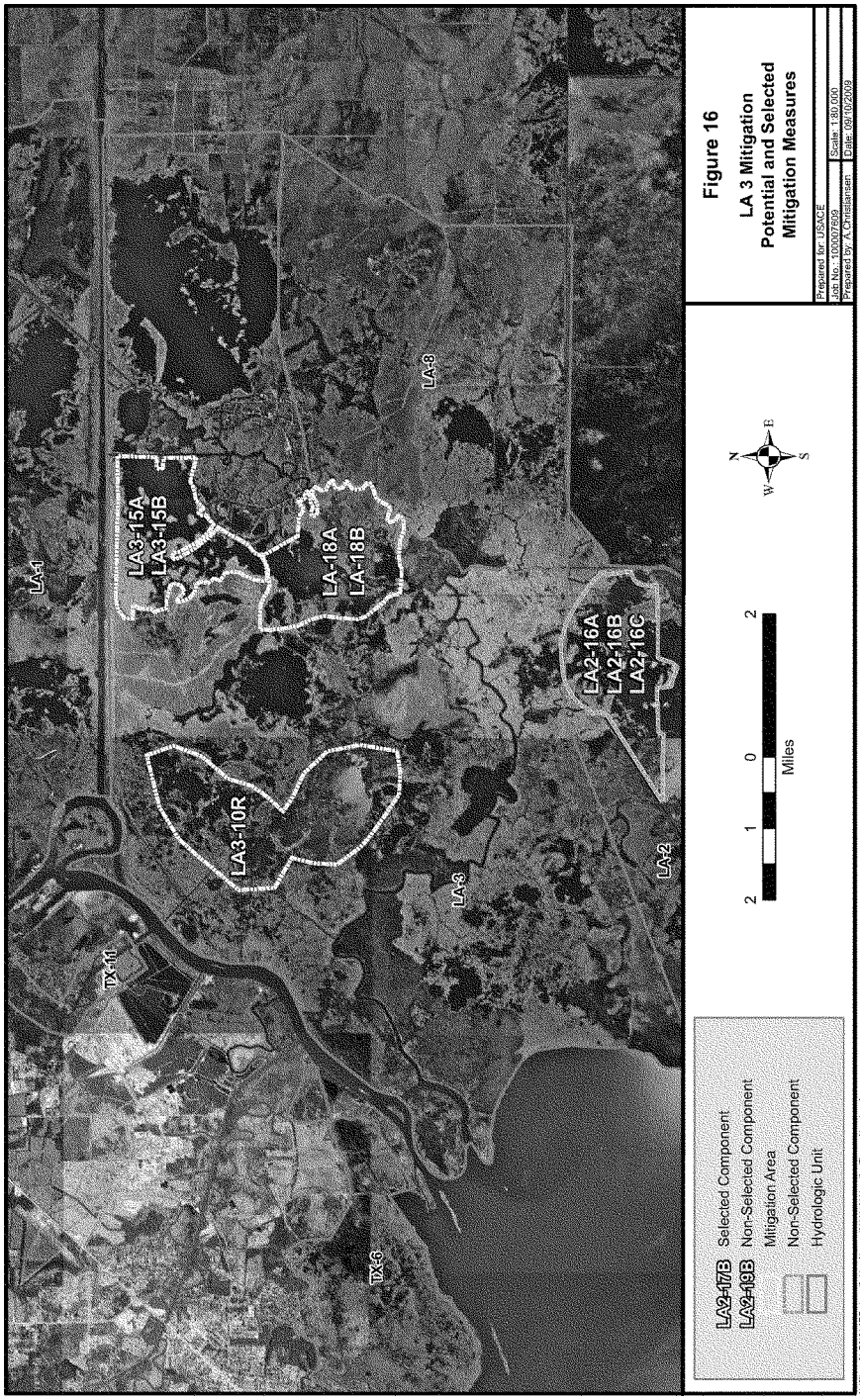



**Figure 16**
**LA 3 Mitigation Potential and Selected Mitigation Measures**

Prepared for: USACE
Job No.: 410007939
Prepared by: A.Christiansen
Scale: 1:80,000
Date: 08/10/2009

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*8.5.1.1.1 Willow Bayou In Situ Terracing*

Marsh terracing in the Willow Bayou hydro-unit has been identified as a mitigation measure. Four areas in Sabine NWR units 5 and 7 are combined as one incrementally scaled measure in the CE/ICA. For example, terracing would first be conducted in LA 2-16A, followed step-by-step by LA 2-17A, LA 2-19A, and LA 2-18A, forming four scales of potential terracing (Table 22). Targeted areas encompass areas of disintegrating, or breaking, marsh that would benefit from a marsh restoration effort. Areas affected by terracing projects south of Greens Lake and south of the Willow Bayou Canal (CWPPRA Project No. CS-32, East Sabine Lake Hydrologic Restoration Project) are not included in the footprint of this measure.

Table 22: Summary of Benefits, Willow Bayou Marsh Terracing Measure

| Mitigation Measure | AAHU | Influence Area (acres) | Existing Marsh (acres) | Open Water (acres) | Restored Emergent Marsh (acres) |
|---|---|---|---|---|---|
| LA 2-16A | 17 | 1,831 | 803 | 1,028 | 38 |
| LA 2-17A | 20 | 2,297 | 1,003 | 1,294 | 45 |
| LA 2-19A | 12 | 1,809 | 910 | 899 | 28 |
| LA 2-18A | 4 | 681 | 367 | 314 | 11 |

Construction of the earthen terraces would follow specifications established by USFWS for nearby terraces, with a height modification to accommodate predicted RSLR. Earthen terraces would be built using an amphibious excavator in "duck-wing" shapes with in situ material from open-water areas of the marsh. Each terrace would be 1,000 feet long, with 100-foot gaps between terraces and approximately 500 feet between each row of terraces. Marsh grass would be planted on the crowns and side slopes. Acreage of restored emergent marsh was determined by estimating the total terrace length in each unit and assuming a 22-foot-wide vegetated crown. The acreage restored by this measure is low compared to other restoration methods.

Marsh restoration benefits are associated with the additional marsh acreage and the terracing's effect on hydrology and wind fetch. Terracing would be expected to reduce wind fetch and promote more still-water conditions favorable for SAV growth. In addition, land loss rates would be expected to be lower due to the reduction in fetch. Impacts associated with construction are limited to the excavation of shallow open-water areas within the marsh. It is anticipated that these borrow areas would eventually fill with degraded organic material from the vegetated terraces. Salinities are expected to remain the same as FWP projections.

*8.5.1.1.2 Willow Bayou Marsh Restoration – Dedicated Dredging or SNWW New Work Material*

Marsh restoration using material from dedicated dredging of Sabine Lake (B) or SNWW new work material (C) was also proposed within the Willow Bayou hydro-unit. In addition to LA 2-16 through LA

2-19, a fifth area (LA 2-ADD) in Sabine NWR Unit 5 was added for the dedicated dredging solution. All are combined in various incremental combinations in the CE/ICA according to the most cost effective pumping distances and dredges proposed for use. For both solutions, marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevation for intermediate marsh. If needed, tidal creek channels could be constructed in the marsh creation area after the dredged material has settled to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

The dedicated dredging alternative (B) would take material from a borrow area in Sabine Lake located at least 1,000 feet from the Sabine NWR shore. The borrow area would average 1,100 feet wide and range from 1.8 to 7.8 miles long, depending upon how many of the unit increments are adopted. The borrow area would be 7.5 feet deep, as measured from the lake bottom; it would be continuous and parallel with the common longshore circulation pattern present in Sabine Lake. This circulation is expected to prevent the development of hypoxic conditions that would be detrimental to aquatic organisms. The borrow area would eventually fill with Sabine River sediments. An access channel would also be needed for the pipeline dredge to reach the proposed borrow area. The borrow area is located within an area designated as an oyster seed harvesting ground by the State of Louisiana. However, commercial oyster species are not present in the area. Oyster reefs are restricted to higher-salinity areas in the southern part of Sabine Lake near Blue Buck Point. LDWF has stated that it would require that an oyster ground survey be conducted prior to its approval for use in conjunction with this mitigation measure.

The SNWW new work material alternative (C) would pump dredged material from the deepening of the navigation channel across Sabine Lake into the Willow Bayou marshes. The pumping distance is approximately 11 miles and would require the use of a several booster dredges. An access canal would be required for boosters to access the lakeshore.

Marsh restoration benefits (Table 23) are associated with the additional marsh acreage, and the restored marshes' affect on hydrology and wind fetch. Restoration of marsh in open-water areas would reduce wind fetch and promote the still-water conditions favorable for SAV growth. In addition, land loss rates would be expected to be lower due to a stable, higher marsh elevation. Salinities would be expected to remain the same as FWP projections.

Table 23: Summary of Benefits, Willow Bayou Marsh Restoration Measures B and C

| Mitigation Measure | AAHU | Influence Area (acres) | Existing Marsh (acres) | Open Water (acres) | Restored Emergent Marsh (acres) |
|---|---|---|---|---|---|
| LA 2-16B & C | 445 | 1,831 | 803 | 1,028 | 822 |
| LA 2-17B & C | 492 | 2,297 | 1,003 | 1,294 | 1,035 |
| LA 2-19B & C | 419 | 1,809 | 910 | 899 | 719 |
| LA 2-18B & C | 152 | 681 | 367 | 314 | 251 |
| LA 2-ADD B | 214 | 1,285 | 745 | 540 | 436 |

*8.5.1.1.3 Black Bayou Marsh Restoration – Channel to Orange Maintenance Material*

Marsh restoration using material from maintenance dredging of the Channel to Orange has been proposed in the vicinity of Rusty Vincent Lake (see Figure 16). The mitigation measure (LA 3-10R) would be located in open-water areas west of Rusty Vincent Lake. Intermediate marsh restoration in LA 3-10R would be accomplished in six cycles between TY 20 and TY 45, adding 132 acres each 5-year cycle for a total of 792 acres.

The marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevation for intermediate marsh. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

Marsh restoration benefits (Table 24) would be associated with the restoration of marsh acreage, and the restored marshes' affect on hydrology and wind fetch. Approximately 70 percent of the open water would be restored to intermediate marsh, and existing fringe marsh would be nourish by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved from 100 percent Class 3 and 4 to 100 percent Class 1 and 2 in both areas. Restoration of marsh in open-water areas would reduce wind fetch and promote the still water conditions favorable for SAV growth. In addition, land loss rates are expected to be lower due to a more stable, higher marsh elevation. Salinities are expected to remain the same as FWP projections.

Table 24: Summary of Benefits, Black Bayou Marsh Restoration Measures, Channel to Orange Maintenance Material

| Mitigation Measure | AAHU | Influence Area (acres) | Existing Marsh (acres) | Open Water (acres) | Restored Emergent Marsh (acres) |
|---|---|---|---|---|---|
| LA 3-10R | 198 | 2,465 | 1,317 | 1,148 | 792 |

*8.5.1.1.4 Black Bayou Marsh Restoration – Dedicated dredging of Lake Charles Deep Water Channel/GIWW*

Marsh restoration using dedicated dredging of accumulated material in the Lake Charles Deep Water Channel/GIWW has been proposed for three areas in the vicinity of the Black Bayou Cut Off Canal (see Figure 16). The Lake Charles Deep Water Channel coincides along its entire 24.9-mile length with the GIWW between the Sabine River and Lake Charles. Constructed by local interests, the 30-foot channel was authorized as a Federal channel by the River and Harbor Act of 1935 (USACE, 1998). It was approved to provide a deep-water navigation channel to the Port of Lake Charles through the Sabine River, Sabine-Neches Canal, Port Arthur Canal, and Sabine Pass to the Gulf of Mexico. It was last maintained to 30 feet in 1940 because direct access to the Gulf was provided by the Calcasieu River and Pass Project. Communications with the USACE, New Orleans District indicate that a considerable amount of material has accumulated in the 30-foot channel, and it is this material that could be used to restore marshes in the Black Bayou area.

Material would be pumped from a 13-mile stretch of the GIWW in two increments. The first increment (LA 3-15) is located adjacent to the GIWW and has the shortest pumping distance; pumping would move to LA 3-18 after LA 3-15 is complete. In addition, two different percentages are evaluated for marsh restoration. LA 3-15A and LA 13-18A would fill 60 percent of open-water areas, and LA 3-15B and LA 13-18B would fill 75 percent of open-water areas. Marsh would be constructed through unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevation for intermediate marsh. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

Marsh restoration benefits (Table 25) are associated with the restoration of marsh acreage, and the restored marshes' affect on hydrology and wind fetch. Between 60 and 75 percent of the open water would be restored to intermediate marsh, and existing fringe marsh would be nourish by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved from 100 percent Class 3 and Class 4 to at least 90 percent Class 1 in both areas. Restoration of marsh in open-water areas would reduce wind fetch and promote the still-water conditions favorable for SAV growth. Land loss rates are expected to remain the same because the area is projected to have a low land loss rate with construction of CWPPRA Project No. CS-27. Salinities are expected to remain the same as FWP projections. Dedicated dredging would not establish a hydrologic connection to the deeper navigation channels in the Sabine and Calcasieu rivers, and thus would not provide a channel for their salinity wedges to enter the GIWW.

Table 25: Summary of Benefits, Black Bayou Marsh Restoration Measures, GIWW Dedicated Dredging

| Mitigation Measure | AAHU (A) | AAHU (B) | Influence Area (acres) | Existing Marsh (acres) | Open Water (acres) | Restored Emergent Marsh (A) | Restored Emergent Marsh (B) |
|---|---|---|---|---|---|---|---|
| LA 3-15 | 231 | 307 | 1,788 | 878 | 910 | 546 | 683 |
| LA 3-18 | 239 | 310 | 1,876 | 1,048 | 828 | 497 | 621 |

*8.5.1.1.5 Gulf Shore Nourishment*

Gulf shoreline nourishment using the unconfined placement of new work material with a hydraulic pipeline dredge was proposed as a mitigation measure for the LPP. If one of these measures were selected by the CE/ICA, it would be constructed prior to the Louisiana Point (LA 5/6) DMMP measure, which uses maintenance material. Three different scales of shoreline nourishment using new work material were proposed (Table 26). The first scale (LA 5-3) would nourish 0.5 mile of shoreline and was intended initially to provide minimum compensation for the FWP loss of 7.6 acres due to erosion. The second scale (LA 5-1/6-1) was designed to use half of all material from Section 5, the nearest dredging reach. Only half of the material could be used since it would be shared equally between the states of Texas and Louisiana. The third scale (LA 5-5) was designed to use half of all material from sections 5 and 6, the farthest pumping distance considered feasible. The location of these measures is shown on Figure 16.

Table 26: Summary of Benefits, Gulf Shore Nourishment Measures, Louisiana Point

| Mitigation Measure | New Work Quantity (mcy*) | Dredging Reach | AAHU | Nourished Shoreline (miles) |
|---|---|---|---|---|
| LA 5-3 | 0.78 | Section 5 | 5 | 0.5 |
| LA 5-1/6-1 | 2.5 | Section 5 | 54 | 3.0 |
| LA 5-5 | 4.3 | Sections 5 and 6 | 90 | 3.0 |

mcy = million cubic yards

Core borings in Sabine Pass Channel (USACE, 1982) indicate new work material would originate from the relict Sabine River channel. There is little stiff clay; core borings show mostly soft, high-plasticity clay and some sand lensing. It would likely not stack but would spread in a mass, acting much like SNWW maintenance material from these reaches. The material would be hydraulically pumped into the nearshore zone, and some material would be expected to flow over existing marsh while the remainder flows into the nearshore waters. Marsh plantings would occur as soon as possible on the inland half of the emergent berm, to assist in stabilization. Recent experience with a similar Section 204 CAP project constructed at Texas Point indicates that the dredged material would dissipate quickly during a placement event, with 60 percent remaining and forming a shelf on the shallow nearshore slope in front of the

existing marsh edge. Since the material is unconsolidated and prone to erosion, it is estimated that 50 percent of the material that remains after each placement episode would erode away by TY 25. It is assumed that all of the new work material would erode by TY 65.

The Habitat Workgroup concluded that unconfined placement on the shoreline would have a net beneficial effect on this environment. It could widen the marsh, create a shallow shelf in the nearshore zone, and/or create sand bars just offshore, providing more storm protection for interior marsh. It would inject additional sediment into the littoral drift and potentially benefit shorelines to the east during those limited periods when the net drift is eastward. The placement event would impact shallow nearshore waters and marsh, but benthic organisms in the nearshore zone would quickly rebound from the short-term impacts, as would marsh areas that would be nourished with additional sediment. The potential for the nourishment activity to affect threatened and endangered species was evaluated. USFWS has designated the entire shoreline between Constance Beach and Sabine Pass (Unit LA 1, in part) as Critical Habitat for the wintering piping plover; however, the shoreline in the proposed nourishment area is eroding marsh shoreline with no, or only a narrow, beach. Therefore, minimal intertidal beaches, dunes, or sand flats used by the plover as its wintering range would be affected by this measure. Should beach nourishment occur when piping plovers are utilizing the proposed nourishment area, they would be temporarily displaced to nearby habitat to the east, but would not be permanently excluded from using the area as nourishment would only occur every 6 years. The piping plover and its Critical Habitat would experience beneficial habitat enhancement (i.e., shoreline nourishment) from the proposed mitigation measure. While it is unlikely that the creation of more beach on Louisiana Point would allow sea turtle nesting, it would have no adverse impacts on potential nesting habitat.

## 8.6 RECOMMENDED MITIGATION PLAN

Best Buy Plan 6 appears to be an efficient mitigation plan since it reaches the mitigation target of 1,159 AAHUs by providing a total of 1,181 AAHUs. Best Buy Plan 6 consists of emergent marsh restoration in two Willow Bayou areas (totaling 607 acres) and three areas in the Black Bayou area (totaling 2,096 acres). All measures included in the recommended mitigation plan are identified in Table 27. Maps of the recommended measures are provided on figures 15 and 16. The mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The plan will restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. In total, these measures produce 1,181 AAHUs, providing full compensation for all Louisiana impacts of the CIP. Given the Texas BU benefits net gain of 316 AAHUs, the mitigation plan would result in a net gain of 338 AAHUs for the project as a whole. The FFR and FEIS provide details of the CE/ICA process and a summary of all agency coordination regarding this plan.

Table 27: Recommended Mitigation Measures, SNWW LPP

| Recommended Mitigation Plan | AAHUs |
|---|---|
| **Willow Bayou** | |
| LA 2-18B Marsh Restoration (Sabine Lake dredging ) | 152 |
| LA 2A-DD B Marsh Restoration (Sabine Lake dredging) | 214 |
| **Black Bayou West** | |
| LA 3-10R Marsh Restoration (Sabine River Channel maintenance material) | 198 |
| **Black Bayou East** | |
| LA 3-15B Marsh Restoration (GIWW dredging) | 307 |
| LA 3-18B Marsh Restoration (GIWW dredging) | 310 |
| Total Compensation | 1,181 |
| FWP Mitigation Target | –1,159 |
| **Net Benefits After Compensation** | **22** |

### 8.6.1 Willow Bayou Mitigation Measures

Recommended Willow Bayou mitigation measures (LA 2-18B and LA 2-ADD B) would be located within the boundaries of the Sabine NWR. Material dredged from a borrow area in Sabine Lake would be used to restore 687 acres of emergent marsh within open-water areas, improve 167 acres of shallow-water habitat, and nourish 1,112 acres of existing marsh within the total influence area of 1,966 acres (Table 28). Small ponds and sinuous, interconnected channels would be created to maintain tidal connectivity, increase marsh edge, and create protected areas for SAV. Approximately 1,966 acres of existing marsh in the influence area would also be renourished by winnowing fine-grained suspended solids during placement events. Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. In order to maximize edge in the marsh, topographic relief would be created by varying the final elevation of material placement, and planting with appropriate native flora at each elevation. The varied topography would allow for differences in duration of tidal inundation, create different floral communities, and maximize biodiversity. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled. These would be needed to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

Table 28: Recommended Mitigation Measures, Acreage Analysis

| Mitigation Measure | AAHUs | Total Influence Area (acres) | Nourished Existing Marsh (acres) | Restored Open Water (acres) | Restored Emergent Marsh (acres) |
|---|---|---|---|---|---|
| | | **Willow Bayou** | | | |
| LA 2-18B | 152 | 681 | 367 | 63 | 251 |
| LA 2-ADD B | 214 | 1,285 | 745 | 104 | 436 |
| Subtotal | 366 | 1,966 | 1,112 | 167 | 687 |
| | | **Black Bayou West** | | | |
| LA 3-10R | 198 | 2,465 | 1,317 | 356 | 792 |
| | | **Black Bayou East** | | | |
| LA 3-15B | 307 | 1,788 | 878 | 227 | 683 |
| LA 3-18B | 310 | 1,876 | 1,048 | 207 | 621 |
| Subtotal | 617 | 3,664 | 1,926 | 434 | 1,304 |
| **Total Compensation** | 1,181 | 8,095 | 4,355 | 957 | 2,783 |

The dedicated dredging would take approximately 3.1 million cubic yards (mcy) of material from a 1.8-mile-long borrow area in Sabine Lake. The borrow area would be located at least 1,000 feet from the Sabine NWR shore, and would average 1,030 feet wide by 7.5 feet deep. The borrow area would be continuous and parallel the current shoreline and the common longshore circulation pattern in Sabine Lake. The circulation would prevent the development of hypoxic conditions that would be detrimental to aquatic organisms. It is expected that the borrow area would eventually fill with Sabine River sediments. An access channel, approximately 8 miles long, from the GIWW near the mouth of the Sabine River, would be needed for the dredge to reach the proposed borrow trench area.

One-time impacts of the borrow area and access channel dredging include an increase in water column turbidity during dredging activities; such effects would be temporary and local to nekton, phytoplankton, and water quality. A hydraulic pipeline dredge would be used to minimize turbidity. No further effects to water quality and related organisms would be expected. Benthic fauna would be removed due to evacuation of sediment during dredging activities; however, benthic organisms can rapidly recolonize, and no long-term effects would be anticipated. A study by T. Baker Smith, Inc. (2006) found no live oyster reefs in this area. SAV cover is not likely to be found in this area due to low salinities and turbidity.

### 8.6.2 Black Bayou Mitigation Measures

For the Black Bayou West (LA 3-10R) mitigation measure, material from maintenance dredging of the Sabine River Channel between East Pass and the GIWW would be used to restore a large area of marsh north of Black Bayou and west of Rusty Vincent Lake. Maintenance dredging of the Sabine River Channel is routinely conducted for a separate deep-draft navigation project within the SNWW system; the Channel to Orange has a different non-Federal sponsor. It is a FWOP condition for the SNWW CIP, and

therefore only the incremental cost associated with placing the material in the marsh is included in the cost estimate. Material removed during regularly scheduled maintenance dredging of this channel would be hydraulically pumped into a large degraded marsh area west of Rusty Vincent Lake. This area is close to the navigation channel, minimizing pumping distance and cost. Marsh restoration in LA 3-10R would be accomplished in six 5-year dredging cycles beginning within 5 years of the completion of CIP construction. Each dredging cycle would pump approximately 526,000 cubic yards of material and create 132 acres of emergent marsh, creating a total of 792 acres over 30 years. In addition, 356 acres of shallow-water habitat would be improved and 1,317 acres of existing marsh would be nourished within the total 2,465 acres influenced by the unconfined flow of dredged material.

For Black Bayou East (LA 3-15B and LA 3-18B) mitigation measures, marsh restoration would be accomplished in two areas just west of the Black Bayou Cut-Off Canal using dedicated dredging of accumulated material in the Lake Charles Deepwater Channel/GIWW East. Dedicated dredging of the Lake Charles Deepwater Channel for Black Bayou mitigation efforts would remove and kill benthic organisms; however, constant ship traffic in the shallow channel is an ongoing disturbance to benthic organisms. Recovery of benthic organisms would be rapid (Sheridan, 1999). No impacts to salinity are expected because the dredged section would not connect with the Sabine River Channel or the Calcasieu Ship Channel; therefore, there would be no connection with the saltwater wedge in the Calcasieu Ship Channel (there is no Sabine River wedge; Brown and Stokes, 2009). It is expected that sediment will accumulate over time, refilling the channel to its current depth of approximately –12 feet.

Approximately 10.5 mcy of material would be pumped from a 13-mile stretch of the GIWW East into two degraded marsh areas. The first (LA 3-15B) is located adjacent to the GIWW and has the shortest pumping distance; the second is located south of LA 3-15B and pumping would move to it after the first is complete. A total of 1,304 acres of emergent marsh would be restored, 434 acres of shallow-water habitat would be improved, and 1,926 acres of existing marsh would be nourished within the total 3,664 acres influenced by the unconfined flow of dredged material.

Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. In order to maximize edge in the marsh, topographic relief would be created by varying the final elevation of material placement, and planting with appropriate native flora at each elevation. The varied topography would allow for differences in duration of tidal inundation, create different floral communities, and maximize biodiversity. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled. These would be needed to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

# 9.0 UNCERTAINTIES ASSOCIATED WITH ECOLOGICAL MODELING FOR THE SNWW CIP

## 9.1 ACTIONS FOR CHANGE DIRECTIVE

An analysis of risk and uncertainty associated with the WVA models' application to the SNWW CIP has been performed in consideration of recommendations contained in the Actions for Change directive (USACE, 2006). This analysis will facilitate risk-informed decision-making regarding the levels of ecological impacts and resulting recommended compensatory mitigation that was established using the models. The analysis will allow decision-makers to evaluate uncertainties associated with impact predictions, and understand how different predictable outcomes would affect the cost of the mitigation plan.

## 9.2 TYPES OF RISK ASSOCIATED WITH PREDICTIVE ECOLOGICAL MODELING

Risks to human health and safety associated with ecological impacts evaluated by the model are small. The primary impact of the Preferred Alternative is an indirect impact associated with a small increase in salinity and an associated reduction in biological productivity over approximately 182,000 acres (284 square miles) of intertidal marshes and swamps. The loss in productivity includes the loss of some marsh within the area of tidal influence in the Sabine-Neches study area. The most likely loss of marsh acreage is about 691 acres (about 2/5ths of 1 percent of the affected emergent marsh acreage) in the interior of the large estuarine marshes east of Sabine Lake. This amount of additional marsh loss would not affect the overall effectiveness of these coastal wetlands in buffering inland areas from storm surge effects. The proposed compensatory mitigation plan would contribute to the long-term sustainability of areas with the highest FWP impacts by adding stabilizing mineral sediments, increasing marsh elevations, and decreasing the size of open-water areas within the marsh.

The primary risks associated with ecological modeling for the SNWW CIP relate to the accuracy of the impact assessment and the cost of mitigation. Although the incremental impacts of the project as quantified by the WVA models have been determined to be small, when applied to the unusually large size of the affected area, the amount of net impacts as quantified in AAHUs is relatively high (1,511 AAHUs). An extensive evaluation of mitigation measure alternatives and a CE/ICA analysis, described in FEIS Section 5.4, have identified the Best Buy combination of recommended mitigation measures. Most of the measures included in the Best Buy mitigation plan involve the use of dedicated dredging to obtain mineral soils for marsh restoration. Dredged material originating with construction or maintenance of the Preferred Alternative cannot be used because of lengthy pumping distances, and therefore, dredging must be conducted to provide sediment for some mitigation measures (hence the term "dedicated dredging"). The entire cost of two dedicated dredging contracts (contracts 13 and 15) is thus included in the mitigation cost. One of the mitigation measures does take advantage of the only close source of maintenance material, i.e., regular maintenance dredging of the nearby Sabine River Channel (Contract 14). The Sabine River Channel is a separate deep-draft navigation project with a different non-Federal sponsor. In this case, only the incremental cost of using the material to restore marsh elevation is included

in the mitigation cost. The first cost of construction for the entire compensatory mitigation plan is $77,491,000 (contracts 13, 14, and 15; August 2009 cost estimate). An evaluation of the risks and uncertainties involved in application of the ecological model, on which the amount of proposed compensatory mitigation is based, is necessary to support the recommended Federal investment in a mitigation plan of this magnitude.

## 9.3 UNCERTAINTIES ASSOCIATED WITH PREDICTIVE ECOLOGICAL MODELING

There are two types of uncertainty that have been identified for the predictive ecological modeling conducted in this study—uncertainty associated with model quality and performance, and uncertainty associated with model predictions. Extensive review of both the WVA models and the HS model has been conducted to ensure they are technically sound and defensible. Technical reviews of both models have been completed as reported below. Uncertainty of model predictions is addressed with sensitivity analyses of critical model assumptions and parameter quality.

The HS model is an established engineering model that has been used by ERDC's CHL for computing hydrodynamics, salinity, and sediment transport for numerous studies across the nation for nearly 20 years (Brown and Stokes, 2009). The SNWW application of the model underwent agency technical review (ATR) by the Deep Draft Center for Expertise, and an Independent External Peer Review (IEPR) (Battelle, 2010). These reviews affirmed the technical quality of the model and the computational accuracy of its software and systems, as well as its application to the SNWW study.

Application of the WVA models was also evaluated by both an ATR at the Deep Draft Center of Expertise, and an IEPR (Battelle, 2010). All ATR questions concerning the WVA models have been resolved, and IEPR comments have been addressed with revised HS and WVA modeling that are reported in this document. To further evaluate technical quality, an assessment of the suite of WVA models used in this application has also been performed to determine if the models are technically sound and that they satisfy general USACE guidelines for mitigation and specific mitigation objectives of the SNWW CIP (LBG and TEA, 2008). This satisfies the requirements of EC 1105-2-407, as the WVA models were developed by a Federal agency other than USACE, and are therefore subject to approval for use rather than certification.

The WVA model assessment (LBG and TEA, 2008) determined that the theoretical approaches behind the WVA Emergent Marsh Community Model, the Swamp Community Model, and the Bottomland Hardwoods Model are valid. These community models use scientifically established structural surrogates to evaluate wetland quality. The concept and application of the models are sound for planning efforts. The models' variables, calculated using established protocols, provide a reasonable description of the emergent marsh, swamp, and bottomland hardwood habitats. The models identify habitat structural components, evaluate habitat-related ecological functional processes that may be affected by the project, and assess damages or losses attributable to the project. Model testing and validation was performed by running the model using three test data sets from each community type and comparing the results. The

model assessment confirmed that the assumptions of variables are appropriate and that the basic mathematics and spreadsheet formulas have been appropriately computed.

As part of the WVA model assessment, a sensitivity analysis was employed to verify that the models would behave as intended with incremental changes in input variables (Hamby, 1994; Jackson et al., 2000). The value of each variable was tested at 10, 20, and 30 percent while holding the others constant. Model outputs responded as expected to changes in model input, and in conformance with theoretical assumptions expressed as model equations. Uncertainty in model behavior was found to be low; model output did not react disproportionately to changes in variable values (LBG and TEA, 2008).

## 9.4 SENSITIVITY ANALYSES OF WVA MODEL PREDICTIONS

Uncertainty associated with WVA model predictions (e.g., how different predictable outcomes could affect ecological impacts and costs) was evaluated with a different type of sensitivity analysis. The WVA models do not include a direct way to measure risk, i.e., the model does not calculate a probability distribution that provides a statistically significant confidence level for the model projections. However, it is possible to conduct a sensitivity analysis of the model results by varying input values for the most significant variables. In this case, a range of possible outcomes associated with variable $V_1$ (percent of emergent marsh) in the EMCM, and variables $V_4$ and $V_5$ (salinity) in the SCM and EMCM, respectively, were evaluated to determine how uncertainties related to variable assumptions and values could affect impact predictions and compensatory mitigation decisions. Since the analysis is being conducted to evaluate uncertainties with the recommended level of compensatory mitigation, the analysis was performed for the Louisiana hydro-units in which unavoidable impacts would occur.

While the WVA modeling was originally performed by the ICT Habitat Workgroup, the sensitivity analyses presented below were performed solely by USACE. For the salinity sensitivity study, changes to salinity variable values were determined by statistical analysis. ERDC-CHL was consulted for advice in calculating some of the statistics used in the analysis. For the percent emergent marsh sensitivity analysis, the USFWS Louisiana Ecological Services Field Office provided a revised equation for the $V_1$ (percent of emergent marsh) variable. In the salinity sensitivity analysis, changes in the salinity variable induced changes in other variables. In adjusting these other variables, care was taken to ensure that the direction and magnitude of the adjustments were consistent with the original application of the WVA models by the ICT.

### 9.4.1 Salinity Sensitivity Analysis

#### 9.4.1.1 Methodology

Salinity is the driving force influencing ecological model predictions for the SNWW CIP. The WVA EMCM and SCM were specifically chosen to evaluate impacts of the SNWW CIP because changes in salinity are the primary project impact and these models directly measure the impact of salinity changes on various aspects of habitat quality and quantity. Salinity affects five of the six variables in the EMCM

($V_1$, percent of the wetland covered by emergent vegetation; $V_2$, percent of the open water covered by SAV; $V_3$, marsh edge and interspersion; $V_4$, percent of the open-water area less than or equal to 1.5 feet deep; and $V_5$, salinity). In the SCM, three of the four variables are influenced by salinity ($V_1$, stand structure, $V_2$, stand maturity, and $V_4$, mean high salinity during the growing season). The BHM does not contain a variable that measures salinity directly, but the effects of salinity were captured indirectly by its effect on growth rates, as reflected in three of the model's seven variables ($V_1$, tree species composition, $V_2$, stand maturity, and $V_3$, midstory/understory coverage). Because of uncertainties associated with HS model predictions of salinity impacts, and the wide range of salinity variability in the SNWW estuarine system, a sensitivity analysis was performed to evaluate the full range of potential project effects.

Salinity changes predicted with implementation of the Preferred Alternative were provided by the HS model. HS model output includes a statistical analysis of the salinity differences between existing and FWP conditions at 13 salinity sampling stations used for the calibration and verification of the model. This analysis includes standard deviations of the differences between existing and FWP **mean salinity** values that can be used to calculate the range of potential impacts for brackish and saline marshes. For intermediate and fresh marshes, and swamps and bottomland hardwoods, **mean high salinity** during the growing season was used to evaluate impacts. Standard deviations for mean high salinity values at model nodes were generated from a salinity exceedance analysis produced in conjunction with the HS model. The range of these mean high salinity values was used to calculate the range of potential impacts for these communities. More information on the biological assumptions related to these statistics is provided in Section FEIS 4.6.3.

High- and low-salinity values bracketing the 95 percent confidence level were entered into WVA model land loss spreadsheets and worksheets for all habitats in Louisiana hydro-units. The high and low range of salinities and associated AAHU impacts for all Louisiana hydro-units are presented in Table 29. For comparative purposes, the FWP salinity and AAHU impacts are shown in the middle columns. Table 30 shows the high and low land loss predictions that are associated with the range of salinity values.

9.4.1.2 Analysis

For brackish and saline marshes, a range equal to the mean salinity ± 2 standard deviations provides impact predictions at the 95 percent confidence level. For saline marshes, the sensitivity analysis yielded a maximum salinity range of 15.3 to 19.2 ppt, as compared to the FWP salinity of about 17.3 ppt. For brackish marshes, the sensitivity analysis predicts a maximum range of 3.7 to 10.6 ppt, as compared to the FWP range of 5.3 to 8.6 ppt. With the exception of brackish marsh in the Sabine Lake Ridges hydro-unit, salinity for the full 95 percent confidence range was forecast to remain within the optimal range as defined by the WVA model. For salinities at the high end of the range, brackish marsh would be

Table 29: WVA Salinity Sensitivity Analysis

| Hydro-Unit # | Hydro-Unit Name | Habitat Type | 95 Percent Confidence Range* | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Low Range | | Most Likely | | High Range | |
| | | | Low Salinity (ppt) | Lower Limit of Impacts or Benefits (– or + AAHUs) | FWP Salinity (ppt) | FWP Impacts (– AAHUs) | High Salinity (ppt) | Upper Limit of Impacts (– AAHUs) |
| **Bottomland Hardwoods (optimal salinity range ≤1 ppt)** | | | | | | | | |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0.0 | 0– | 0.1 | 0.0 | 0.2 | 0.0 |
| LA 1 | Perry Ridge | Bottomland Hardwood | 1.4 | 0.0 | 2.3 | 0.0 | 3.1 | 0.0 |
| **Cypress–Tupelo Swamp (optimal salinity range ≤1 ppt)** | | | | | | | | |
| LA/TX 1 | Sabine Island | Cypress/Tupelo Swamp | 0.0 | 0.0 | 0.1 | 0 | 0.2 | 0 |
| LA/TX 2 | Blue Elbow | Cypress/Tupelo Swamp (BH lumped) | 0.3 | 0.0 | 0.9 | 0 | 1.5 | –9 |
| **Fresh Marsh (optimal salinity range ≤2 ppt)** | | | | | | | | |
| LA 1 | Perry Ridge | Fresh Marsh | 1.4 | –5 | 2.3 | –65 | 3.1 | –412 |
| LA 7 | Southeast Sabine | Fresh Marsh | 2.2 | –3 | 2.4 | –11 | 2.6 | –23 |
| LA 8 | Southwest Gum Cove | Fresh Marsh | 1.5 | 0 | 2.0 | –2 | 2.5 | –42 |
| **Intermediate Marsh (optimal salinity range ≤4 ppt)** | | | | | | | | |
| LA 1 | Perry Ridge | Intermediate Marsh | 4.5 | 0 | 5.6 | –53 | 6.7 | –107 |
| LA 2 | Willow Bayou | Intermediate Marsh | 7.0 | –93 | 7.7 | –328 | 8.0 | –317 |
| LA 3 | Black Bayou | Intermediate Marsh | 5.4 | –113 | 6.5 | –509 | 7.6 | –927 |
| LA 4 | West Johnson's Bayou | Intermediate Marsh | 5.9 | –60 | 7.3 | –269 | 8.0 | –275 |
| LA 5 | Sabine Lake Ridges | Intermediate Marsh | 5.9 | –43 | 7.3 | –218 | 8.0 | –269 |
| LA 7 | Southeast Sabine | Intermediate (Brackish lumped) | 2.2 | –1 | 2.4 | 0 | 2.6 | –1 |
| LA 8 | Southwest Gum Cove | Intermediate (Brackish lumped) | 2.9 | 0 | 3.9 | –4 | 4.9 | –62 |
| LA 9 | East Johnson's Bayou | Intermediate Marsh | 4.0 | –2 | 4.8 | –190 | 5.6 | –449 |
| **Brackish Marsh (optimal salinity range ≤10 ppt)** | | | | | | | | |
| LA 2 | Willow Bayou | Brackish Marsh (shifts from intermediate) | NA | NA | NA | NA | 8.9 | –29 |
| LA 2 | Willow Bayou | Brackish Marsh | 6.3 | 1 | 8.6 | –1 | 9.3 | –1 |
| LA 3 | Black Bayou | Brackish Marsh | 3.7 | 0 | 5.3 | –1 | 6.6 | –3 |
| LA 4 | West Johnson's Bayou | Brackish Marsh (shifts from intermediate) | NA | NA | NA | NA | 7.7 | –46 |
| LA 4 | West Johnson's Bayou | Brackish Marsh | 5.1 | 0 | 7.0 | –1 | 7.9 | –2 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh (shifts from intermediate) | NA | NA | NA | NA | 7.7 | –26 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh | 6.0 | 13 | 8.3 | –14 | 10.6 | –77 |
| LA 6 | Johnson's Bayou Ridge | Brackish Marsh | 5.5 | –2 | 7.0 | –6 | 7.9 | –9 |
| **Saline Marsh (optimal salinity range ≥9 ≤21 ppt)** | | | | | | | | |
| LA 5 | Sabine Lake Ridges | Saline Marsh | 15.3 | –31 | 17.3 | –35 | 19.2 | –40 |
| LA 6 | Johnson's Bayou Ridge | Saline Marsh | 15.3 | –1 | 17.3 | –2 | 19.2 | –20 |
| | | | | | | | | |
| Range of AAHUs (95 Percent Confidence Range) | | | | 14 | | 0 | | 0 |

*95 percent confidence range for saline and brackish marshes is equivalent to mean salinity ± 2 standard deviations; for swamps, fresh, and intermediate marshes, it is equivalent to mean high 33 percent continuous salinity ± 1 standard deviation.

Table 30: Land Loss Impacts (95 Percent Confidence Range)

| Hydro-Unit # | Hydro-Unit Name | Habitat Type | FWOP Land Loss | | FWP Incremental Land Loss - 95 Percentage Confidence Range | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Low Range Salinity | | Most Likely Salinity | | High Range Salinity | |
| | | | Land loss acres | Hydro-Unit % | Land loss acres | Hydro-Unit % | FWP land loss | Hydro-Unit % | Land loss acres | Hydro-Unit % |
| **Fresh Marsh** | | | | | | | | | | |
| LA 1 | Perry Ridge | Fresh Marsh | -921 | -6.2 | -21 | -0.1 | -50 | -0.3 | -106 | -0.7 |
| LA 7 | Southeast Sabine | Fresh Marsh | -40 | -2.0 | -1 | 0.0 | 0 | 0.0 | -2 | -0.1 |
| LA 8 | Southwest Gum Cove | Fresh Marsh | -153 | -4.4 | -1 | 0.0 | -8 | -0.2 | -15 | -0.4 |
| **Intermediate Marsh** | | | | | | | | | | |
| LA 1 | Perry Ridge | Intermediate Marsh | -191 | -6.3 | 0 | 0.0 | -11 | -0.4 | -22 | -0.7 |
| LA 2 | Willow Bayou | Intermediate Marsh | -2,117 | -1.9 | -1 | 0.0 | -102 | -0.5 | -4 | -0.0 |
| LA 3 | Black Bayou | Intermediate Marsh | -1,713 | -7.0 | -19 | -0.1 | -131 | -0.5 | -121 | -0.5 |
| LA 4 | West Johnson's Bayou | Intermediate Marsh | -1,703 | -4.4 | -1 | 0.0 | -142 | -1.4 | -12 | -0.1 |
| LA 5 | Sabine Lake Ridges | Intermediate Marsh | -1,103 | -13.5 | -4 | -0.3 | -93 | -1.1 | -29 | -0.4 |
| LA 7 | Southeast Sabine | Intermediate (Brackish lumped) | -96 | -2.0 | -2 | -0.1 | -1 | 0.0 | -2 | -0.1 |
| LA 8 | Southwest Gum Cove | Intermediate (Brackish lumped) | -234 | -4.4 | -1 | 0.0 | -15 | -0.3 | -25 | -0.5 |
| LA 9 | East Johnson's Bayou | Intermediate Marsh | -895 | -4.0 | -6 | 0.0 | -46 | -0.2 | -84 | -0.4 |
| **Brackish Marsh** | | | | | | | | | | |
| LA 2 | Willow Bayou | Brackish Marsh (shifts from intermediate) | NA | NA | NA | NA | NA | NA | -87 | -0.4 |
| LA 2 | Willow Bayou | Brackish Marsh | -695 | -61.7 | 1 | 0.1 | -2 | -0.2 | -4 | -0.3 |
| LA 3 | Black Bayou | Brackish Marsh | -803 | -27.2 | -1 | 0.0 | -5 | -0.2 | -10 | -0.3 |
| LA 4 | West Johnson's Bayou | Brackish Marsh (shifts from intermediate) | NA | NA | NA | NA | NA | NA | -113 | -1.2 |
| LA 4 | West Johnson's Bayou | Brackish Marsh | -1,188 | -65.4 | 0 | 0.0 | -6 | -0.4 | -10 | -0.6 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh (shifts from intermediate) | NA | NA | NA | NA | NA | NA | -67 | -0.9 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh | -2,567 | -17.6 | 40 | 0.3 | -43 | -0.3 | -124 | -0.9 |
| LA 6 | Johnson's Bayou Ridge | Brackish Marsh | -707 | -28.9 | -5 | -0.2 | -22 | -0.9 | -36 | -1.5 |
| **Saline Marsh** | | | | | | | | | | |
| LA 5 | Sabine Lake Ridges | Saline Marsh | -399 | -12.6 | -3 | -0.1 | -10 | -0.3 | -22 | -0.7 |
| LA 6 | Johnson's Bayou Ridge | Saline Marsh | -93 | -26.9 | -2 | -0.6 | -5 | -1.5 | -8 | -2.3 |
| Range of Land Loss | | Total Acres and Percentage of Total Emergent Acres | -15,618 | -10.5 | -27 | 0.0 | -692 | -0.5 | -903 | -0.6 |

expected to expand at the expense of intermediate marsh, as described below. The highest impacts would be seen in the Sabine Lake Ridges brackish marsh where the highest potential salinity is predicted to be 10.6 ppt, only marginally suboptimal as defined by the WVA model.

For saline and brackish marshes combined, AAHU losses could range from 20 to 253 AAHUs, as compared to the FWP loss of 60 AAHUs. Overall, impacts at the highest potential salinity would not threaten the sustainability of any of the brackish and saline marshes in the study area over the period of analysis. Salinities remain within or close to the optimal range for each vegetation community, and incremental land loss is small. Land loss could range from 40 to 481 acres, and the maximum percentage loss in a single hydro-unit could be 2.3 percent in the saline marsh of Johnson's Bayou Ridge. When compared to the total acres of brackish and saline emergent marsh in the Louisiana portion of the study area, the highest potential loss of 481 acres would represent a loss of 1.8 percent. For salinities at the low end of the range, small benefits (positive AAHUs) were predicted by the WVA model.

Salinity impacts to fresh and intermediate marshes, cypress-tupelo swamps, and bottomland hardwoods were evaluated using a different statistic required by the WVA model – the mean high salinity. The HS model generated this statistic in accordance with the definition provided in the WVA Models Procedural Manual (USFWS, 2002b). It measures the mean of the highest continuous 33 percent of salinity values (mean high salinity) during a specific period of record. This statistic captures the effect of periodic pulses of higher salinity associated with reduced freshwater inflow or tidal surge. Standard deviations of mean high salinity values were calculated by the Galveston District with the assistance of ERDC-CHL, using output from an exceedance analysis performed as part of the HS modeling study. For the mean high salinity, a range equal to ± 1 standard deviation provides impact predictions at the 95 percent confidence level. The mean high statistic is generally equivalent to the high range of the 68 percent confidence level, and therefore application of ± 1 standard deviation broadens the range to the 95 percent confidence range (Steel and Torrie, 1976).

The largest range of potential impacts would occur within the intermediate marsh community. These marshes are located east of Sabine Lake and are buffered by a band of brackish marsh along the lakefront. Salinity impact predictions for the fresh and intermediate vegetation communities are associated with periods of higher salinity, which generally occur in late summer and early fall, when lower rainfall reduces freshwater inflow from the Sabine and Neches rivers. These pulses change salinities in upper Sabine Lake from almost fresh to brackish, and can remain at high levels for several weeks to months. Similar conditions can occur in association with high tides and storm surges associated with tropical storms and hurricanes. FWOP pulses of higher salinity for the majority of intermediate marsh habitats are expected to be suboptimal; only hydro-units with no frontage on Sabine Lake would remain within the optimal range.

The sensitivity analysis yielded a maximum salinity range of 1.0 to 8.0 ppt within intermediate marshes that remain intermediate, as compared to the FWP predicted range of 2.4 to 7.7 ppt. However, three large areas of intermediate marsh adjacent to the southern part of Sabine Lake (Willow Bayou, 35,109 acres;

West Johnson's Bayou, 11,110 acres; and Sabine Lake Ridges, 9,270 acres) would be expected to convert to brackish marsh about 20 years after project construction. High-range salinities in all but one of the remaining intermediate marshes would push the marshes further into suboptimal range. Salinity in only one hydro-unit (Southeast Sabine) would remain within the optimal range.

Impacts to intermediate marshes represent 92 percent of total FWP impacts. AAHU losses for the intermediate marshes could range from 312 to 2,407 AAHUs, as compared to the FWP loss of 1,571 AAHUs. Overall, impacts at the highest potential salinity would likely result in the conversion of large areas of intermediate marsh to brackish marsh, especially in the marshes east of Sabine Lake. Land loss could range from 34 to 541 acres, and the maximum percentage loss in a single hydro-unit could be 1.4 percent in West Johnson's Bayou. When compared to the total acres of intermediate emergent marsh in the Louisiana portion of the study area, the highest potential loss of 541 acres would represent a loss of 0.5 percent. While the highest range of potential impacts would not be expected to threaten the long-term sustainability of the overall marsh community, the diversity of habitats and the fish and wildlife species they support would be reduced with the conversion of large areas of formerly intermediate marsh to brackish marsh.

For the fresh marsh communities, the sensitivity analysis yielded a maximum salinity range of 1.4 to 3.1 ppt, as compared to the most likely salinity range of 2.0 to 2.4 ppt. AAHU losses could range from 8 to 477, as compared to the mostly likely loss of 78 AAHUs. Periodic pulses of higher salinities in all of the fresh marsh communities would be suboptimal for most of the salinity range, but not to the extent that conversion to intermediate marsh would likely result. The percentage incremental increase in land loss within fresh marsh is less than predicted for the intermediate marshes, ranging between 0 and 0.7 percent for any individual hydro-unit. The total number of acres predicted to be lost ranges from 23 to 123, or a maximum of 0.6 percent of total emergent fresh marsh in the Louisiana portion of the study area. The highest potential salinity would not threaten the sustainability of the fresh marsh communities, and incremental land loss is small.

For cypress-tupelo swamps, the sensitivity analysis yielded a potential salinity range of 0.0 to 1.5 ppt, compared to the most likely range of 0.0 to 0.9 ppt. In the uppermost reaches of the Sabine River, only a minimal increase in salinity over normal fresh conditions (0.2 ppt) is predicted even at the high end of the range. The Blue Elbow swamp could experience salinities ranging from 0.3 to 1.5 ppt, with the highest potential salinity extending into the suboptimal range. AAHU losses could range from 0.0 to 9.0, with no impact predicted to be most likely. Even at the maximum salinity, salinity levels would not be suboptimal to the extent that sustainability of the swamp forest would be threatened. Studies indicate that mean salinities must exceed 4 ppt before swamp forest converts to marsh habitat (Visser et al., 2004).

No impacts would be expected in the bottomland hardwood habitats at the maximum range of salinity predicted by the sensitivity analysis (3.1 ppt at Perry Ridge). Located on higher ridges or terrace margins and buffered by intervening swamp and marsh, this community would only occasionally be exposed to

the higher salinities present in the surrounding marshes. No loss of bottomland hardwood acreage is predicted.

9.4.1.3 Conclusions

The salinity sensitivity analysis of the WVA models demonstrated that there is a wide range of potential outcomes in AAHU losses attributable to uncertainties in salinity predictions. These outcomes range from a loss of 340 to 3,146 AAHUs within the 95 percent confidence range of salinity, the primary driver in the EMCM and SCM. After adjustments for the Gulf Shore BU Feature benefits (210 AAHUs) and the BU offset of impacts to Federal lands (340 AAHUs), losses could range from zero to 2,596 AAHUs. Based on the cost per AAHU of the recommended mitigation plan ($77.5 million; 1,181 AAHUs), the cost of compensatory mitigation could range from $0 to about $170 million. The total predicted FWP loss of 1,499 AAHUs in Louisiana is based upon forecasts of the most likely salinity levels and takes into account the potential FWOP effects of RSLR and changes in future freshwater inflows. The recommended mitigation plan contains sufficient mitigation to ensure that the selected plan will not have more than negligible impacts on the ecological resources of the project area.

However, in light of the uncertainties in the projection of salinity change due to the project, it is recommended that salinities before, during, and after construction of the SNWW CIP be monitored by USACE for evidence that the salinity levels associated with implementation of the Preferred Alternative are significantly different than predicted. Salinity data, routinely collected throughout the study area by several State and Federal agencies, can be gathered and applied for this purpose.

9.4.2 Percent Emergent Marsh Sensitivity Analysis

9.4.2.1 Methods

One hundred percent of Louisiana impacts predicted by the ecological model were made using the WVA EMCM. The most highly weighted variable in this model is $V_1$ (percent emergent marsh). This parameter is considered most significant because persistent emergent vegetation provides foraging, resting, and breeding habitat for a variety of coastal fish and wildlife species. Detritus from coastal marshes also provides a source of mineral and organic nourishment for organisms at the base of the food chain. Without the structure provided by the emergent marsh, the majority of the ecological benefits provided by these systems disappear. Changes in the value of this parameter were predicted by relating changes in salinity to changes in marsh loss using a process that is described in FEIS Section 4.10. The salinity sensitivity analysis, above, includes an analysis of the effect of different salinities in land loss projections and productivity impacts.

This sensitivity analysis explores the effects of an assumption that underlies the valuation of emergent marsh in this variable. The SNWW application of this model uses the same assumptions adopted by the EnvWG in its application of the model to CWPPRA restoration projects (USFWS, 2002b). In this model, optimal vegetative coverage is assumed to be 100 percent (SI = 1.0) for all marsh types ($V_1$-Original).

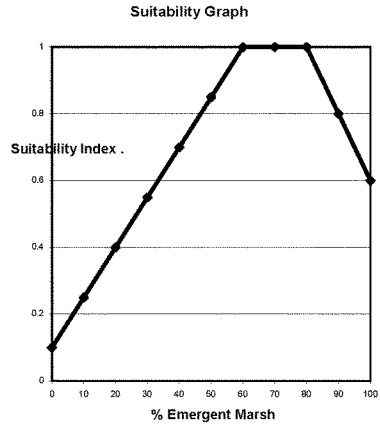
This assumption diverges from the general biological understanding that optimum cover falls in the 60–80 percent range, but it was adopted by the EnvWG to reflect CWPPRA's objective of long-term marsh creation and restoration. Questions have arisen as to whether maximizing the value of marsh coverage is appropriate for the SNWW application in which the primary purpose is the identification of project impacts and compensatory mitigation.

Selection of 100 percent marsh cover as the optimal habitat condition ($V_1$-Original) for the SNWW application was based upon several factors. Loss of emergent coastal marsh is a serious existing condition in the study area, and it is assumed that this loss would continue and most likely accelerate due to an increased rate of RSLR (NOAA-USDC, 2006; IPCC, 2007). Existing and potentially increased marsh loss associated with channel deepening has been identified as one of the highest concerns by resource agencies and the general public. The $V_1$-Original model assumption maximizes the value of emergent marsh when measuring impacts or determining compensatory mitigation. Maximizing the value of emergent marsh over associated shallow-water habitat is based upon the important ecological concept of long-term sustainability. With the SNWW project, marshes would continue to degrade over the 65-year period of analysis due to the effects of RSLR. Without the associated marshes, the small open-water areas would lose their value as nursery habitat, becoming open bay or open Gulf habitat. When marshes are restored to levels that will ensure sustainability for a minimum of 50 years postconstruction, small channels and ponds would be created naturally because of the ongoing effects of RSLR and salinity increases. Restoration or mitigation projects generally need to maximize the creation of emergent marsh, so as to ensure the sustainability of the land itself.

To evaluate the effect of this assumption on the SNWW application, the EMCM was rerun using a revised formula for the variable in which optimal vegetative coverage (SI = 1.0) is assumed for a marsh coverage of 60 to 80 percent ($V_1$-Revised). At the request of USACE, USFWS provided the revised formulas, suitability index graph (Figure 17), and revised worksheets specifically for this sensitivity analysis. The graph illustrates the assumption that underlies $V_1$-Revised. The value of the percentage of emergent marsh (versus the percentage of open water) is assumed to rise linearly from an SI value of 0.1 at zero percent emergent marsh to an SI of 1.0 for marsh coverage between 60 and 80 percent. The SI value of marsh above 80 percent then drops linearly to an SI of 0.6 at 100 percent marsh coverage. The graph for the $V_1$-Original (not illustrated) rises linearly from an SI value of 0.1 at zero percent emergent marsh to an SI of 1.0 for marsh coverage of 100 percent.

Using the $V_1$-Revised assumption, the model was rerun to calculate impacts to marsh communities in all of the Louisiana hydro-units and for the proposed compensatory mitigation measures. No adjustments were necessary to any of the parameter values, as they were not affected by the change in SI formula. In addition, there was no need to rerun the land loss spreadsheets since none of the assumptions that underlie that impact prediction were affected by the SI formula change.

Figure 17: Revised Suitability Index Graph for $V_{1\ Percent}$ Emergent Marsh




**$V_1$-Revised Line Formula** (all marsh types)

If $0 \leq \% < 60$, then SI = (0.015 * %) + 0.1

If $60 \leq \% \leq 80$, then SI = 1.0

If % > 80, then SI = (–0.02 * %) + 2.6

9.4.2.2 Analysis

The results of the percent emergent marsh sensitivity analysis on project impacts are shown in Table 31. Overall, impacts dropped 3 percent when $V_1$-Revised was used. WVA worksheets were reviewed to determine which hydro-units were affected most by the revised formula. As would be expected, the smallest percentage changes would occur in marshes where the percent emergent marsh remained between 60 and 80 percent for both the FWOP and FWP conditions.

If the $V_1$-Revised formula were used to calculate the mitigation target for the SNWW CIP, it would be 1,078 AAHUs. A comparison of the $V_1$-Original and $V_1$-Revised mitigation targets is presented in Table 32. To calculate the mitigation target, it was necessary to recompute compensation that would be earned by recommended mitigation measures and the Louisiana Gulf Shore BU Feature. WVA EMCM worksheets for these measures were rerun using the $V_1$-Revised formula shown above. A comparison of the compensation earned using both formulae is shown in Table 33.

Table 31: $V_1$ Revised Sensitivity Analysis – Comparison of Impact Predictions

| HU # | Hydrologic Unit | Habitat Type | FWP Impacts (AAHUs) | $V_1$ Sensitivity Impacts (AAHUs) |
|---|---|---|---|---|
| LA 1 | Perry Ridge | Bottomland Hardwood | 0 | NA |
| LA/TX 1 | Sabine Island | Bottomland Hardwood | 0 | NA |
| LA/TX 1 | Sabine Island | Cypress/Tupelo Swamp | 0 | NA |
| LA/TX 2 | Blue Elbow | Cypress/Tupelo Swamp (Bottomland Hardwood lumped) | 0 | NA |
| LA 1 | Perry Ridge | Fresh Marsh | –65 | –61 |
| LA 7 | Southeast Sabine | Fresh Marsh | –11 | –11 |
| LA 8 | Southwest Gum Cove | Fresh Marsh | –2 | –2 |
| LA 1 | Perry Ridge | Intermediate Marsh | –53 | –53 |
| LA 2 | Willow Bayou | Intermediate (Brackish lumped) | –328 | –339 |
| LA 3 | Black Bayou | Intermediate Marsh | –509 | –502 |
| LA 4 | West Johnson's Bayou | Intermediate Marsh | –269 | –254 |
| LA 5 | Sabine Lake Ridges | Intermediate Marsh | –218 | –208 |
| LA 7 | Southeast Sabine | Intermediate (Brackish lumped) | 0 | 0 |
| LA 8 | Southwest Gum Cove | Intermediate (Brackish lumped) | –4 | –3 |
| LA 9 | East Johnson's Bayou | Intermediate Marsh | –190 | –173 |
| LA 2 | Willow Bayou | Brackish Marsh | –1 | –1 |
| LA 3 | Black Bayou | Brackish Marsh | –1 | –1 |
| LA 4 | West Johnson's Bayou | Brackish Marsh | –1 | –2 |
| LA 5 | Sabine Lake Ridges | Brackish Marsh | –14 | –9 |
| LA 6 | Johnson's Bayou Ridge | Brackish Marsh | –6 | –2 |
| LA 5 | Sabine Lake Ridges | Saline Marsh | –35 | –34 |
| LA 6 | Johnson's Bayou Ridge | Saline Marsh | –2 | –1 |
| Total | | | –1,709 | –1,656 |

Table 32: Comparison of Louisiana Impacts with $V_1$ Sensitivity

| Net FWP Impacts for Project (AAHUs) | (444) | |
|---|---|---|
| | Original $V_1$ (AAHUs) | Revised $V_1$ (AAHUs) |
| Total FWP Impacts in Louisiana | –1,709 | –1,656 |
| Benefits of Gulf Shore BU Feature | 210 | 235 |
| Net FWP Louisiana Impacts | –1,499 | –1,421 |
| Reduced by Sabine NWR Impacts | 340 | 343 |
| **FWP Mitigation Target for Louisiana (Total State Impacts less Sabine NWR Impacts)** | **–1,159** | **–1,078** |

Table 33: $V_1$ Sensitivity Analysis – Comparison of Compensatory Mitigation Computation

| Mitigation Measures | Best Buy Plan #6 (AAHUs) | $V_1$ Sensitivity of Best Buy Plan #6 (AAHUs) | $V_1$ Sensitivity of Modified Best Buy Plan #6 (AAHUs) |
|---|---|---|---|
| Willow Bayou | | | |
| LA 2-18B Marsh Restoration (Sabine Lake Dredging) | 152 | 98 | 108 |
| LA 2-ADD B Marsh Restoration (Sabine Lake Dredging) | 214 | 168 | 167 |
| Black Bayou West | | | |
| LA 3-10R Marsh Restoration (Sabine River Channel Maintenance Material) | 198 | 177 | 185 |
| Black Bayou East | | | |
| LA 3-15B Marsh Restoration (GIWW Dredging) | 307 | 223 | 248 |
| LA 3-18B Marsh Restoration (GIWW Dredging) | 310 | 164 | 203 |
| Total | 1,181 | 830 | 911 |
| Mitigation Target | 1,159 | 1,078 | 1,078 |
| Net Excess or Deficit | 22 | –248 | –167 |

The amount of credit (in AAHUs) earned by the proposed marsh mitigation measures would decrease by about 30 percent with the $V_1$-Revised formula. This is to be expected since no additional credit is earned by any marsh fill that exceeds 80 percent. The percentage of emergent marsh relative to open water ranges from 81.0 to 86.4 percent in the five recommended mitigation areas. Filling above 80 percent was considered desirable by the Louisiana agencies because of the significant existing rate of RSLR and the uncertainties associated with an unknown increase in the rate of RSLR due to climate change. It was decided that the mitigation features should maximize the creation of emergent marsh, so as to ensure the sustainability of the land itself. In addition to the creation of small channels during construction, it is expected that small channels and ponds would establish themselves naturally with the gradual increase in RSLR. It also appears that filling above 80 percent would be more cost effective because greater benefits are earned over the same area, as costs for longer pumping distances and additional pipe movement that would be needed to fill a lower percentage over a greater area were avoided.

If $V_1$-Revised were used to compute compensatory mitigation as it is currently designed, mitigation costs would increase by at least 42 percent to meet the $V_1$-Revised mitigation target. The $V_1$-Revised mitigation plan would need to provide an additional 248 AAHUs (see Table 33). Based upon the cost per acre of the recommended mitigation plan, the additional cost would at least equal that of the last two added increments of mitigation (LA 2-18B and LA 2-ADD B). Together, these mitigation measures would provide 266 AAHUs at a first cost of construction of $33.5 million (October 2009 price level). Costs would likely be higher, however, as the incremental cost of each AAHU would be more than the measures already selected.

If the same five mitigation measures were redesigned so that marsh fill would never exceed 80 percent (see $V_1$-Sensitivity Modified Best Buy Plan #6 in Table 33), the amount of restored acres would drop from 2,696 to 2,215 acres. However, compensation as measured with the $V_1$-Revised formula would increase from 830 to 911 AAHUs, and the number of additional AAHUs needed to meet the $V_1$-Revised mitigation target would be 167 AAHUs. Based upon the cost of the recommended mitigation plan, it is estimated that the total mitigation cost would be about 3 percent greater than the recommended mitigation plan. More significantly, the modified plan would restore about 18 percent fewer acres and do less to ensure the long-term sustainability of the marsh than the recommended mitigation plan.

#### 9.4.2.3 Conclusions

It is obvious, therefore, that the $V_1$-Original assumption is most advantageous for the computation of mitigation. The WVA model assessment (LBG and TEA, 2008) confirmed that the original model assumption applied for variable $V_1$ (e.g., optimal vegetative coverage is assumed to be 100 percent) is appropriate for the SNWW application in computing both impacts and mitigation, as it reflects the importance of emergent vegetation as habitat for this study area.

Given serious existing rates of marsh loss, the predicted increase in marsh loss in the FWP condition, and uncertainties related to salinity and land loss impacts due to the project, it is reasonable and appropriate to

utilize the assumption that maximizes the value of emergent marsh to the sustainability of the marsh system. Without the structure provided by the emergent marsh, the majority of the ecological benefits provided by these systems disappear. In addition, use of the $V_1$-Original assumption provides a larger margin of protection for the mitigation that is being proposed.

## 9.5 RECOMMENDATIONS RESULTING FROM THE WVA SENSITIVITY ANALYSES

The recommended compensatory mitigation plan is based upon the most likely range of salinity change as established by the HS model, scientifically based projections of changes in habitat resulting from the predicted salinity change, and the professional judgment and knowledge of the area by the large team of natural resource and engineering professionals who applied the HS and WVA models to the SNWW CIP. The HS model was developed and applied by experts at ERDC-CHL, with oversight from engineers and HS modeling experts from the TWDB, TPWD, and LDNR. The ICT Habitat Workgroup contained professionals with expertise in wetland impact evaluation, marsh restoration, wetland forest management, aquatic habitat evaluation, freshwater and marine fisheries, terrestrial and avian wildlife biology, as well as natural resource management personnel from all of the protected lands in the study area.

In addition, the recommended mitigation plan maximizes the value of emergent marsh when measuring impacts and determining compensatory mitigation for project-related losses to this nationally significant, endangered resource. It uses the $V_1$-Original assumption (e.g., optimal vegetative coverage is assumed to be 100 percent) to predict project impacts and compute compensatory mitigation. For these reasons, no changes to the recommended mitigation plan are proposed as a result of this sensitivity analysis. It is recommended that Best Buy Plan #6 mitigation plan (described in FEIS Section 5) be selected as it incorporates the level of compensation needed to address the most likely impacts of the SNWW CIP.

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# Attachment 1

# Wetland Value Assessment Model Approved for Use Memorandum

**DEPARTMENT OF THE ARMY**
SOUTH ATLANTIC DIVISION, CORPS OF ENGINEERS
ROOM 9M15, 60 FORSYTH ST., S.W.
ATLANTA, GEORGIA 30303-8801

REPLY TO
ATTENTION OF
CESAD-PDS-P

30 June 2009

MEMORANDUM FOR

COMMANDER, HQ USACE (CECW-PC/Bruce D. Carlson)
COMMANDER, SOUTHWEST DIVISION (CESWD-PDS-P/JoAnn M. Duman)

SUBJECT: Wetlands Value Assessment Model Assessment Report - Recommendation for Use for the Sabine-Neches Waterway Study, Galveston District

1. References:

a. EC 1105-2-407 Planning Models Improvement Program: Model Certification (CECW-CP, 31 May 2005).

b. Memorandum, CECW-CP, 13 August 2008, Subject: Policy Guidance on Certification of Ecosystem Output Models.

c. Model Assessment Support to Ecosystem Planning Center of Expertise For Wetland Value Assessment Model Application in the Sabine Neches Waterway Channel Improvement Project.

d. Final Wetland Value Assessment Model Application in the Sabine-Neches Waterway (SNWW) Channel Improvement Project Model Assessment Report prepared by The Louis Berger Group, Inc. and Toxicological and Environmental Associates, April 2008.

2. The Deep Draft Navigation Planning Center of Expertise (DDN-PCX) in consultation with the National Ecosystem Planning Center of Expertise (ECOPCX) has evaluated the use of the Wetland Value Assessment (WVA) Model for use in the plan formulation of channel improvements to the SNWW in accordance with references 1.a. and 1.b. above. The assessment followed the scope of work in reference 1.c above. The report, reference (d) concluded that the application of the WVA Marsh, Swamp, and Bottomland Hardwood Community Models to the SNWW Feasibility Study had: (a.) valid theoretical approaches within the context of USACE guidelines; (b.) provided reasonable descriptions of system habitats; (c.) identified habitat structural components and functional processes; (d.) assessed damages that may result from the project using habitat units; (e.) included appropriate variables; and (f.) used appropriate and accurate formulas in a spreadsheet format.

CESAD-PDS-P 30 June 2009
SUBJECT: Wetlands Value Assessment Model Assessment Report – Recommendation for Use for the Sabine-Neches Waterways Study, Galveston District

3. Based on these findings we concur that the WVA Marsh, Swamp, and Bottomland Hardwood Community Models are certified for use in the SNWW Feasibility study.

4. The Mobile District point of contact is Dr. Susan Ivester Rees, CESAM-PD, (251) 694-4141.

FOR THE COMMANDER:

WILBERT V. PAYNES
Director of Deep Draft Navigation
Planning Center of Expertise

CF:
Janelle S. Stokes (CESWG-PE-PR)
Jodi K. Staebell (CEMVD-RB-T)

# Appendix D

# Dredged Material Management Plan

2199

APPENDIX D

# ENVIRONMENTAL IMPACT STATEMENT
# SABINE-NECHES WATERWAY
# CHANNEL IMPROVEMENT PROJECT, TEXAS
# DREDGED MATERIAL MANAGEMENT PLAN

**PREPARED BY:**


**U.S. ARMY CORPS OF ENGINEERS**
**GALVESTON DISTRICT**
**SOUTHWESTERN DIVISION**



June 2010

*Printed on recycled paper*

APPENDIX D
SABINE-NECHES WATERWAY, TEXAS AND LOUISIANA
CHANNEL IMPROVEMENT PROJECT
DREDGED MATERIAL MANAGEMENT PLAN

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ACRONYMS

| | |
|---|---|
| AO | allowable overdepth |
| BU | beneficial use |
| CG | Construction General |
| CIP | Channel Improvement Project |
| CPT | cone penetrometer testing |
| cy | cubic yards |
| DAMP | Disposal Area Management Plan |
| DMMP | Dredged Material Management Plan |
| EPA | U.S. Environmental Protection Agency |
| ERDC | Engineer Research and Development Center |
| FEIS | Final Environmental Impact Statement |
| FFR | Final Feasibility Report |
| GIWW | Gulf Intracoastal Waterway |
| HTRW | hazardous, toxic, and radioactive waste |
| ICT | Interagency Coordination Team |
| JCND | Jefferson County Navigation District |
| LPP | Locally Preferred Plan |
| mcy | million cubic yards |
| NWP | New Work Plan |
| O&M | operations and maintenance |
| ODMDS | Ocean Dredged Material Disposal Sites |
| PA | placement area |
| PED | Preconstruction Engineering and Design |
| psf | per square foot |
| SH | State Highway |
| SNND | Sabine Neches Navigation District (SNND |
| SNWW | Sabine-Neches Waterway |
| TCB | Turner Collier Braden, Inc. |
| TPWD | Texas Parks and Wildlife Department |
| TxDOT | Texas Department of Transportation |
| URS | URS Corporation |
| USACE | U.S. Army Corps of Engineers |

## 1.0 PURPOSE

The purpose of the Dredged Material Management Plan (DMMP) is to guide the Federal and non-Federal sponsors in the placement of material to be dredged from the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) for the 50-year period of analysis. This DMMP would apply to both construction (new work) and maintenance dredging.

The DMMP was developed by the U.S. Army Corps of Engineers (USACE), Galveston District, the Sabine Neches Navigation District (SNND), and the SNWW Interagency Coordination Team (ICT). The DMMP includes the use of construction and maintenance material for marsh restoration and Gulf shore nourishment, and modification of existing practices for the remaining construction and maintenance material.

## 2.0 DESCRIPTION OF EXISTING AND CIP

### 2.1 EXISTING SNWW PROJECT

The existing Sabine-Neches Waterway (SNWW) extends from the Gulf of Mexico through a jettied entrance at the mouth of Sabine Pass through Port Arthur, and up the Neches River into Beaumont, Texas (Drawing G-01 in Appendix 1 of the Final Feasibility Report [FFR]). It is 63.8 miles in length and has a 40-foot authorized depth. Channel dimensions for the 40-foot project are shown in Table 2-1.

**Table 2-1: Existing 40-Foot Authorized Channel Dimensions**

| Reach | Station | to | Station | Bottom Width (feet) | Project Depth (feet MLT) | Channel Depth (feet MLT) | Allowable Overdepth (feet) | Side Slope |
|---|---|---|---|---|---|---|---|---|
| Sabine Bank Channel | 95+734 | | 18+000 | 800 | 42 | 44 | 2 | 1V/2H |
| Sabine Pass Outer Bar | 18+000 | | 0+000 | 800 | 42 | 44 | 2 | 1V/10H |
| Sabine Pass Jetty Channel | –214+88 | | 0+00 | 800–500 | 40 | 42 | 2 | 1V/2H |
| Sabine Pass Channel | 0+00 | | 296+24 | 500 | 40 | 42 | 2 | 1V/2H |
| Port Arthur Canal | 0+00 | | 326+24 | 500 | 40 | 42 | 1 | 1V/2H |
| Sabine-Neches Canal | 0+00 | | 593+69 | 400 | 40 | 42 | 1 | 1V/2H |
| Neches River Channel | 0+00 | | 978+60 | 400 | 40 | 42 | 2 | 1V/2H |
| **Taylor Bayou** | | | | | | | | |
| Entrance Channel | 0+00 | | 19+05 | 275–678 | 40 | 42 | 1 | 1V/2H |
| East Turning Basin | 0+00 | | 17+65 | 420 | 40 | 42 | 1 | 1V/2H |
| West Turning Basin | 19+05 | | 31+10 | 600 | 40 | 42 | 1 | 1V/2H |
| Connecting Channel | 31+10 | | 61+30 | 200–250 | 40 | 42 | 1 | 1V/2H |
| Taylor Bayou Turning Basin | 61+30 | | 96+00 | 1000 | 40 | 42 | 1 | 1V/2H |

Channel Depth includes Advance Maintenance depth – there is a constant 2 feet for the entire waterway.
Existing stationing applies to this table.
^Entrance Channel and East and West Turning Basins are also called "Port Arthur Turning Basins."

## 2.2 PROPOSED SNWW CIP

The SNWW CIP would deepen the navigation channel to 48 feet and extend the channel an additional 13.2 miles into the Gulf of Mexico (Drawing G-02 in Appendix 1 of the FFR), resulting in a total SNWW CIP length of 77 miles (Table 2-2). Proposed project channel reaches are illustrated in drawings C-01 through C-12 in Appendix 1 of the FFR. The Channel to Orange is considered part of the SNWW system but it is not a part of this study.

**Table 2-2: Proposed SNWW CIP 48-Foot Project Dimensions**

| Reach | Station | to | Station | Bottom Width (feet) | Project Depth (feet) | Side Slope |
|---|---|---|---|---|---|---|
| Extension Channel | 165+443 | | 95+734 | 700 | 50 | 1V/2H |
| Sabine Bank Channel | 95+734 | | 25+800 | 700 | 50 | 1V/2H |
| | 25+800 | | 23+300 | 700–800 | 50 | 1V/2H |
| | 23+300 | | 18+000 | 800 | 50 | 1V/2H |
| Sabine Pass Outer Bar | 18+000 | | 0+000 | 800 | 50 | 1V/10H |
| Sabine Pass Jetty Channel | –214+88 | | 0+00 | 500–800 | 48 | 1V/2H |
| Sabine Pass Channel | 0+00 | | 296+25 | 1355–500 | 48 | 1V/2H |
| Port Arthur Canal | 0+00 | | 325+84 | 1660–500 | 48 | 1V/2H |
| Sabine-Neches Canal | 0+00 | | 592+94 | 1050–400 | 48 | 1V/2H |
| Neches River Channel | 0+00 | | 980+00 | 400–1413 | 48 | 1V/2H |
| **Taylor Bayou** | | | | | | |
| Entrance Channel | 0+00 | | 25+27 | 406–764 | 48 | 1V/2H |
| East Turning Basin | 0+00 | | 17+65 | 532–354 | 48 | 1V/2H |
| West Turning Basin | 25+27 | | 41+30 | 776 | 48 | 1V/2H |
| Connecting Channel | 41+30 | | 71+50 | 470–250 | 48 | 1V/2H |
| Taylor Bayou Turning Basin | 71+50 | | 106+25 | 1000 | 48 | 1V/2H |

## 3.0 GEOTECHNICAL INVESTIGATIONS

The level of geotechnical engineering performed for this report is fully sufficient to substantiate the recommended plan. Additional investigations and analyses, briefly outlined in Section 6.0 in accordance with ER 1110-2-1150, Appendix C-4, would be performed during both the Preconstruction Engineering and Design (PED) and Construction General (CG) phases of the project, and documented in a Design Documentation Report before each feature is constructed.

## 3.1 REGIONAL AND SITE GEOLOGY

### 3.1.1 Regional Geology

The project site, as shown on Drawing G-01 in Appendix 1 of the FFR, is located in the Coastal Plain physiographic province of Texas. This region contains marine sediments, mainly younger Holocene

deposits overlay older Pleistocene deposits. More-recent riverine overwash deposits overlay the Holocene sediments in floodplains in the Neches and Sabine rivers. The subdivision of the Coastal Plain in which the project lies is called the Coastal Prairie. This area is characterized by low-lying flat land and has evolved to its present conditions by erosion, deposition, compaction, and subsidence, all of which are still active. Gradual faulting continues as Pleistocene and older Gulf basin sediments continue to compact.

### 3.1.2 Site Geology

The site geology is characterized by modern marine deposits overlaying recent Holocene deposits that in turn overlay the Beaumont and Lissie formations of the Pleistocene Series. The modern deposits are generally normally consolidated clays, silts, and fine sands that were deposited through natural overwash and sedimentation processes or through man-made depositional processes. The recent deposits of the Holocene consist of silts, clays, silty sands, clayey sands, and clayey silts that exhibit the characteristics of normally to lightly overconsolidated materials. These deposits are generally encountered to depths of 30 to 40 feet.

Beaumont Clay is the predominant Pleistocene formation whose eroded surface forms the upper limit of stiff to very stiff clay material. It is red, yellow, and brown calcareous stiff clay that weathers into black or gray soil at the surface. Lenses of fine-grained, poorly graded sand and silt and a few calcareous nodules are sometimes encountered in this formation. The clay fraction is composed of montmorillonite (generally with calcium as the exchangeable cation), kaolinite, illite, and finely ground quartz, in that order of prevalence. The high percentage of montmorillonite accounts for the high shrink-swell potential of the material. Previous desiccation of the clays results in significant overconsolidation to great depths, with preconsolidation pressure approaching 3 tons per square foot. In addition to preconsolidating the soil, the desiccation process, along with occasional rewetting, has resulted in a network of fissures and slickensides that are now closed but that represent potential planes of weakness within the stratum. The thicknesses of these clays range from 25 to 400 feet. The Lissie Formation underlies the Beaumont and consists primarily of sands and silty sands.

## 3.2 FIELD EXPLORATION

Limited field investigations were conducted for this project. Those conducted were limited to cone penetrometer testing along the proposed levee alignments at selected placement areas. In addition, probings were taken at selected environmental features to evaluate near-surface foundation issues. The majority of the subsurface data for the project was compiled from existing data – data from the channel that were collected for the 40-foot project and data from placement areas that have been collected during periodic levee-raising projects. Site subsurface data are presented on drawings F-1 through F-6 in Appendix 1 of the FFR. Recommendations for additional geotechnical investigation, both project channel and placement areas along with associated laboratory testing are provided in Section 6.0.

### 3.2.1 Core Borings and Laboratory Testing

Where noted on the plans, core borings were previously drilled to explore the subsurface conditions along the channel and at some placement areas. Unless otherwise indicated, the borings were drilled to obtain 3-inch-diameter undisturbed continuous samples of cohesive materials and split-spoon, disturbed samples of cohesionless materials. Consistencies of cohesive materials were determined in the field using a pocket penetrometer or a Torvane Shear test apparatus. Where cohesionless materials were encountered, disturbed samples were taken at approximately 5-foot depth intervals during the performance of standard penetration tests.

Laboratory testing was generally conducted on representative samples. Tests on cohesive materials consisted of determining moisture content, unit dry weight, sieve analyses, liquid limit, and plastic limit. Sieve analyses were performed on typical samples of cohesionless materials. The results of these tests were used to classify the various material layers. Unconsolidated undrained shear strengths of typical samples of cohesive materials were determined in the laboratory by performing unconfined compression tests, single point Unconsolidated Undrained "Q" Triaxial compression tests, and Torvane Shear tests.

### 3.2.2 Off-channel Probings

Probings, using a 1.5-inch-diameter, capped PVC pipe, were conducted off channel in selected areas intended for restoration features. These probings were used to evaluate the open-water foundation conditions. These data were used to estimate the thickness of soft bay-bottom mud and determine how much displacement may occur during hydraulic fill construction. This information was incorporated into the conceptual level design of these features.

### 3.2.3 Cone Penetrometer Testing

Cone penetrometer testing (CPT) was conducted at selected placement areas (PAs) in 2002 to evaluate levee and levee foundation conditions. PAs 5, 8, 9, 11, 12, 13, 14, 23, 24, 25, and 27B were evaluated. Except at PA 25, the CPTs were conducted by the USACE Vicksburg District using their in-house, truck-mounted electric cone penetrometer. At PA 25, CPTs were conducted by Fugro, Inc. under subcontract to URS Corporation (URS). URS also reviewed the data and prepared soil profile drawings. These data were used to develop embankment design recommendations and to provide recommendations for additional exploratory studies.

At PA 9, in addition to taking CPTs along the perimeter levees, URS performed in situ vane shear tests at selected locations in PA 9 to confirm the Nk value selected for analysis of the CPT field data.

## 3.3 DESIGN CONSIDERATIONS

### 3.3.1 Selection of Preliminary Design Parameters

The geotechnical design parameters used to develop the features presented in this feasibility study are varied and range from the traditional geotechnical parameters for shear strength and consolidation to hydraulic dredging parameters for bulking, retention, and shrinkage. These preliminary design parameters were developed from a variety of sources. These sources include contractor work by URS, recent in-house experience with the construction of hydraulic levees, historic in-house data associated with dredged material placement, and local knowledge based on the historic performance of foundation soils at specific placement areas.

### 3.3.2 Shoaling Rate

Shoaling rates for the new channel were developed by the USACE's Coastal and Hydraulics Laboratory at the Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi (Reference 1). The study evaluated the existing reaches and calculated a combined shoaling factor. Initially this study was developed for a 50-foot-deep channel. Subsequently, the model was revised to reflect the 48-foot channel. The conclusion of this report states that annual dredging quantity in the SNWW would increase from an average of 8.1 million cubic yards (mcy) per year (407 mcy over 50 years) for the current 40-foot project to 13.0 mcy per year (650 mcy over 50 years) for the proposed 48-foot project. Three of the reaches evaluated are located offshore of the jetties. On average, the shoaling increased by 12 percent through the offshore portion of the waterway due primarily to the increased length of the offshore channel. These new shoaling rates have been used to develop the DMMP.

### 3.3.3 Bulking Factor

The bulking factor is a design parameter primarily used to develop levee height requirements. The factor is greater than 1 and generally ranges between 1.3 and 1.8. The bulking process is a result of the structural disruption of the dredged sediments and the entrainment of water into the sediments during dredging. This factor is traditionally defined as the ratio of the volume occupied by the dredged material in the placement area immediately after completion of dredging to the volume occupied by the same material in the channel before dredging. The amount of bulking varies with the type of sediments and the method of dredging (mechanical or hydraulic). Other factors that affect bulking include size of dredge, horsepower, and residence time in the pipeline. For dredged material placed in upland PAs or used in environmental features, dredging would be conducted hydraulically. Sediments include both new work clay and sand and maintenance materials. Some maintenance materials reportedly contain high sand contents. Generally, fine-grained sediments bulk more (exhibit a larger bulking factor) than coarse-grained sediments, and maintenance material bulks more than new work. Bulking occurs during dredging operations. Upon completion of pumping, the PA is dewatered, and shrinkage of the newly placed dredge sediments begins. The bulked volume in conjunction with freeboard and ponding requirements is calculated to develop the required levee crest elevations.

$$Bulking\ Factor = \frac{(Volume\ of\ Dredged\ Material\ in\ Placement\ Area)}{(Volume\ in\ Channel\ Prior\ to\ Dredging)}$$

Bulking factors for each reach of the SNWW were developed by URS using available geotechnical data from channel borings. These values ranged from 1.8 in the reaches where clay predominated to 1.2 where more coarse-grained materials were encountered.

### 3.3.4 Retention Factor

The retention factor is a parameter used in the design of hydraulically constructed levees. The design of hydraulic levees includes the evaluation of the dredge fill material, levee foundation, site conditions, and construction methods (type, size, and horsepower of dredge and pipeline distance). Typically, the design provides a final levee template that incorporates all of these components through the use of a retention factor. This factor quantifies the fact that not 100 percent of the actual dredged quantity would fall within the desired template while constructing a hydraulic levee. A retention factor is therefore calculated as the ratio of the apparent volume of retained fill divided by the actual dredged quantity:

$$Retention\ Factor = \frac{(Volume\ of\ Retained\ Fill)}{(Actual\ Dredging\ Quantity)}$$

The retention factor is a single number that includes allowances for material degradation (i.e., clay ball degradation), displacement of the foundation, depth of water, amount and distribution of sand within the dredge cut, the dredging operation itself (type and size of dredge, number of booster pumps, type of cutterhead used, and control of the cutterhead), and relative difference between the design template and the natural angle of repose of the dredge fill.

Hydraulic levees would be utilized on this project for restoration features. These marsh restoration features would be constructed in water depths ranging from 2 to 5 feet. Based on the District's experience with similar construction projects on the Houston Ship Channel (Atkinson Island and Mid Bay Marsh), retention factors typically range from 0.35 to 0.45. These values have been incorporated into preliminary design for this plan. Additional design documentation for these features is located in Reference 2. During final design of these features, the retention factor along with other design parameters would be reevaluated using site-specific data.

Hydraulic levees are also planned for new levee construction at new upland PAs. At these sites, the contractor is afforded more control over the dredge fill because the fill surface is emergent. The use of dredged material for construction can be maximized by building containment dikes ("potato rows") on the inside of the PA and other specific construction methods. Similar projects have been constructed on the Houston Ship Channel (Spillman Island and Alexander Island). Retention factors ranging from 0.60 to 0.70 are expected with these construction methods.

### 3.3.5 Shrinkage Factor

The shrinkage factor is a design parameter used to evaluate the long-term storage capacity of a PA for use in developing the DMMP. It is defined as the ratio of the long-term volume occupied by a certain quantity of dredged material in a PA, to the volume it occupied in the channel prior to dredging. Generally, this parameter is associated with maintenance material, but may also be associated with new work material.

$$Shrinkage\ Factor = \frac{(Long\text{-}term\ Volume\text{-}Disposal\ Area)}{(Volume\ Occupied\text{-}Channel\ Before\ Dredging)}$$

This factor is a measure of volume change between dredging and the long-term condition. As with the retention factor, the shrinkage factor includes allowances for material type and degradation and the dredging operation (type and size of dredge, number of booster pumps, type of cutterhead used, and control of the cutterhead). Additional components that contribute to the shrinkage factor include consolidation of the dredged material due to self weight and desiccation, climatological conditions, and maintenance, including drainage and usage schedule of the PA.

Determination of a precise shrinkage factor for a PA can be a complex task and includes modeling the consolidation and desiccation shrinkage based on laboratory test data, climatological data, drainage characteristics, and operational characteristics. Based on the District's experience along the SNWW, shrinkage factors generally range from 0.55 to 0.75, with coarse-grained material exhibiting less shrinkage. Along this waterway, PAs usage varies from 2 to 6 years per cycle. In addition, very little maintenance (i.e., dewatering) is conducted on the PAs between cycles.

### 3.3.6 Shear Strength

Shear strength values have been considered for two conditions – channel slopes and placement area levee/embankment slopes. Where channel slopes would be excavated for the new template, long-term drained shear strengths are generally considered critical. Under these conditions, pore pressures increase with time as the excavated material is relieved of the overburden pressure. This increase in pore pressure reduces the shear strength of the soil. Where fill slopes are located such as the levee slopes of PAs, undrained shear strengths are generally considered critical. Under these conditions, pore pressures increase immediately as the foundation is surcharged with new fill. These elevated pore pressures reduce the shear strength of the soil. Overtime, pore pressures dissipate and some strength gain is realized.

Shear strength values and associated design parameters for channel slopes were derived from available subsurface data including boring logs and laboratory test data. Reviewed data included borings along the project channels, borings taken in association with referenced bridges, and borings taken in association with the hurricane flood protection levee.

Shear strength values and associated design parameters for new levee and raised levee construction at the upland placement areas were developed by URS from newly taken CPTs. These data included undrained shear strengths of the cohesive soils. The undrained shear strength assigned to the weakest layers was 500 pounds per square foot (psf). The shear strength of the dredged material was assumed to increase slightly with consolidation over time. An undrained shear strength of 700 psf was assigned to the partially consolidated dredged material. The shear strength of cohesionless soils was based on correlations between CPT data and angle of internal friction.

Recommendations for additional investigation and laboratory testing to refine the design parameters are provided in Section 6.0.

### 3.3.7 Consolidation

Foundation settlement was evaluated where new levees are planned and where levee raisings are planned. Settlement characteristics of the founding soils were developed from existing subsurface data including soil borings and CPT. Laboratory consolidation tests were not available for review, and no additional testing was conducted for this study. Instead, empirical consolidation relationships were used based on the observed consistency of field samples taken from soil borings and CPT results.

## 3.4 SLOPE STABILITY AND FOUNDATION CONCERNS

### 3.4.1 Project Channels

The project channels include three reaches offshore of the Sabine Pass jetties and five reaches onshore (Table 3-1). The existing slope angles for these channels would be maintained for the proposed deepening. Slope angles of 1V:2H are utilized on all channels except the Sabine Pass Outerbar where the slope angle is 1V:10H. The onshore reaches would be deepened to 48 feet while the offshore reaches would be deepened to 50 feet. The channel bottom width onshore is generally 400 feet, while the offshore is generally 700 feet.

**Table 3-1: Reaches of the SNWW**

| Offshore Reaches | Onshore Reaches |
|---|---|
| Extension Channel | Sabine Pass Channel |
| Sabine Bank Channel | Port Arthur Canal (including Taylor Bayou) |
| Sabine Pass Outerbar | Sabine-Neches Canal |
| Sabine Pass Jetty Channel | Neches River Channel |

Channel slope stability was generally evaluated by assessing the performance of the existing slopes through a review of the historic cross-section surveys. In addition, four typical channel cross sections were analyzed by URS for stability using the Modified Bishop analyses. Results indicated that adequate factors of safety were maintained with the deepened channel.

A more detailed analysis of channel slope stability was conducted at the Port Arthur Canal along the alignment of the hurricane flood protection levee as well as at the three bridge locations. This effort was conducted to determine the potential impact to these structures as a result of the channel deepening. These studies revealed potential impacts with corresponding resolutions (Table 3-2).

**Table 3-2: Channel Stability Analyses along the SNWW**

| Location (owner) | Potential Impacts | Resolution |
|---|---|---|
| Port Arthur Canal and Sabine-Neches Canal – Hurricane Flood Protection Levee (JCND) | Destabilize toe of hurricane flood protection levee | Shift channel centerline away from the hurricane flood protection levee |
| Sabine-Neches Canal – Martin Luther King Bridge (TxDOT) | Undermine pile cap and expose tops of piles, destabilize pier protection | Construction of a hardened structure to protect pile cap, piles, and piers |
| Neches River Channel – Rainbow Bridge (TxDOT) | Destabilize pier protection system | Replace pier protection system |
| Neches River Channel – Memorial Bridge (TxDOT) | Destabilize pier protection system | Replace pier protection system |

JCND = Jefferson County Navigation District
TxDOT = Texas Department of Transportation

### 3.4.2 Upland Placement Areas

Both existing and new upland PAs would be used for this project. At the existing PAs, new work material would be hydraulically stockpiled on the interior of the levees. Conceptually, this footprint would extend 100 feet into the interior and would ring the levee. It is expected that this stockpile would displace soft material at the interior toe of the levee and create a stable platform on which to build subsequent levees. At the new PAs, the new work material would be used to build hydraulic levees.

After initial construction with new work material, the design of the final perimeter levee heights for the next 50 years was guided by the results of the slope stability analyses. Conceptual level slope stability analyses were conducted by URS on the levees using the Modified Bishop Method and Taylor's Charts. Analyses were performed for each PA for the selected critical section using the least favorable subsurface conditions encountered at the PA as determined using the CPT data. The overall stability of the PAs (i.e., limit on the maximum height) was controlled by the strength of the partially consolidated dredged material. The levee setbacks were selected to provide an acceptable factor of safety with the anticipated relatively low strength of the partially consolidated dredged material. The minimum factor of safety was found to be 1.2 for slope heights not greater than 40 feet above the levee toe for the design slopes and assumed setbacks. Details of the conceptual level design by URS are included in references 7 and 8. More-detailed analyses of the various slope configurations would be required during subsequent levee-raising efforts for specific PAs.

### 3.4.3 Beneficial Use Features

Preliminary design for the marsh restoration and nourishment sites was conducted in part by Turner Collie & Braden, Inc. (TCB) in the document Feasibility Site Concept Beneficial Use (BU) Development

(Reference 2). The preliminary design of other features was conducted in-house. These designs included hydraulic levees, foundations, consolidation of dredged material, and slope stability. More-detailed design would be conducted during subsequent PED phases.

## 3.5 CONSTRUCTION ISSUES

### 3.5.1 Excavatability

The proposed deepening would entail dredging new work material. Based on a review of limited existing soil boring data taken during previous studies, the material would range from very soft to very stiff clay and loose to dense sand. No rock is anticipated, and blasting would not be required.

The new work material within the offshore reaches (sections 4, 3, 2, 1, A, B, C, and D) and the adjacent onshore reaches (sections 5 and 6) is likely to consist of soft clay with pockets of stiff clay; some sand may also be encountered. These reaches are located within the historic delta region of the Sabine and Neches rivers where normally lightly consolidated materials are located. Materials in this area may vary as the rivers' discharge meandered through the deltaic zone.

New work material within the onshore reaches of the Port Arthur and Sabine-Neches canals (sections 7, 8, 9, 10, and 11) would likely consist of stiff to very stiff clay. These canals are part of the land cut section of the waterway and were excavated early in the 1900s. The stiff consistency of this material can be attributed to the overconsolidation pressure of the material that was previously overlying the canals.

The Neches River channel is located upstream of the Sabine-Neches canal. The new work material for this channel (sections 12 through 18) would vary from stiff clay to medium-dense sand. These variations can be attributed to the historic meanders of the Neches River, although sand was more abundant in the soil samples from sections 15, 16, 17, and 18. In addition, historically the maintenance dredging in these reaches has contained significant amounts of sand.

Throughout the waterway, conventional dredging plants may be used to dredge the new work material. However, in order to achieve the intent of the new work plan (i.e., stockpiling new work material and building hydraulic levees), larger dredge plants may be required to minimize the degradation of the stiff new work clays (clayball material). Plant requirements should be clearly identified in developing the plans and specifications for this work,

### 3.5.2 Dredging

Channel deepening of the inshore reaches would require the use of pipeline dredges of sufficient size and power to pump the new work materials to the areas indicated. Hopper dredges would be required to utilize the offshore sites and be capable of precise location and discharge of loads. The dredging industry has sufficient plants and equipment available in this area as well as nationwide, which are capable of accomplishing this work.

### 3.5.3 Placement Areas

Much of the material to be dredged would consist of new work material made up of stiff clays. The current New Work Plan (NWP) identifies this material to be used for levee building, where new levees are planned, or stockpiling, where existing levees are located. In stockpiled areas, the objective is to use the more dense new work material to displace soft foundation materials on the inside of the existing levees and thus provide a stable platform for future levee raisings. In addition, material may be borrowed from these stockpiles for future levee raisings.

While the new work material is expected to "stack" and be well suited for the proposed construction, specific dredging practices may influence the degree to which this material would stack. These practices include pump distances, pump size, and handling of the pump discharge. Pipeline dredges of sufficient size and power would be required to excavate and pump new work dredged materials to and completely along the inside of the existing perimeter levees. This would require constant monitoring and moving of the dredge discharge pipeline to ensure that the new work clay balls are properly stacked and placed in the proper location along the existing levee side slopes. Stacking of materials in discharge corridors, other than along the inside slopes of existing levees, may be allowed, depending upon the final preparation of plans and specifications for each particular reach of channel. Care should be taken in developing the first contract, plans and specifications to dredge new work material, to ensure that the intent of the NWP is achieved.

### 3.5.4 Beneficial Use Features

The BU features have been identified to receive both new work and maintenance dredged materials and are further discussed in Section 5.3. With the exception of the shoreline nourishment features, these sites would generally consist of marsh restoration features. Difficult access (shallow water) would be encountered at each of the marsh restoration sites. These conditions would require the use of marsh buggies, marsh backhoes, and other pontoon-supported equipment, and airboats. In addition, the size of the sites may limit discharge capacity into the feature and may require the use of Y-valves for more-efficient use of the dredge plant.

## 4.0 DREDGED MATERIAL QUANTITIES

### 4.1 NEW WORK MATERIAL

The term "new work" refers to the material below the existing SNWW channel template, which is needed to be removed in order to increase to the new project depth. The new work material quantities were calculated using an overall surface *.dtm generated by the InRoads software program. The surface is a 3-D representation of the existing SNWW conditions for year 2001. Each channel or canal had its own existing template and proposed template. The template is a trapezoidal shape, defined by bottom width and side slopes. The proposed new template also includes a standard advance maintenance and the allowable overdepth per reach (see tables 4-2 and 4-3). New work material volumes by reach and proposed PAs (the NWP) are presented in Table 4-1.

**Table 4-1: Sabine-Neches Waterway New Work Dredging Volumes for 48-foot LPP Plan**

| Channel Reach | Channel Stations | Water-way Section | New Work Material Designation (PA #) | Estimated New Work Dredged Volume (cy)** | New Work Material Construction | New Work Material Used for Construction Volume (cy) | New Work Material Surplus Volume (cy) |
|---|---|---|---|---|---|---|---|
| Sabine Bank Extension | 165+443 to 150+500 | D | PA D (Offshore) | 4,201,000 | 0 | 0 | 0 |
| | 150+500 to 132+000 | C | PA C (Offshore) | 4,648,000 | 0 | 0 | 0 |
| | 132+000 to 114+000 | B | PA B (Offshore) | 5,296,000 | 0 | 0 | 0 |
| | 114+000 to 95+734 | A | PA A (Offshore) | 4,592,000 | 0 | 0 | 0 |
| Sabine Bank Channel | 95+734 to 53+000 | 1 | PA 1 (Offshore) | 8,307,000 | 0 | 0 | 0 |
| Sabine Bank Channel | 53+000 to 18+000 | 2 | PA 2 (Offshore) | 7,051,000 | 0 | 0 | 0 |
| Sabine Outer Bar | 18+000 to 0+000 | 3 | PA 3 (Offshore) | 5,923,000 | 0 | 0 | 0 |
| Sabine Pass Jetty Channel | –214+88 to 0+00 | 4 | PA 4 (Offshore) | 2,978,000 | 0 | 0 | 0 |
| Sabine Pass Channel | 0+00 to 186+00 | 5 | PA 5 (N and S) | 4,459,600 | New Hyd. levee; 400-foot-wide stockpile | 3,104,137 | 1,093,593 |
| | 186+00 - 296+25 | 6 | PA 5B | 2,263,600 | 400-foot-wide stockpile | 1,362,051 | |
| | | | PA 5C | | 400-foot-wide stockpile | 1,163,419 | |
| Port Arthur Canal | 0+00 –240+00 | 7 | PA 8 | 5,026,000 | Stockpile in southwest corner | 5,026,000 | 0 |
| | 240+00 –325+84 | 8* | PA 8 | 6,671,200 | Stockpile in southwest corner | 3,691,462 | 0 |
| | | | PA 9A | | 300-foot-wide stockpile | 1,898,938 | 0 |
| | | | PA 9B | | 300-foot-wide stockpile | 1,080,800 | 0 |
| Sabine-Neches Canal | 0+00 –170+00 | 9 | PA 8 | 3,092,000 | Stockpile in northeast corner | 3,092,000 | 0 |
| | 170+00 –592+91 | 10 | PA 11 | 8,852,000 | Stockpile in north-south corners | 8,852,000 | 0 |

**Table 4-1 Cont'd)**

| Channel Reach | Channel Stations | Water-way Section | New Work Material Designation (PA #) | Estimated New Work Dredged Volume (cy)** | New Work Material Construction | New Work Material Used for Construction Volume (cy) | New Work Material Surplus Volume (cy) |
|---|---|---|---|---|---|---|---|
| Neches River Channel | 0+00 –96+00 | 11 | PA 12 | 1,628,000 | 100-foot-wide stockpile | 1,135,764 | 74,029 |
| | | | PA 13 | | 100-foot-wide stockpile | 418,207 | |
| | 96+00 – 58+00 | 12 | PA 14 | 698,000 | 100-foot-wide stockpile | 522,906 | –362,241 |
| | | | PA 16 | | 100-foot-wide stockpile | 537,335 | |
| | 158+00 –292+00 | 13 | Old River Cove | 4,882,000 | Marsh BU | 4,882,000 | 0 |
| | 292+00 –422+00 | 14 | PA 18 | 2,213,000 | 100-foot-wide stockpile | 870,540 | 49,295 |
| | | | PA 18A | | New Hyd. Levee | 293,164 | |
| | | | Bessie Heights East | | Hyd. Levee System | 1,000,000 | |
| | 422+00 –522+00 | 15 | PA 21 | 2,611,000 | 100-foot-wide stockpile | 397,094 | 1,739,808 |
| | | | PA 23A | | New Hyd. Levee | 474,098 | |
| | 522+00 –716+00 | 16 | PA 23 | 4,106,000 | 400-foot-wide stockpile | 2,728,359 | –1,766,345 |
| | | | PA 24 | | 400-foot-wide stockpile | 2,624,786 | |
| | | | PA 24A | | New Hyd. Levee | 519,200 | |
| | 716+00 –776+00 | 17 | PA 25 | 2,845,000 | 200-foot-wide stockpile | 2,263,932 | 20,009 |
| | | | PA 25A | | New Hyd. levee; 100-foot-wide stockpile | 561,060 | |
| | 776+00 –980+00 | 18 | PA 25 | 6,031,000 | 50-foot-wide stockpile | 421,197 | 96,456 |
| | | | Rose City East | | Hyd. Levee System | 2,100,000 | |
| | | | PA 26 | | 400-foot-wide stockpile | 1,773,504 | |
| | | | PA 27A | | 200-foot-wide stockpile | 1,136,376 | |
| | | | PA 27C | | New Hyd. Levee | 283,200 | |
| | | | PA 27D | | New Hyd. Levee | 220,267 | |
| **TOTAL** | | | | 98,374,400 | | 54,433,796 | 944,604 |

* Includes new material from Taylor Bayou (0+00 to 106+25).
** New work volume includes additional advance maintenance and proposed allowable overdepth.
cy = cubic yards

### 4.1.1 Allowable Overdepth

An additional depth outside the required template is permitted to allow for inaccuracies in the dredging process. District commanders may dredge a maximum of 2 feet of Allowable Overdepth in coastal regions and in inland navigation channels (ER 1130-2-520, *Navigation and Dredging Operations and Maintenance Policies)*. This additional dredging allowance is referred to as a dredging tolerance, or allowable overdepth (AO). AO for the existing channel varied between 1 to 2 feet AO. The proposed waterway would contain a constant 2 feet AO for the entire length (Table 4-2).

**Table 4-2: Allowable Overdepth**
**Existing and Proposed Project**

| Reach | Allowable Overdepth (feet) |
|---|---|
| Port Arthur Canal (0+00 to 290+00) | 1 |
| Increase to Maximum Allowed | 2 |
| **Port Arthur Junction | 1 |
| Increase to Maximum Allowed | 2 |
| Taylor Bayou (Old Sta. 31+10 to 106+25, East TB) | 1 |
| Increase to Maximum Allowed | 2 |
| Sabine-Neches Canal (40+00 to 592+91) | 1 |
| Increase to Maximum Allowed | 2 |
| Neches River Channel (0+00 to 320+00) | 1 |
| Increase to Maximum Allowed | 2 |
| Neches River Channel (320+00 to 440+00) | 1 |
| Increase to Maximum Allowed | 2 |
| Neches River Channel (440+00 to 978+00) | 1 |
| Increase to Maximum Allowed | 2 |

### 4.1.2 Nonpay Dredging

Nonpay dredging is dredging outside the paid AO that may occur due to such factors as unanticipated variations in substrate, incidental removal of submerged obstructions, or wind or wave conditions. There are no known conditions that would indicate that the contractor would require extensive dredging in order to cut the proposed channel template. Thus, the new work volumes do not include any estimate of nonpay dredging.

### 4.1.3 Non-Federal Dredging

Non-Federal dredging quantities vary throughout the length of the waterway. The non-Federal dredging quantity is defined as a percentage of the channel shoaling by section and can be found in Table 4-4. The non-Federal dredge quantity is based on the presence of local facilities, the square foot of the facility, and the shoaling rate of the adjacent channel. The non-Federal quantities are placed within the same placement areas for each waterway section.

## 4.2 ADVANCE MAINTENANCE

Advance maintenance consists of dredging deeper than the authorized channel dimensions so as to provide for the accumulation and storage of sediment. In critical and fast-shoaling areas, it is required to avoid frequent redredging and to ensure the reliability and least overall cost for operating and maintaining the project authorized dimensions. The existing waterway has a constant 2-foot advance maintenance depth. This 2 feet was assumed to remain constant for the proposed waterway. During Detail Design phase, an analysis was performed to determine any changes in dredging frequencies and if additional advance maintenance would be required. Results are presented in Table 4-3. The proposed advance maintenance increase is the depth that is required to allow the proposed dredging frequency to remain the same as the existing operations and maintenance (O&M) dredging frequency. The additional advance maintenance depths were calculated in 1-foot increments. Channel sections with additional advance maintenance are indicated on project maps in the Final Feasibility Report (FFR) and Final Environmental Impact Statement (FEIS).

**Table 4-3: Advance Maintenance Increase**

| Reach | Proposed Advance Maintenance Increase (feet) |
|---|---|
| Outer Bar Channel (0+000 to 18+000) | 4 |
| Sabine Pass Channel (100+00 to 180+00) | 3 |
| Sabine Pass Channel (230+00 to 295+61) | 3 |
| Port Arthur Canal (0+00 to 290+00) | 1 |
| Port Arthur Junction (as shown on Drawing C-21 in Appendix 1 of the FFR) | 5 |
| Port Arthur Canal (285+00 to 326+37) | 5 |
| Taylor Bayou (0+00 to 41+20) | 5 |
| Taylor Bayou (31+10 to 106+25, East TB) | 1 |
| Sabine-Neches Canal (0+00 to 40+00) | 5 |
| Sabine-Neches Canal (31+10 to 592+91) | 1 |
| Neches River Channel (440+00 to 978+00) | 2 |

## 4.3 DREDGING FREQUENCY

The dredging cycle of a channel is defined by the average number of years between the O&M dredging operations for a historical period. Each channel or canal has its own dredging frequency. The District's Dredging Histories Database Management System contains this information and is the major source for the ERDC's Sediment Study Report. It is assumed for the new project that the dredging frequency would not change and would remain identical to the existing waterway. Frequency can be seen in Table 4-4.

## 4.4 PREDICTED SHOALING RATES

The ERDC desktop study for sediment-related problems produced shoaling estimates based on entire reaches, and therefore, an adjustment was performed on the ERDC values to approximate the dredging sections. These dredging sections are defined as shown on the drawings and used for the construction contracts. Using the assumption that shoaling is linearly uniform along the width and length, the breakout for the following dredging sections can be seen in Table 4-4.

**Table 4-4: Predicted Shoaling by Dredging Sections**

| Channel | Dredging Section | Channel Reach | O&M Cycle Frequency (year) | Shoaling cy/Cycle |
|---|---|---|---|---|
| Extension Channel | Section D | Stations 165+443 to 150+500 | 4 | 647,000 |
| Extension Channel | Section C | Stations 150+500 to 132+000 | 4 | 801,000 |
| Extension Channel | Section B | Stations 132+000 to 114+000 | 4 | 779,000 |
| Extension Channel | Section A | Stations 114+000 to 95+734 | 4 | 791,000 |
| Sabine Bank Channel | Section 1 | Stations 95+734 to 53+000 | 4 | 1,508,000 |
| Sabine Bank Channel | Section 2 | Stations 53+000 to 18+000 | 2 | 3,131,000 |
| Sabine Pass Outer Bar Channel | Section 3 | Stations 18+000 to 0+000 | 1 | 4,473,000 |
| Sabine Pass Jetty Channel | Section 4 | Stations –214+88 to 0+00 | 5 | 1,352,700 |
| Sabine Pass Channel | Section 5 | Stations 0+00 to 186+00 | 3 | 977,900 |
| Sabine Pass Channel | Section 6 | Stations 186+00 to 296+25 | 3 | 1,195, 900 |
| Port Arthur Canal | Section 7 | Stations 0+00 to 240+00 | 3 | 2,148,600 |
| Port Arthur Canal | Section 8* | Stations 240+00 to 325+84 | 2 | 1,939,200 |
| Sabine-Neches Canal | Section 9 | Stations 0+00 to 170+00 | 2 | 1,317,000 |
| Sabine-Neches Canal | Section 10 | Stations 170+00 to 592+91 | 4 | 3,360,000 |
| Neches River Channel | Section 11 | Stations 0+00 to 96+00 | 3 | 669,000 |
| Neches River Channel | Section 12 | Stations 96+00 to 158+00 | 3 | 432,000 |
| Neches River Channel | Section 13 | Stations 158+00 to 292+00 | 3 | 934,000 |
| Neches River Channel | Section 14 | Stations 292+00 to 422+00 | 4 | 1,163,000 |
| Neches River Channel | Section 15 | Stations 422+00 to 522+00 | 6 | 965,000 |
| Neches River Channel | Section 16 | Stations 522+00 to 716+00 | 6 | 1,879,000 |
| Neches River Channel | Section 17 | Stations 716+00 to 776+00 | 6 | 581,000 |
| Neches River Channel | Section 18 | Stations 776+00 to 980+00 | 6 | 1,976, 100 |

* Includes maintenance material from Taylor Bayou (0+00 to 106+25)

## 4.5 MAINTENANCE MATERIAL QUANTITIES

The 50-year quantity of maintenance material from the existing 40-foot project (Base Plan) is shown in Table 4-5. The quantity was determined by reviewing maintenance dredging contracts within the project area and applying an incremental increase due to the widened and deepened channel. Shoaling rates for the new channel were developed by the USACE's Coastal and Hydraulics Laboratory at ERDC in Vicksburg, Mississippi. Annual dredging quantity in the SNWW would increase from an average of 8.1 mcy for the current 40-foot project to 13.0 mcy for the proposed 48-foot project. Material from four of the reaches (Extension Channel, Sabine Bank Channel, Sabine Pass Outerbar Channel, and Sabine Pass Jetty Channel) is placed in Ocean Dredged Material Disposal Sites (ODMDSs) as described in Appendix B of the FEIS. The Environmental Protection Agency (EPA) must formally designate the four new ODMDSs A–D located along the Extension Channel before they can be used. The Gulf Shore BU Feature (TX 8-11 and LA 5-2/6-2), described in Section 5.3.5 below, was found to be a least-cost measure and it has been adopted for Section 5 of the Sabine Pass Channel as part of the Base Plan.

**Table 4-5: 50-Year Maintenance Material Base Plan ***
**(SNWW FEASIBILITY STUDY – 40-FOOT PROJECT – 50-YEAR DMMP SUMMARY)**

| Channel Reach | Channel Stations | Waterway Section | Maintenance Material Designation | Dredge Quantity Per Cycle (cy) | Years Per Cycle | Total # of Cycles | 50-Year Maintenance Material Total (cy) |
|---|---|---|---|---|---|---|---|
| Sabine Bank Channel | 95+734 to 53+000 | 1 | PA 1 (Offshore) | 2,512,800 | 4 | 12 | 30,153,600 |
| | 53+000 to 18+000 | 2 | PA 2 (Offshore) | 1,722,400 | 4 | 12 | 20,668,800 |
| Sabine Pass Outer Bar Jetty Channel | 18+000 to 0+000 | 3 | PA 3 (Offshore) | 1,993,700 | 1 | 50 | 99,685,000 |
| Sabine Pass Jetty Channel | -215+59 to 0+00 | 4 | PA 4 (Offshore) | 1,138,500 | 5 | 10 | 11,385,000 |
| Sabine Pass Channel | 0+00 to 186+00 | 5 | TX 8-11/LA 5-1/6-1 | 860,100 | 3 | 16 | 13,761,600 |
| | 186+00 to 295+60 | 6 | PAs 5N, 5S, 5B, and 5C | 1,051,800 | 3 | 16 | 16,828,800 |
| Port Arthur Canal* | 0+00 to 240+00 | 7 | PA 8 | 1,890,000 | 3 | 16 | 30,240,000 |
| | 240+00 to 326+24 | 8* | PAs 8, 9, and 9A | 2,320,350 | 2 | 25 | 58,008,750 |
| Sabine-Neches Canal | 0+00 to 170+00 | 9 | PA 8 | 1,219,400 | 2 | 25 | 30,485,000 |
| | 170+00 to 592+91 | 10 | PA 11 | 2,469,800 | 4 | 12 | 29,637,600 |
| Neches River Channel | 0+00 to 96+00 | 11 | PAs 12 and 13 | 491,900 | 3 | 16 | 7,870,400 |
| | 96+00 to 158+00 | 12 | PA 14 | 317,700 | 3 | 16 | 5,083,200 |
| | 158+00 to 292+00 | 13 | PAs 16 and 17 | 686,600 | 3 | 16 | 10,985,600 |
| | 292+00 to 422+00 | 14 | PAs 18 and 21 | 855,000 | 4 | 12 | 10,260,000 |
| | 422+00 to 522+00 | 15 | PAs 23 and 23A | 771,900 | 6 | 8 | 6,175,200 |
| | 522+00 to 716+00 | 16 | PA 24 | 1,380,500 | 6 | 8 | 11,044,000 |
| | 716+00 to 776+00 | 17 | PA 25 | 426,960 | 6 | 8 | 3,415,680 |
| | 776+00 to 980+00 | 18 | PAs 25A, 26, 27A, 27C, and 27D | 1,451,700 | 6 | 8 | 11,613,600 |
| | | | | | | | **407,301,830** |

* Includes maintenance material from Taylor Bayou (0+00 to 106+25)

## 5.0 BORROW AND DISPOSAL

### 5.1 PLANNING CONSIDERATIONS

The utilization of borrow material and the handling of disposal material is a complex order for this project given the length of channel improvements. An ODMDS plan (Appendix B of the SNWW CIP FEIS) and this DMMP, which includes an NWP, have been developed to evaluate borrow and disposal requirements of specific areas of the SNWW. These reports contain detailed information pertaining to the utilization of specific existing and new PAs and BU sites for disposal of new work and maintenance dredged materials. The placement plan for both new work and maintenance material incorporates BU features developed by the ICT. Engineering criteria for the DMMP were developed in-house with preliminary reports provided by URS (Reference 7). The ODMDS was developed by PBS&J in consultation with the EPA (Reference 3). These plans are summarized in the following paragraphs. Additional details can be found under the separate reports.

The dredged material management along the waterway was evaluated based on 22 subdivided dredging sections. Eight of these sections were located offshore, with Section 4 located at the jetties; sections 3, 2, and 1 extending offshore, within the existing channel alignment; and sections A, B, C, and D extending farther offshore as the channel extension for the new alignment. Fourteen dredging sections were located inshore, with Section 5 located upstream of the jetties and Section 18 located at the terminus of the channel at the Beaumont turning basin on the Neches River. These dredging sections were developed for cost-estimating purposes for the feasibility report. Actual dredging sections for contracting and construction may vary from those identified herein.

In developing the DMMP, a variety of uses, including BU, construction material, and general disposal, were identified for the dredged material, both new work and maintenance. Preliminary designs, including assumptions and quantity requirements, for these uses are presented in the DMMP and NWP and are briefly discussed in the following paragraphs. The following prioritization of use was established in developing these documents:

a. New hydraulic levee construction (highest priority for new work material)
b. Stockpile new work material along the interior of existing levees for future use
c. Feature construction with new work material for restoration and nourishment sites
d. Feature construction with maintenance material for restoration and nourishment sites
e. General disposal of new work and maintenance material in PAs

The DMMP was used as a tool to distribute both the new work and maintenance dredged materials for the feasibility level design. It is anticipated that this plan would change over time as scope or priorities change and contracts are developed. These changes would be reflected during subsequent PED phases, and changes affecting restoration and nourishment sites would be coordinated with the SNWW ICT to ensure that obligations for offsetting impacts of the SNWW CIP are fulfilled.

## 5.2 UPLAND PLACEMENT AREA DESCRIPTIONS

### 5.2.1 Overview

Sixteen PAs would be used to manage the CIP's new work and maintenance material over a 50-year period, as described below (Table 5-1). Twelve of these PAs are currently used on the existing project, while four PAs are currently not utilized. Two new cells to two existing PAs have been proposed. All of these PAs are confined with water discharged from the sites via controlled spillways to outfall canals and drainage ditches. For purposes of the DMMP and NWP, the levees are assumed to be at least 4 feet above the interior PA elevation. At some PAs, a stockpile of new work material would ring the perimeter levees as identified in the NWP. The stockpile would serve to displace soft material and provide a stable platform for future levee raising and also provide a material source for subsequent levee construction. Where new levees are required, hydraulic fill levees would be constructed using new work material. The design template provides a 100-foot crest width, 3:1 side slopes, and a 6-foot height. The locations of each PA are shown on drawings C-1 through C-12 in Appendix 1 of the FFR.

**Table 5-1: Upland PAs for the Preferred Alternative**

| Placement Area | Additional Cell(s) | Size (acres) | Associated Waterway Section |
|---|---|---|---|
| 5 | N&S, B, C | 957 | Sabine Pass Channel (sections 5 and 6) |
| 8 | | 3,570 | Port Arthur Canal (sections 7 and 8)<br>Sabine-Neches Canal (Section 9) |
| 9A | B | 481 | Port Arthur Canal (Section 8) |
| 11 | | 2,170 | Sabine-Neches Canal (Section 10) |
| 12 | | 355 | Neches River Channel (Section 11) |
| 13 | | 140 | Neches River Channel (Section 11) |
| 14 | | 255 | Neches River Channel (Section 12) |
| 16 | | 288 | Neches River Channel (Section 12) |
| 17 | | 316 | Not Used for New Work Material |
| 18 | A* | 432 | Neches River Channel (Section 14) |
| 21 | | 135 | Neches River Channel (Section 15) |
| 23 | A** | 773 | Neches River Channel (sections 15 and 16) |
| 24 | A* | 575 | Neches River Channel (Section 16) |
| 25 | A** | 820 | Neches River Channel (sections 17 and 18) |
| 26** | | 192 | Neches River Channel (Section 18) |
| 27 | A, C**D** | 270 | Neches River Channel (Section 18) |

* = New cells (PAs 18A and 24A), which enlarge existing PAs.
** = Undeveloped cells.

### 5.2.2 Levee Raisings

The DMMP identifies periodic levee raisings to accommodate specific dredging cycles. A summary of the final levee design elevations as developed for this study is presented in Table 5-2. A 4-foot levee raising was assumed for each increment. A maximum levee height of 40 feet was assumed. In developing the DMMP, minimal interior dewatering was assumed. Current practice along the waterway does not

include the use of an active Disposal Area Management Plan (DAMP) in which trenching and dewatering methods are used to maximize shrinkage and thus maximize storage within upland PAs. Therefore, in developing the DMMP for the FFR, it was assumed that DAMPing would not be used. A shrinkage factor of 0.80 was assumed. A regular DAMPing program has been used at select PAs on the Houston Ship Channel, and shrinkage factors on the order of 0.45 have been achieved.

**Table 5-2: Summary of Placement Area Final Levee Design Elevations**

| PA | Assumed Initial Elevation | Final Elevation | Change in Height (feet) | PA | Assumed Initial Elevation | Final Elevation | Change in Height (feet) |
|---|---|---|---|---|---|---|---|
| 5 | 18 | 26 | 8 | 18A | 8 | 16 | 8 |
| 8 | 15 | 27 | 12 | 21 | 12.5 | 20.5 | 8 |
| 9A | 28 | 36 | 8 | 23 | 13.5 | 17.5 | 4 |
| 9B | 17 | 41 | 24 | 23A | 8 | 12 | 4 |
| 11 | 11.2 | 23.2 | 12 | 24 | 14 | 30 | 16 |
| 12 | 24 | 28 | 4 | 24A | 8 | 28 | 20 |
| 13 | 19 | 31 | 12 | 25 | 10 | 12 | 4 |
| 14 | 13 | 29 | 16 | 25A | 8 | 20 | 12 |
| 16 | 13.5 | 21.5 | 8 | 26 | 22 | 34 | 12 |
| 17 | 12 | 20 | 8 | 27A | 26 | 38 | 12 |
| 18 | 16 | 20 | 4 | 27C, D | 17 | 29 | 12 |

### 5.2.3 LPP Placement Plans

The new work material placement plan for the proposed 48-foot LPP is summarized in Table 4.1. The 50-year plan for maintenance material is presented in Table 5-3. Plans for the utilization of each PA through the project life are provided below. The 16 existing PAs that would be used for the CIP are discussed first, followed by the two new PA cells that would be needed. The location of each PA is shown on drawings C-1 through C-12 in Appendix 1 of the FFR.

#### 5.2.3.1 Existing PAs

**Placement Area Nos. 5 (N&S), 5B, and 5C**

PAs 5 (N&S), 5B, and 5C are located on the east bank of the Sabine Pass Channel in Louisiana and bounded on the east by State Highway (SH) 82 and marshlands. The combined PA consists of 957 acres and is located as shown on Drawing C-09 in Appendix 1 of the FFR. The area would be used to place approximately 6.7 mcy of new work dredged materials from the sections 5 and 6 of the Sabine Pass Channel portion of the project. Prior to placement of new work material, the existing levees would be initially raised about 5.5 feet and new levee reaches raised to match raised existing levees, to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. Three cells would have all the new work materials stockpiled, with berm widths approximately 400 feet placed around the existing levee perimeter. The PA would be used for management of maintenance material from Section 6. The maintenance material from Section 5 would be used for environmental features TX 8-11 and LA 5-2/6-2 – Shoreline Nourishment.

**Table 5-3: SNWW Feasibility Study – 48-Foot Project – 50-Year DMMP Summary**

| Channel Reach | Channel Stations | Waterway Section | Maintenance Material Designation | Dredge Quantity Per Cycle (cy) | Years Per Cycle | Total # of Cycles | Dredging Cycle Schedule | 50-Year Maintenance Material Total (cy) |
|---|---|---|---|---|---|---|---|---|
| Sabine Bank Extension | 165+443 to 150+500 | D | PA D (Offshore) | 647,000 | 4 | 12 | Cycle 1 through 12 | 7,764,000 |
| | 150+500 to 132+000 | C | PA C (Offshore) | 801,000 | 4 | 12 | Cycle 1 through 12 | 9,612,000 |
| | 132+000 to 114+000 | B | PA B (Offshore) | 779,000 | 4 | 12 | Cycle 1 through 12 | 9,348,000 |
| | 114+000 to 95+734 | A | PA A (Offshore) | 791,000 | 4 | 12 | Cycle 1 through 12 | 9,492,000 |
| Sabine Bank Channel | 95+734 to 53+000 | 1 | PA 1 (Offshore) | 1,508,000 | 4 | 12 | Cycle 1 through 12 | 18,096,000 |
| Sabine Bank Channel | 53+000 to 18+000 | 2 | PA 2 (Offshore) | 3,131,000 | 2 | 25 | Cycle 1 through 25 | 78,275,000 |
| Sabine Outer Bar | 18+000 to 0+000 | 3 | PA 3 (Offshore) | 4,473,000 | 1 | 50 | Cycle 1 through 50 | 223,650,000 |
| Sabine Pass Jetty Channel | –214+88 to 0+00 | 4 | PA 4 (Offshore) | 1,352,700 | 5 | 10 | Cycle 1 through 10 | 13,527,000 |
| Sabine Pass Channel | 0+00 – 186+00 | 5 | TX 8-11, | 977,900 | 3 | 16 | LA 5-6: Cycle 1, 3, 5, 7, 9, 11, 13, 15 | 15,646,400 |
| | | | LA 5-6 | | | | TX 8-11: Cycle 2, 4, 6, 8, 10, 12, 14, 16 | |
| | 186+00 – 296+25 | 6 | PA 5 (N and S) | 824,700 | 3 | 16 | Cycle 1 through 16 | 13,195,200 |
| | | | PA 5B | 243,700 | 3 | 16 | Cycle 1 through 16 | 3,899,200 |
| | | | PA 5C | 127,500 | 3 | 16 | Cycle 1 through 16 | 2,040,000 |
| Port Arthur Canal | 0+00 – 240+00 | 7 | PA 8 | 2,148,600 | 3 | 16 | Cycle 1 through16 | 34,377,600 |
| | 240+00 – 325+84 | 8* | PA 8 | 1,317,000 | 2 | 25 | Cycle 1 through 25 | 32,925,000 |
| | | | PA 9A | 311,100 | 2 | 25 | Cycle 1 through 25 | 7,777,500 |
| | | | PA 9B | 311,100 | 2 | 25 | Cycle 1 through 25 | 7,777,500 |
| Sabine-Neches Canal | 0+00 – 170+00 | 9 | PA 8 | 1,317,000 | 2 | 25 | Cycle 1 through 25 | 32,925,000 |
| | 170+00 – 592+91 | 10 | PA 11 | 3,360,000 | 4 | 12 | Cycle 1 through 12 | 40,320,000 |

**Table 5-3 (Cont'd)**

| Channel Reach | Channel Stations | Waterway Section | Maintenance Material Designation | Dredge Quantity Per Cycle (cy) | Years Per Cycle | Total # of Cycles | Dredging Cycle Schedule | 50-Year Maintenance Material Total (cy) |
|---|---|---|---|---|---|---|---|---|
| Neches River Channel | 0+00 – 96+00 | 11 | PA 12 | 479,800 | 3 | 16 | Cycle 1 through 16 | 7,676,800 |
| | | | PA 13 | 189,200 | 3 | 16 | Cycle 1 through 16 | 3,027,200 |
| | 96+00 – 158+00 | 12 | PA 14 | 432,000 | 3 | 16 | Cycle 1 through 16 | 6,912,000 |
| | 158+00 – 292+00 | 13 | PA 16, TX 5-2 | 445,400 | 3 | 16 | TX 5-2: Cycle 1–9, PA 16: Cycle 10–16 | 7,126,400 |
| | | | PA 17, TX 5-2 | 488,600 | 3 | 16 | TX 5-2: Cycle 1–9, PA 17: Cycle 10–16 | 7,817,600 |
| | 292+00 – 422+00 | 14 | PA 18, TX 5-2 | 740,500 | 4 | 12 | TX 5-2: Cycle 1–7, PA 18: Cycle 8–12 | 8,886,000 |
| | | | PA 18A, TX 5-2 | 145,600 | 4 | 12 | TX 5-2: Cycle 1–7, PA 18A: Cycle 8–12 | 1,747,200 |
| | | | PA 21, TX 5-2 | 276,900 | 4 | 12 | TX 5-2: Cycle 1–7, PA 21: Cycle 8–12 | 3,322,800 |
| | 422+00 – 522+00 | 15 | PA 23, TX 5-2 | 629,200 | 6 | 8 | TX 5-2: Cycle 1–4, PA 23: Cycle 5–8 | 5,033,600 |
| | | | PA 23A, TX 5-2 | 335,800 | 6 | 8 | TX 5-2: Cycle 1–4, PA 23A: Cycle 5–8 | 2,686,400 |
| | 522+00 – 716+00 | 16 | PA 24 | 1,267,900 | 6 | 8 | Cycle 1 through 8 | 10,143,200 |
| | | | PA 24A | 611,100 | 6 | 8 | Cycle 1 through 8 | 4,888,800 |
| | 716+00 – 776+00 | 17 | PA 25 | 581,000 | 6 | 8 | Cycle 1 through 8 | 4,648,000 |
| | 776+00 – 980+00 | 18 | PA 25A, TX 3-1E | 542,900 | 6 | 8 | TX 3-1E: Cycle 1, PA 25A: Cycle 2–8 | 4,343,200 |
| | | | PA 26, TX 3-1E | 595,600 | 6 | 8 | TX 3-1E: Cycle 1, PA 26: Cycle 2–8 | 4,764,800 |
| | | | PA 27A, TX 3-1E | 397,100 | 6 | 8 | TX 3-1E: Cycle 1, PA 27A: Cycle 2–8 | 3,176,800 |
| | | | PA 27C, TX 3-1E | 269,900 | 6 | 8 | TX 3-1E: Cycle 1, PA 27C: Cycle 2–8 | 2,159,200 |
| | | | PA 27D, TX 3-1E | 170,600 | 6 | 8 | TX 3-1E: Cycle 1, PA 27D: Cycle 2–8 | 1,364,800 |
| *Includes maintenance material from Taylor Bayou (0+00 to 106+25) | | | | | | | **50-Year Maintenance Material Total** | **650,372,200** |

**Placement Area No. 8**

PA 8 is located in Sabine Lake and is bounded by Sabine Lake to the east and Pleasure Island to the west. Reportedly, all but the far west side of this PA has been constructed of dredged material. The far west side of the PA was part of the original Sabine Lake shoreline before the waterway was dredged in the early 1900s. The PA is approximately 3,570 acres in size and is located as shown on drawings C-06, 07, and 08 in Appendix 1 of the FFR. Approximately 5.0 mcy of new work material from Section 7 would be dredged to this site. Approximately 3.7 mcy of new material would be dredged from a portion of Section 8 of the Port Arthur Canal and 3.9 mcy from Section 9 of the Sabine-Neches Canal. Prior to placement of new work material, the existing levees would be initially raised 1 foot to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. The new work material would be stockpiled within the southwest corner of the PA from Section 7 and Section

8 and the northeast corner from Section 9. The PA has also been designated to handle about 2.1 mcy of maintenance material from Section 7 on a 3-year cycle and about 2.6 mcy of maintenance material from sections 8 and 9 on a 2-year cycle.

**Placement Area No. 9A and 9B**

PA 9A is located on the west bank of the Port Arthur Turning Basin near the junction of the Gulf Intracoastal Waterway (GIWW) and Taylor Bayou. This placement area is approximately 318 acres in size and is located as shown on Drawing C-07 in Appendix 1 of the FFR. Placement Area No. 9B is located adjacent to and west of PA 9A at the intersection of the GIWW and Taylor Bayou. It is rectangular and encompasses about 163 acres with a perimeter of 8,200 linear feet as shown on Drawing C-07 in Appendix 1 of the FFR. Based on dated aerial photographs, the site appears to be ringed with a short levee. PA 9A, along with PA 9B, would be used to contain approximately 3.0 mcy of new work dredged material from predominantly from Taylor Bayou (Section 8). This material would be stockpiled (berm widths approximately 300 feet) around the existing levee along the entire perimeter of PAs 9A and 9B. Prior to placement of new work material at 9B, the existing levees would be initially raised about 2 feet to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. PA 9A does not require a levee lift. Approximately 311,000 cy each of maintenance material would be placed in PAs 9A and 9B on a 2-year cycle.

**Placement Area No. 11**

PA 11 is located in Sabine Lake and is bound on the west by Pleasure Island. Like PA 8, PA 11 was apparently constructed of dredged material except along the west side of the island. The far west side of the PA was part of the original Sabine Lake shoreline before the waterway was dredged in the early 1900s. The SNND has photographs illustrating this land cut and the original shoreline. This PA is about 2,170 acres in size and is located as shown on drawings C-05 and C-06 in Appendix 1 of the FFR. It would be used to stockpile approximately 8.8 mcy of new work dredged material (at the north and south corners of the PA) from Section 10 and contain 3.4 mcy of maintenance dredged material from Section 10 of the Sabine-Neches Canal portion of the project. Section 10 would be dredged on a 4-year cycle.

**Placement Area No. 12**

PA 12 is located on the west side of an abandoned section of the Sabine-Neches Canal. It is bounded to the west by SH 87, on the north by PA 13, and to the south by low-lying areas and marshes. This placement area is 355 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 1.1 mcy of new work dredged material would be stockpiled in PA 12 around the existing levee along the perimeter, using a berm width of 100 feet. PA 12 would be used to contain 480,000 cy of maintenance dredged material per 3-year cycle from Section 11.

**Placement Area No. 13**

PA 13 is located on the south bank of the Neches River. It is bounded on the south by PA 12, on the west by SH 87, and on the east by a county road and a waterfront development area. The placement area is 140 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 400,000 cy of new work dredged material would be stockpiled in PA 13. PA 13 would be used to contain

190,000 cy of maintenance dredged material per 3-year cycle from Section 11 of the Neches River Channel portion of the project.

**Placement Area No. 14**

PA 14, located on the south bank of the Neches River, is bounded by a refinery to the north, marshlands to the south, a wastewater effluent ditch and SH 87 to the east, and an outfall canal to the west. This placement area is 255 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 525,000 cy of new work dredged material from Section 12 would be stockpiled within PA 14 around the existing levee along the perimeter, using a berm width of 100 feet. PA 14 would be used to contain 430,000 cy of maintenance dredged material per 3-year cycle from Section 12. The levee at PA 14 would require an initial 2 feet levee lift.

**Placement Area No. 16**

PA 16 is on the south bank of the Neches River and is enclosed by marshlands to the east, south, and west. This placement area is 288 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 540,000 cy of new work dredged material will be stockpiled in PA 16. PA 16 would be used to contain approximately 450,000 cy of maintenance dredged material per 3-year cycle from Section 13. However, the PA would not be utilized for maintenance material placement until year 30 of the 50-year plan. Material from the first nine maintenance dredging cycles would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2), including a large portion of available new work material from Section 14 during the initial deepening. The levee for PA 16 would require an initial 2.5 feet levee lift.

**Placement Area No. 17**

PA 17 is located on the south bank of the Neches River and is bordered by marshlands on the south and east and by marsh and industrial development to the west. This placement area is 316 acres in size and is located as shown on Drawing C-03 in Appendix 1 of the FFR. Beginning in year 30, it would be used to contain approximately 490,000 cy of maintenance dredged material per 3-year cycle from Section 13. Material from the first nine dredging cycles would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2). PA 17 is not planned to be used for new work material placement.

**Placement Area No. 18**

PA 18, located on the north bank of the Neches River, is bounded by the Neches River to the southwest and marshlands to the northeast. This placement area is 361 acres in size and is located as shown on Drawing C-03 in Appendix 1 of the FFR. Approximately 870,000 cy of new work dredged material from Section 14 would be stockpiled and placed in PA 18. Beginning in target year 32, PA 18 would be used to contain approximately 740,000 cy of maintenance dredged material per 4-year cycle from Section 14. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2). New work material placed in PA 18 would be stockpiled, berm width of approximately 100 feet, around the existing levee along the perimeter.

**Placement Area No. 21**

PA 21 is located on the north bank of the Neches River and is bounded by marsh areas to the east and north and an oxbow (abandoned portion of the river) to the west. This PA is 135 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. PA 21 would be used to place approximately 400,000 cy of new work material to be dredged from Section 15. This material would be stockpiled, berm width of approximately 100 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet of levee lift. Beginning in target year 32, PA 21 would be used to contain approximately 280,000 cy of maintenance dredged material from Section 14 on a 4-year cycle. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

**Placement Area No. 23**

PA 23 is located on the south bank of the Neches River. It is bounded by the Neches River on the north, marshlands on the west, railroad tracks on the south, and Smith Bluff on the east. This PA is 504 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. PA 23 would be used to place approximately 2.7 mcy of the new work material from Section 16. This material would be stockpiled, berm width of approximately 400 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet of levee lift. Beginning in target year 30, PA 23 would be used to contain approximately 630,000 cy of maintenance dredged material from Section 15 on a 6-year cycle. Initial material (from the first four dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

**Placement Area No. 23A**

PA 23A is located adjacent to and south of PA 23. This site is about 269 acres in size as shown on Drawing C-02 in Appendix 1 of the FFR. A pipeline corridor is located at the junction between PA 23 and PA 23A. PA 23A would be used to place approximately 470,000 cy of new work material from Section 15. Beginning in target year 30, PA 23A would be used to contain approximately 340,000 cy of maintenance dredged material from Section 15 on a 6-year cycle. Initial material (from the first four dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

**Placement Area No. 24**

PA 24 is located on the north bank of the Neches River and is bounded by the Neches River to the west, the MARAD Reserve Fleet Anchorage to the south, and marshlands to the northeast. This PA is 388 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. Approximately 2.6 mcy of new work dredged material from Section 16 would be stockpiled in PA 24 around the existing levee along the perimeter, at a berm with of approximately 400 feet. PA 24 would be used to contain approximately 1.3 mcy of maintenance dredged material from Section 16 on a 6-year cycle.

**Placement Area No. 25**

PA 25 is located on the west bank of the Neches River and is bounded by privately maintained canals on the north and south, and by a railroad on the west. This PA is 645 acres in size and is located as shown on Drawing C-01 in Appendix 1 of the FFR. Approximately 2.7 mcy of new work dredged material from sections 17 and 18 would be stockpiled in PA 25, around the existing levee along the perimeter at a berm

width of approximately 250 feet. The levee would require an initial 2 feet levee lift. It would be used to contain approximately 580,000 cy of maintenance dredged material from Section 17 on a 6-year cycle.

**Placement Area No. 25A**

PA 25A is located adjacent to and west of PA 25. The site is about 175 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. Approximately 560,000 cy of new work material from Section 18 would be placed and stockpiled in PA 25A at a berm width of approximately 100 feet. PA 25A would contain approximately 540,000 cy of maintenance dredged material from Section 18 on a 6-year cycle. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E).

**Placement Area No. 26**

PA 26 is located on the north bank of the Neches River and is bounded on the northeast by Star Bayou and on the west by an oxbow. The Port Arthur Area office indicated that this PA was previously used and should be adequate for use on this project. Aerial photographs, supported by a site visit from district representatives, indicated that the levees are substantially adequate for the first filling. The site is about 192 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. PA 26 would be used to place approximately 1.8 mcy of new work material from Section 18. This material would be stockpiled, berm width of approximately 400 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet levee lift. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E). Additionally, PA 26 would contain approximately 600,000 cy of maintenance dredged material from Section 18 on a 6-year cycle.

**Placement Areas No. 27A, 27C, and 27D**

PAs 27A, 27C, and 27D are located on the north bank of the Neches River and are bounded on the east and west by marshland and on the west by industry. PA 27A is 128 acres, PA 27C is 87 acres, and PA 27D is 55 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. PAs 27A, 27C, and 27D would be used to place approximately 1.6 mcy of the new work material from Section 18. This material would be stockpiled, berm width of approximately 200 feet, around the existing levee perimeter of PA 27A. In addition, the levee would require an initial levee lift of 2 feet. PAs 27C and 27D would have hydraulic levees constructed. These three PAs would contain approximately 840,000 cy of maintenance dredged material from Section 18 on a 6-year cycle. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E).

5.2.3.2 New PAs

The project utilizes two new upland confined sites to manage new work material from the deepening and maintenance material through the 50-year design period, as described in the following paragraphs.

**Placement Area No. 18A**

PA 18A is located adjacent to and east of PA 18, at the south end of PA 18. The area is about 71 acres in size as shown on Drawing C-03 in Appendix 1 of the FFR. A new dewatering structure with conveyance ditches would be constructed. In addition to providing additional capacity, this PA would allow more-

efficient use of the existing PA 18. The existing ground appears to be flat. New hydraulic levees would be constructed at the site with a lift of 8 feet to a final elevation of 16 feet. PA 18A would receive approximately 300,000 cy of new work material from Section 14. This PA would contain approximately 150,000 cy of maintenance dredged material from Section 14 on a 4-year cycle. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

**Placement Area No. 24A**

PA 24A is located adjacent to and north of PA 24. This PA is 187 acres in size and is located as shown on Drawing C-01 in Appendix 1 of the FFR. PA 24A would receive approximately 300,000 cy of new work material from Section 16. It would be used to contain approximately 610,000 cy of maintenance dredged material from Section 16 on a 6-year cycle.

## 5.3 Beneficial Use Features

### 5.3.1 Conceptual Design Development

The feasibility/conceptual level designs of the marsh restoration and shoreline nourishment sites were developed in-house and through a contractor (Table 5-4). The designs for some components of the Neches River BU Feature (Rose City East, Bessie Heights East) and the Gulf Shore BU Feature were developed by TCB (Reference 2). These designs included discussions of specific feature and constructability issues such as adequacy of foundation materials, hydraulic levee construction, levee protection, pumping distances, interior filling, circulation development, and plantings. TCB designs were used as the general concept for marsh restoration and shoreline nourishment, but actual plans for the CIP are somewhat different. New work dredged material would be utilized at three BU features (Rose City East, Bessie Heights East, and Old River Cove). Maintenance dredged material would also be used at four features (Rose City East, Bessie Heights East, Texas Point shoreline nourishment, and Louisiana Point shoreline nourishment).

**Table 5-4: Summary of Environmental Restoration Sites**

| | Feature # | BU Feature | Component |
|---|---|---|---|
| New Work Material | TX 3-1E | Neches River BU Feature | Rose City East Marsh Restoration |
| | TX 5-2 | | Bessie Heights East Marsh Restoration |
| | TX 6-1A | | Old River Cove Marsh Restoration |
| Maintenance Material | TX 3-1E | Neches River BU Feature | Rose City East Marsh Restoration |
| | TX 5-2 | | Bessie Heights East Marsh Restoration |
| | TX 8-11 | Gulf Shore BU Feature | Texas Point Shoreline Nourishment |
| | LA 5-1/6-1 | | Louisiana Point Shoreline Nourishment |

Conceptual designs for the measures and BU features were done during the Plan Formulation Phase. The terms "minimization" and "mitigation" are used throughout this appendix to refer to measures that were studied to avoid or compensate impacts from the deepening project. Over 300 minimization and mitigation alternatives were evaluated. General assumptions were used. The least-cost methods were generally used in developing designs. It was assumed that no relocations would be necessary and that rights-of-way and rights-of-entry would be available. Specific field and design data were provided by the Environmental Section. During the Detailed Design phase, the selected mitigation and BU features were individually evaluated and updated. Final measures for mitigation measures can be seen as shown in the FFR, FEIS, and Engineering drawings in Appendix 1 of the FFR. The majority of the measures are for marsh restoration as BU sites and mitigation measures, and these sites are accessible by water. Swamp accessible machinery would be required during construction. Hydraulic levees would be built with the new work dredged material at several sites. The dredge pipeline routes are assumed to be the shortest distance to the middle of the site. Levee side slopes have some type of slope protection: riprap, concrete cellular mats, and/or vegetation. Marsh fill would occur with selective placement of dredged material within the marsh site boundary. Marsh fill can be new work or maintenance material, depending on the measure. Where plantings occur, it is assumed that abundant local species are available. During PED, each site would be analyzed for local drainage requirements, so as not to impede existing area drainage. Also during PED, final marsh designs would be optimized for constructability. The complete descriptions and details can be found in planning documents. Site locations can be found in drawings C-01 through C-28 in Appendix 1 of the FFR.

### 5.3.2 Neches River BU Feature – Rose City

The conceptual plan calls for restoration of 345 acres of fresh marsh, improvement of 72 acres of shallow water, and nourishment of 151 acres of existing marsh in two construction events (first construction and first maintenance cycle). New work material (approximately 2.1 mcy) from Section 18 would be used to restore 225-acres of marsh and to construct hydraulic containment levees and higher-elevation features. Maintenance material (approximately 540,000 cy) from the first maintenance cycle from Section 18 would be used to restore an additional 120 acres of marsh.

The Rose City East Marsh Restoration Feature is shown on Drawing C-01 in Appendix 1 of the FFR. The marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

### 5.3.3 Neches River BU Feature – Bessie Heights East

The conceptual plan is to restore 679 acres of brackish and 1,190 acres of intermediate marsh, improve 660 acres of shallow-water habitat, and nourish 651 acres of existing marsh. The marsh would be constructed with maintenance material originating from Section 13 during the first nine maintenance cycles, Section 14 during the first seven maintenance cycles, and Section 15 during the first four

maintenance cycles. Approximately 1.0 mcy of new work material from Section 14 would be used to build the hydraulic containment levee.

The Bessie Heights East site is located within the much larger Bessie Heights Marsh (Drawing C-24 in Appendix 1 of the FFR). This was a natural emergent marsh that over time has seen the majority of its marsh acreage convert to open water. The site is located on Texas Parks and Wildlife Department (TPWD) property and privately owned land. Bessie Heights East totals 3,180 acres. The revision to the feasibility study design caused Bessie Heights West to be deleted.

Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

### 5.3.4 Neches River BU Feature – Old River Cove

The Old River Cove site TX 6-1 is located north of the Neches River on property owned by TPWD (Drawing C-25 in Appendix 1 of the FFR). Approximately 5.0 mcy of new work material from Section 13 would be used to construct hydraulic levees and restore 639 acres of brackish marsh, improve 139 acres of shallow-water habitat, and nourish 432 acres of existing marsh, as suspended fine-grained sediments disperse beyond restored emergent marsh areas. Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora.

### 5.3.5 Gulf Shore BU Feature (Texas and Louisiana Points)

The shoreline nourishment sites (TX 8-11 and LA 5-2/6-2) are located on the east and west sides of the Sabine Pass jetties (Drawing C-27 in Appendix 1 of the FFR). Each area begins approximately 0.5 mile from the respective jetty and extends about 3.5 miles away. The land on the Texas side is part of the Texas Point National Wildlife Refuge, while the land on the Louisiana side is privately owned. The conceptual plan calls for placing maintenance material at the shoreline in an unconfined manner. The material would be placed using a pipeline dredge from Section 5 (approximately 1.0 mcy) of the Sabine Pass Channel. Placement would alternate between the Louisiana and Texas shorelines with each complete maintenance cycle, so that each side receives material every 6 years for the 50-year period of analysis, or eight placement episodes. The plan anticipates that much of the material would be redistributed into the littoral system.

## 5.4 OFFSHORE PLACEMENT AREAS

The project would utilize existing offshore placement sites termed ODMDSs to manage materials from the CIP and maintenance dredging through the 50-year period of analysis. Four existing ODMDSs (1–4) and four new sites (A–D) would be used. New work and maintenance quantities for the 50-year project are provided in Appendix B to the ODMDS FEIS and the Site Management and Monitoring Plan, which is attached as an exhibit to Appendix B of the FEIS.

# 6.0 ADDITIONAL BORINGS AND LABORATORY TESTING PROGRAM

## 6.1 SUBSURFACE INVESTIGATIONS

Limited subsurface data were used to develop the feasibility level designs for the project features. Additional explorations to obtain subsurface data would be required to verify and/or revise design assumptions for final design of these features subsequent to the authorization of the project during the PED phase. These explorations would include soil borings, CPTs, and probings. Initial recommendations for exploration and lab testing requirements were developed by URS for channel and placement area concerns and by TCB for environmental restoration concerns (see Reference 2). The initial recommendations were revised to reflect the final feasibility plan. A summary of these recommendations is presented in Table 6-1.

**Table 6-1: Summary of Additional Subsurface Explorations**

| | Soil Borings (number – LF) | CPTs |
|---|---|---|
| **Channel** | 84 – 4,720 | n/a |
| **Placement Areas** | 84 – 2,520 | 224, 11,208 |
| **Environmental Features** | 60 – 1,200 | n/a |

## 6.2 LABORATORY TESTING

Laboratory testing would also be required during the PED phase to verify design assumptions regarding the behavior of the foundation and dredged materials. A summary of anticipated lab tests is provided in Table 6-2. While an estimated cost for additional laboratory testing was provided for the feasibility cost estimate, specific quantities of tests would be developed during subsequent exploration and design tasks.

## 6.3 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE EVALUATION

Information on hazardous, toxic, and radioactive waste (HTRW) sites in the project area was conducted by PBS&J in June 2002; this is summarized in the FEIS. Information from this report was used to determine the probability and severity of encountering HTRW problems at PAs and restoration sites.

Based upon the HTRW assessment and additional in-house research, it has been determined that there are presently no known HTRW sites that would impact the SNWW CIP with the exception of sites of unknown significance in PA 17. Current regulatory agency investigations around PA 17 are being

monitored by USACE. If the Environmental Protection Agency investigations identify problems within PA 17, the affected area would be removed from the PA. In the event that investigations of identified sites within PA 17 do not provide sufficient information, waste identification and delineation investigations would have to be conducted by the non-Federal sponsor. If remediation is recommended, PA 17 would be resized to remove areas requiring remediation or abandoned.

**Table 6-2: Summary of Additional Laboratory Tests**

| |
|---|
| Moisture content |
| Atterberg Limits |
| Grain-size analysis |
| Consolidation |
| Triaxial shear |
| Unconfined compression |
| Density |
| Column settling |
| Self-weight consolidation |
| Void ratio |

## 7.0 CONSTRUCTION

### 7.1 CONTRACT SCHEDULE

Fifteen construction contracts are planned. Contracts 1–5 would be constructed with hopper dredges and contracts 6–12 with hydraulic pipeline dredges. The dredging contracts would be accomplished over a period of about 6 years. The ecological mitigation contracts (13–15) would be accomplished early in the construction sequence. Dredging for the mitigation contracts does not involve the use of new work or maintenance material from the SNWW Preferred Alternative. Refer to the FEIS for a description of this work. The proposed sequence for dredge and construction is shown in Table 7-1.

### 7.2 CONSTRUCTION METHOD

The construction would utilize a combination of traditional and relatively new dredging techniques. Equipment used to dredge the channels would be those traditionally employed: hopper dredges in the offshore reaches and hydraulic pipeline dredges in the other reaches. Disposal of the new work material would be in conventional upland PAs and offshore PAs, as well as the innovative, nontraditional dredging technique of placement into marshes and adjacent shorelines. These techniques are mandated due to the requirements of the mitigation and DMMP restoration and nourishment features. Contracts would be written to not only emphasize the removal of material from the channel, but also emphasize successful completion of mitigation and restoration features so that they would perform to intended purposes.

**Table 7-1: Construction Contract Schedule**

| Contract No. | Contract Schedule | Construction Start (Month/FY) | Construction Finish (Month/FY) |
|---|---|---|---|
| | **Hopper Dredging:** | | |
| 1 | **Sabine Bank Extension** | October 2012 | January 2013 |
| | Section D Station 165+000 to 165+443 | | |
| | Section C Station 165+443 to 132+000 | | |
| 2 | Section B Station 132+000 to 114+000 | February 2013 | July 2014 |
| | Section A Station 114+000 to 95+734 | | |
| 3 | **Sabine Bank Channel** | October 2015 | August 2015 |
| | Section 1 Station 95+734 to 53+000 | | |
| 4 | **Sabine Pass Outer Bar & Bank Channels** | October 2016 | March 2017 |
| | Section 2 Station 53+000 to 18+000 | | |
| | Section 3 Station 18+000 to 0+000 | | |
| 5 | **Sabine Pass Jetty Channel** | April 2017 | September 2017 |
| | Section 4 Station -214+88 to 0+00 | | |
| | **Pipeline Dredging:** | | |
| 6 | **Sabine Pass Channel** | October 2016 | January 2018 |
| | Section 5 Station 0+00 to 186+00 | | |
| | Section 6 Station 186+00 to 296+25 | | |
| 7 | **Port Arthur Canal** | October 2012 | July 2015 |
| | Section 7 Station 0+00 to 240+00 | | |
| | Section 8 Station 240+00 to 325+84 | | |
| | **Taylor Bayou Basin Area:** | | |
| 8 | **Sabine-Neches Canal** | April 2017 | September 2018 |
| | Section 9 Station 0+00 to 170+00 | | |
| 9 | Section 10 Station 170+00 to 592+94 | April 2014 | May 2017 |
| 10 | **Neches River Channel** | October 2012 | March 2014 |
| | Section 11 Station 0+00 to 96+00 | | |
| | Section 12 Station 95+00 to 158+00 | | |
| | Section 13 Station 158+00 to 292+00 | | |
| 11 | Section 14 Station 292+00 to 422+00 | April 2015 | July 2018 |
| | Section 15 Station 422+00 to 522+00 | | |
| | Section 16 Station 522+00 to 716+00 | | |
| 12 | Section 17 Station 716+00 to 776+00 | October 2012 | March 2015 |
| | Section 18 Station 776+00 to 980+00 | | |
| 13 | **Mitigation for Willow Bayou, Louisiana** | October 2015 | May 2018 |
| 14 | **Mitigation for West Black Bayou, Louisiana** | October 2012 | February 2014 |
| 15 | **Mitigation for East Black Bayou, Louisiana** | October 2014 | May 2015 |

## 7.3 MATERIAL SOURCES AND MATERIAL INVESTIGATIONS

Materials utilized for this project would consist primarily of dredged material, both new work and maintenance. These materials would be used to construct new levees, raise existing levees, create stockpiles, marsh restoration, and shoreline nourishment. In addition, minor amounts of riprap would be used for shoreline protection at selected PAs and for erosion control at outlet structures for all of the PAs.

Dredged material sources were evaluated using existing subsurface data as previously discussed. These data were used to determine various parameters for designing hydraulic levees, filling marsh cell and placement areas, and other related hydraulic structures. Some assumptions were made, based on previous experience with similar materials, regarding degradation of material during dredging operations, material losses during construction, and consolidation of new work and maintenance materials. These assumptions are based on both material types and construction methods. Deviations from these assumptions may impact the quantity of available material for construction. As such, additional investigation of the dredged material sources would be required for final design as discussed in Section 4.3. Furthermore, the final design documents should identify specific construction methods and monitoring methods to ensure that the desired construction outcome is achieved.

The structures and features presented herein are primarily associated with levees related to PAs and levees related to restoration features. These structures and features were sized to accommodate the proposed channel depth (48 feet). The specific types of dredged material would be confirmed during future evaluations as identified in Section 5.0. However, if the project is modified from the one identified in the report, the quantity of specific dredged material would change, and this change should be reflected in the specific design features of this study. That is, if a channel less than 48 feet is authorized, less material would be available for use, and thus the size of the associated features should be reduced accordingly.

Neither soil borings nor laboratory testing were conducted to study the proposed deepening for this feasibility study. Instead, existing data from previous projects were used to evaluate the new work materials. Subsurface data were collected at specific existing placement areas as well as at proposed environmental restoration features. These data are provided in referenced reports.

## 8.0 REFERENCES

1. *Desktop Study for Sediment-Related Problems at Sabine-Neches Project*, dated June 2005.
2. *Sabine-Neches Waterway Feasibility Site Concept Beneficial Use Development*, Turner Collie and Braden, Inc., July 14, 2003.
3. *Environmental Impact Statement, Sabine-Neches Waterway, Channel Improvement Project, Texas, Ocean Dredged Material Disposal Site Designation*, PBS&J, January 2006.
4. *Hurricane Flood Protection Design Memorandum No. 2 (General Design Memorandum)*, Volumes I and II, March 1965.
5. *Design Memorandum No. 2 (Sabine-Neches Waterway, Texas, 40-foot Project and Channel to Echo, Bridge Replacement at Port Arthur, dated May 1964)*, prepared by Modjeski and Masters, Inc.

6. *Excel Spreadsheet, SNWN Geotech 30 accts.xls*, outline of additional soil boring and laboratory testing requirements, May 8, 2006.
7. *Sabine-Neches Waterway, 50-foot Project, Dredged Material Management Plan,* prepared by URS Group, Inc., dated April 30, 2004.
8. *Sabine-Neches Waterway, Texas Feasibility Report, Draft Submission of Geotechnical Portion of Engineering Appendix*, prepared by URS Group, Inc. dated August 2004.

# Appendix E

# Clean Water Act Section 404(b)(1) Evaluation

# APPENDIX E
# SABINE–NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT, TEXAS SECTION 404(b)(1) EVALUATION

## I. Project Description

### a. Location

The Sabine-Neches Waterway (SNWW) Channel Improvement Project (CIP) is located on the upper Texas Gulf Coast at the Texas-Louisiana state boundary. The existing 40-foot SNWW project is a federally authorized and maintained waterway located in Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana. All subsequent references to the SNWW in this report focus on the 77-mile-long channel flowing through Jefferson and Orange counties, Texas, and Cameron Parish, Louisiana (includes a 13.2-mile channel extension into the Gulf of Mexico [Gulf]). The SNWW begins offshore, follows the west side of Sabine Lake, and terminates just upstream of the Beaumont Turning Basin on the Neches River.

The project area for the Preferred Alternative is defined as areas that would be directly affected by implementation of the CIP (i.e., the proposed dredging footprint, existing and proposed placement areas [PAs] identified in the Dredged Material Management Plan [DMMP], and mitigation areas).

The study area includes a larger area for which environmental effects of alternatives have been analyzed. The study area encompasses 2,000 square miles, which contains the smaller project area, and includes the following water bodies and adjacent coastal wetlands: Sabine Lake and adjacent marshes in Texas and Louisiana, Neches River Channel up to the new Neches River Saltwater Barrier, Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf.

Further descriptions of the SNWW CIP can be found within chapters 1 and 3 and Figure 1.1-2 of the Final Environmental Impact Statement (FEIS).

### b. General Description

This Section 404(b)1 evaluation addresses the discharge of dredged or fill material into the waters of the U.S. The objectives of the SNWW CIP include improvements to the efficiency of the deep-draft navigation system, and maintenance or enhancement of the quality of the area's coastal and estuarine resources. Maintenance and enhancement of the area's coastal and estuarine resources are associated with potential for reduced accidents and oil spills; beneficial use of dredged material; minimization of effects to oyster beds, seagrasses, and other valuable habitats; and avoiding areas of known cultural resources.

To achieve navigation efficiency objectives, the following is proposed:

- Deepening the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont from 40 to 48 feet.
- Deepening the existing SNWW Entrance Channel in the Gulf from 42 to 50 feet, plus advance maintenance and allowable overdepth, and constructing an extension of the offshore entrance channel (50 x 700 feet x 13.2 miles). Dredging would be conducted by hopper dredge. Additional details of this construction are provided below because of its potential to affected endangered sea turtles.
- Dredging in the Sabine Pass Jetty Channel would be conducted by hopper dredge, while the remaining inshore channels would be constructed with hydraulic pipeline dredges.
- Deepening the Taylor Bayou Channel and basins to 48 feet, and widening the entrance and connecting channels to improve vessel maneuverability.
- Dredging one new anchorage basin and two turning and anchorage basins on the Neches River Channel.
- Using 16 existing upland placement areas and two new expansions of existing placement areas for construction and maintenance of the Preferred Alternative. The quantity of maintenance material to be removed over the 50-year period of analysis is estimated to total approximately 650 million cubic yards (mcy).

To achieve coastal resource protection and ecological enhancement objectives, the following is proposed:

- Avoidance and minimization of resource impacts through alternative analyses.
- Avoidance of cultural and historical resources (e.g., Civil War–era shipwrecks).
- Implementation of Beneficial Use (BU) features for resource protection and restoration. Appropriate dredged materials, as part of the DMMP, would be beneficially used to restore 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat with the Neches River BU Feature (comprised of Rose City East, Bessie Heights East, and Old River Cove West), and regularly nourish approximately 6 miles of shoreline with the Gulf Shore BU Feature (Texas and Louisiana Points). Gulf shore nourishment, which affects piping plover Critical Habitat at Louisiana Point, is described in detail below.
- Unavoidable impacts of the Preferred Alternative in Texas are offset through the DMMP; impacts in Louisiana, however, required compensatory mitigation. Therefore, the mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. The amount of recommended mitigation is based upon the amount of marsh acreage that could be lost as a result of the project, and the additional amount that would need to be restored in order to fully compensate for adverse changes to biological function of the remaining marsh throughout the affected area over the period of analysis.

The proposed plan is the least environmentally damaging practicable alternative.

**c. Authority and Purpose**

The Senate Committee on Environment and Public Works Resolution, dated June 5, 1997, authorized the U.S. Army Corps of Engineers (USACE) to review previous USACE reports on the SNWW and other pertinent reports to determine the feasibility of modifying the channels serving the ports of Beaumont, Port Arthur, and Orange, Texas, in the interests of commercial navigation. These channels are collectively named the SNWW. The Sabine-Neches Navigation District (SNND), non-Federal sponsor of the existing channels to Beaumont and Port Arthur, requested that USACE initiate a reconnaissance study of potential channel improvements in September 1998. The reconnaissance investigation resulted in a finding that there was a Federal interest in the project and recommended that the study be continued into the feasibility phase. The SNND expressed its intent to act as the non-Federal sponsor for this phase of the study. The Final Feasibility Report (FFR) for the SNWW CIP would determine whether improvements to the existing Federal navigation project are justified, and provide documentation needed to request Congressional authorization and funding for construction of the project. The Sabine River Channel to Orange, Texas, was not included in this FFR due to expectations of continued low utilization of the existing 30-foot channel.

In March 2000, the USACE and the SNND signed an agreement to conduct an FFR and prepare a Final Environmental Impact Statement (FEIS) for the proposed CIP. The lead agency for the FEIS is USACE, with the U.S. Environmental Protection Agency (EPA) as a cooperating agency. The cost of the FFR and FEIS is shared by the USACE and the SNND.

**d. General Description of Dredged or Fill Material**

**(1) General Characteristics of Material**

Extensive core borings were taken and analyzed in conjunction with the 1982 feasibility report for the SNWW (USACE, 1982). Profiles of these borings are shown in cross sections of the project plans, included in that report. These borings support the general information presented below.

*Site Geology*

The site geology is characterized by modern marine deposits overlaying recent Holocene deposits that in turn overlay the Beaumont and Lissie formations of the Pleistocene Series. The modern deposits are generally normally consolidated clays, silts, and fine sands that were deposited through natural overwash and sedimentation processes or through man-made depositional processes. The recent deposits of the Holocene consist of silts, clays, silty sands, clayey sands, and clayey silts that exhibit the characteristics of normally to lightly overconsolidated materials. These deposits are generally encountered to depths of 30 to 40 feet.

Beaumont Clay is the predominant Pleistocene formation whose eroded surface forms the upper limit of stiff to very stiff clay material. It is red, yellow, and brown calcareous stiff clay that weathers into black or gray soil at the surface. Lenses of fine-grained, poorly graded sand and silt, and a few calcareous nodules are sometimes encountered in this formation. The clay fraction is composed of montmorillonite

(generally with calcium as the exchangeable cation), kaolinite, illite, and finely ground quartz, in that order of prevalence. The high percentage of montmorillonite accounts for the high shrink-swell potential of the material. Previous desiccation of the clays results in significant overconsolidation to great depths, with preconsolidation pressure approaching 3 tons per square foot. In addition to preconsolidating the soil, the desiccation process, along with occasional rewetting, has resulted in a network of fissures and slickensides that are now closed but that represent potential planes of weakness within the stratum. The thicknesses of these clays range from 25 to 400 feet. The Lissie Formation underlies the Beaumont and consists primarily of sands and silty sands.

*Field Exploration*

Limited field investigations were conducted for this project. Those conducted were limited to cone penetrometer testing along the proposed levee alignments at selected placement areas. In addition, probings were taken at selected restoration and minimization features to evaluate near surface foundation issues. The majority of the subsurface data for the project was compiled from existing data—data from the channel that was collected for the 40-foot project and data from placement areas that have been collected during periodic levee raising projects.

*Excavatability*

The proposed deepening will entail dredging new work material. Based on a review of limited existing soil boring data taken during previous studies, the material will range from very soft to very stiff clay and loose to dense sand. No rock is anticipated and blasting will not be required.

The new work material within the offshore reaches (sections 4, 3, 2, 1, A, B, C, and D) and the adjacent onshore reaches (sections 5 and 6) is likely to consist of soft clay with pockets of stiff clay; some sand may also be encountered. These reaches are located within the historic delta region of the Sabine and Neches rivers where normally to lightly consolidated materials are located. Materials in this area may vary as the rivers' discharge meandered through the deltaic zone.

New work material within the onshore reaches of the Port Arthur and Sabine-Neches canals (sections 7, 8, 9, 10, and 11) will likely consist of stiff to very stiff clay. These canals are part of the land cut section of the waterway and were excavated early in the 1900s. The stiff consistency of this material can be attributed to the overconsolidation pressure of the material that was previously overlying the canals.

The Neches River Channel is located upstream of the Sabine-Neches Canal. The new work material for this channel (sections 12 through 18) will vary from stiff clay to medium-dense sand. These variations can be attributed to the historic meanders of the Neches River, although sand was more abundant in the soil samples from sections 15, 16, 17, and 18. In addition, historically the maintenance dredging in these reaches has contained significant amounts of sand.

**(2) Quantity of Material**

*New Work Material*

Construction of the Preferred Alternative would require the development of significantly more PA capacity than currently exists for the SNWW project. The existing project uses 16 upland PAs. Construction of the Preferred Alternative would generate 98 mcy of new work material. The term "new work" refers to the material below the existing Waterway channel template, which is needed to be removed in order to increase to the new project depth. The following table depicts the volume in cubic yards (cy) of new work material from all reaches of the Preferred Alternative:

| Section | Station | To Station | Estimated New Work (cy) | Total Per Reach (cy) |
|---|---|---|---|---|
| D | 165+443 | 150+500 | 4,201,000 | |
| C | 150+500 | 132+000 | 4,648,000 | |
| B | 132+000 | 114+000 | 5,296,000 | |
| A | 114+000 | 95+734 | 4,592,000 | 18,737,000 |
| 1 | 95+734 | 53+000 | 8,307,000 | 8,307,000 |
| 2 | 53+000 | 18+000 | 7,051,000 | |
| 3 | 18+000 | 0+000 | 5,923,000 | 12,974,000 |
| 4 | 0+00 | –126 | 2,978,000 | 2,978,000 |
| 5 | 0+00 | 186+00 | 4,459,600 | |
| 6 | 186+00 | 296+25 | 2,263,600 | 6,723,200 |
| 7 | 0+00 | 240+00 | 5,026,000 | |
| 8 | 240+00 | 325+84 | 3,281,900 | |
| 8TB | 0+00 | 106+24 | 3,893,000 | 11,697,200 |
| 9 | 0+00 | 170+00 | 3,092,000 | |
| 10 | 170+00 | 592+93 | 8,852,000 | 11,944,000 |
| 11 | 0+00 | 96+00 | 1,628,000 | |
| 12 | 96+00 | 158+00 | 698,000 | |
| 13 | 158+00 | 292+00 | 4,882,000 | |
| 14 | 292+00 | 420+00 | 2,213,000 | |
| 15 | 420+00 | 522+00 | 2,611,000 | |
| 16 | 522+00 | 716+00 | 4,106,000 | |
| 17 | 716+00 | 776+00 | 2,845,000 | |
| 18 | 776+00 | 980+00 | 6,031,000 | 25,014,000 |
| | | | **Total** | **98,374,400** |

*Maintenance Material*

Shoaling is projected to increase with the Preferred Alternative for several reasons. The Entrance Channel would extend an additional 13.2 miles into the Gulf, and this would result in higher offshore dredging quantities. The deeper channel would have a greater cross-sectional area, making it function as a larger sediment trap, and higher salinities would increase flocculation and the deposition of suspended sediment. Section 2.5.2 in the FEIS describes, in detail, the SNWW sediment system and the existing project

shoaling and sediment transport conditions. Shoaling and sediment transport conditions for the existing SNWW include all segments of the existing SNWW navigation system that are discussed in detail in the FEIS. The discussion in the FEIS begins with the upstream end of the SNWW (the Neches River Channel), and moves downstream through the confined Sabine-Neches and Port Arthur canals, the Sabine Pass Channel, and then offshore into the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, and the Sabine Bank Channel. Finally, the interaction of the channel and adjacent shoreline sections is described (refer to Section 2.5.2 in the FEIS).

The existing shoaling quantities for the 40-foot project are summarized in the following table (these quantities were summarized from Section 2.5.2.7 of the FEIS and the sediment study by Parchure [2005]):

| Channel | Material Types | cy/year |
|---|---|---|
| Sabine Bank Channel | 76% silt/clay, 24% clay | 4,235.2 |
| Sabine Pass Outer Bar Channel | 96% silt/clay, 4% sand | 1,993.7 |
| Sabine Pass Jetty Channel | 89% silt/clay, 11% sand | 1,138.5 |
| Sabine Pass Channel | 70% silt/clay, 30% sand | 1,911.9 |
| Port Arthur Canal | 84% silt/clay, 16% sand | 4,210.4 |
| Sabine-Neches Canal | 78% silt/clay, 22% sand | 3,689.2 |
| Neches River Channel | 62% silt/clay, 38% sand | 6,382.3 |

It is expected that the material types for the projected maintenance dredging would be similar to the existing. The predicted shoaling quantities for the 48-foot project are summarized in the following table:

| Channel | cy/year |
|---|---|
| Extension | 3,018.0 |
| Sabine Bank Channel | 4,639.0 |
| Sabine Pass Outer Bar Channel | 4,473.0 |
| Sabine Pass Jetty Channel | 1,352.7 |
| Sabine Pass Channel | 2,173.8 |
| Port Arthur Canal | 4,087.8 |
| Sabine-Neches Canal | 4,677.0 |
| Neches River Channel | 8,599.1 |

The predicted shoaling by dredging sections are presented in the following table:

| Channel | Dredging Section | Channel Reach | O&M Cycle Freq (Year) | Shoaling cy/Cycle |
|---|---|---|---|---|
| EXT | D | Station 165+443 to 150+500 | 4 | 647,000 |
| EXT | C | Station 150+500 to 132+000 | 4 | 801,000 |
| EXT | B | Station 132+000 to 114+000 | 4 | 779,000 |
| EXT | A | Station 114+000 to 95+734 | 4 | 791,000 |
| ENT | 1 | Station 95+734 to 53+000 | 4 | 1,508,000 |
| ENT | 2 | Station 53+000 to 18+000 | 4 | 3,131,000 |
| SPOB | 3 | Station 18+000 to 0+000 | 1 | 4,473,000 |
| SPJ | 4 | Station -214+88 to 0+00 | 5 | 1,352,700 |
| SPC | 5 | Station 0+00 to 186+00 | 3 | 977,900 |

| Channel | Dredging Section | Channel Reach | O&M Cycle Freq (Year) | Shoaling cy/Cycle |
|---|---|---|---|---|
| SPC | 6 | Station 186+00 to 295+60 | 3 | 1,195,800 |
| PAC | 7 | Station 0+00 to 240+00 | 3 | 2,148,600 |
| PAC | 8 | Station 240+00 to 326+24 | 2 | 2,340,000 |
| | | TB 0+00 to 106+25 | 2 | 1,327,000 |
| SNC | 9 | Station 0+00 to 170+00 | 2 | 1,317,000 |
| SNC | 10 | Station 170+00 to 592+91 | 4 | 3,360,000 |
| NRC | 11 | Station 0+00 to 96+00 | 3 | 669,000 |
| NRC | 12 | Station 96+00 to 158+00 | 3 | 432,000 |
| NRC | 13 | Station 158+00 to 292+00 | 3 | 934,000 |
| NRC | 14 | Station 292+00 to 422+00 | 4 | 1,163,000 |
| NRC | 15 | Station 422+00 to 522+00 | 6 | 965,000 |
| NRC | 16 | Station 522+00 to 716+00 | 6 | 1,879,000 |
| NRC | 17 | Station 716+00 to 776+00 | 6 | 581,000 |
| NRC | 18 | Station 776+00 to 980+00 | 6 | 1,976,000 |

NOTE: This table only shows the predicted shoaling per section estimate

Because of this predicted shoaling, maintenance dredging is projected to increase for the entire channel, from 407 mcy to 650 mcy over the 50-year period of analysis. Expressed as average annual quantities, quantities will increase from 8.1 mcy per year to 13.0 mcy per year (an increase of approximately 60 percent). Fifty-seven percent of the maintenance quantities for the Preferred Alternative would originate from the offshore channels, and 43 percent from the inshore channels. As would be expected with the offshore channel extension, maintenance dredging volumes for the offshore channel would increase more than the inshore reaches, with an increase from 162 mcy to 370 mcy and 251 mcy to 281 mcy, respectively.

Finding areas suitable for the development of new upland PAs along the inshore reaches was difficult. The majority of land adjacent to the SNWW is either covered by residential and industrial development and existing PAs, or is coastal wetland. For this reason, considerable effort was directed toward evaluating alternatives for the placement of dredged material. Maintenance material would be used to the greatest extent possible in the resulting DMMP. A discussion of the process used to evaluate these alternatives, and a description of alternatives considered, is provided in Section 2.5 of the FEIS.

**e. Description of the Proposed Discharge**

**(1) Location**

Sixteen PAs would be used to manage the CIP's new work and maintenance material over a 50-year period (see tables below and refer to figures 2.4-1c–g of the FEIS). Twelve of these PAs are currently used on the existing project, while four PAs are currently not utilized. Two new cells to two existing PAs have been proposed. All of these PAs are confined with water discharged from the sites via controlled spillways to outfall canals and drainage ditches.

New work material volumes by reach and proposed PAs (the new work plan) are presented in the following table:

| Channel Reach | Channel Stations | Water-way Section | New Work Material Designation | New Work Dredged Volume (cy)** | New Work Material Construction | New Work Material Used for Construction Volume (cy) | New Work Material Surplus Volume (cy) |
|---|---|---|---|---|---|---|---|
| Sabine Bank Extension | 165+443 to 150+500 | D | PA D (Offshore) | 4,201,000 | 0 | 0 | 0 |
| | 150+500 to 132+000 | C | PA C (Offshore) | 4,648,000 | 0 | 0 | 0 |
| | 132+000 to 114+000 | B | PA B (Offshore) | 5,296,000 | 0 | 0 | 0 |
| | 114+000 to 95+734 | A | PA A (Offshore) | 4,592,000 | 0 | 0 | 0 |
| Sabine Bank Channel | 95+734 to 53+000 | 1 | PA 1 (Offshore) | 8,307,000 | 0 | 0 | 0 |
| Sabine Bank Channel | 53+000 to 18+000 | 2 | PA 2 (Offshore) | 7,051,000 | 0 | 0 | 0 |
| Sabine Outer Bar | 18+000 to 0+000 | 3 | PA 3 (Offshore) | 5,923,000 | 0 | 0 | 0 |
| Sabine Pass Jetty Channel | –214+88 to 0+00 | 4 | PA 4 (Offshore) | 2,978,000 | 0 | 0 | 0 |
| Sabine Pass Channel | 0+00 to 186+00 | 5 | PA 5 (N and S) | 4,459,600 | New Hyd. levee; 400-foot-wide stockpile | 3,104,137 | 1,093,593 |
| | 186+00 – 296+25 | 6 | PA 5B | 2,263,600 | 400-foot-wide stockpile | 1,362,051 | |
| | | | PA 5C | | 400-foot-wide stockpile | 1,163,419 | |
| Port Arthur Canal | 0+00 –240+00 | 7 | PA 8 | 5,026,000 | Stockpile in southwest corner | 5,026,000 | 0 |
| | 240+00 –325+84 | 8* | PA 8 | 6,671,200 | Stockpile in southwest corner | 3,691,462 | 0 |
| | | | PA 9A | | 300 foot-wide stockpile | 1,898,938 | 0 |
| | | | PA 9B | | 300-foot-wide stockpile | 1,080,800 | 0 |
| Sabine-Neches Canal | 0+00 – 170+00 | 9 | PA 8 | 3,092,000 | Stockpile in northeast corner | 3,092,000 | 0 |
| | 170+00 – 592+91 | 10 | PA 11 | 8,852,000 | Stockpile in north-south corners | 8,852,000 | 0 |

| Channel Reach | Channel Stations | Water-way Section | New Work Material Designation | New Work Dredged Volume (cy)** | New Work Material Construction | New Work Material Used for Construction Volume (cy) | New Work Material Surplus Volume (cy) |
|---|---|---|---|---|---|---|---|
| Neches River Channel | 0+00 – 96+00 | 11 | PA 12 | 1,628,000 | 100-foot-wide stockpile | 1,135,764 | 74,029 |
| | | | PA 13 | | 100-foot-wide stockpile | 418,207 | |
| | 96+00 – 158+00 | 12 | PA 14 | 698,000 | 100-foot-wide stockpile | 522,906 | –362,241 |
| | | | PA 16 | | 100-foot-wide stockpile | 537,335 | |
| | 158+00 – 292+00 | 13 | Old River Cove | 4,882,000 | Marsh BU | 4,882,000 | 0 |
| | 292+00 – 422+00 | 14 | PA 18 | 2,213,000 | 100-foot-wide stockpile | 870,540 | 49,295 |
| | | | PA 18A | | New Hyd. Levee | 293,164 | |
| | | | Bessie Heights East | | Hyd. Levee System | 1,000,000 | |
| | 422+00 – 522+00 | 15 | PA 21 | 2,611,000 | 100-foot-wide stockpile | 397,094 | 1,739,808 |
| | | | PA 23A | | New Hyd. Levee | 474,098 | |
| | 522+00 – 716+00 | 16 | PA 23 | 4,106,000 | 400-foot-wide stockpile | 2,728,359 | –1,766,345 |
| | | | PA 24 | | 400-foot-wide stockpile | 2,624,786 | |
| | | | PA 24A | | New Hyd. levee | 519,200 | |
| | 716+00 – 776+00 | 17 | PA 25 | 2,845,000 | 200-foot-wide stockpile | 2,263,932 | 20,009 |
| | | | PA 25A | | New Hyd. levee; 100-foot-wide stockpile | 561,060 | |
| | | | PA 25 | | 50-foot-wide stockpile | 421,197 | |
| | | | Rose City East | | Hyd. Levee System | 2,100,000 | |
| | 776+00 – 980+00 | 18 | PA 26 | 6,031,000 | 400-foot-wide stockpile | 1,773,504 | 96,456 |
| | | | PA 27A | | 200-foot-wide stockpile | 1,136,376 | |
| | | | PA 27C | | New Hyd. Levee | 283,200 | |
| | | | PA 27D | | New Hyd. Levee | 220,267 | |
| | | | | | **Total** | 54,433,796 | 944,604 |

* Includes new material from Taylor Bayou (0+00 to 106+25).

** New work volume includes additional advance maintenance and proposed allowable overdepth.

The 50-year plan for maintenance material is presented in the following table:

| Chan. Reach | Channel Stations | Water-way Section | Maintenance Material Designation | Dredge Quantity Per Cycle (cy) | Years Per Cycle | Total # of Cycles | Dredging Cycle Schedule | 50-Year Maint-enance Material Total (CY) |
|---|---|---|---|---|---|---|---|---|
| Sabine Bank Extension | 165+443 to 150+500 | D | PA D (Offshore) | 647,000 | 4 | 12 | Cycle 1 through 12 | 7,764,000 |
| | 150+500 to 132+000 | C | PA C (Offshore) | 801,000 | 4 | 12 | Cycle 1 through 12 | 9,612,000 |
| | 132+000 to 114+000 | B | PA B (Offshore) | 779,000 | 4 | 12 | Cycle 1 through 12 | 9,348,000 |
| | 114+000 to 95+734 | A | PA A (Offshore) | 791,000 | 4 | 12 | Cycle 1 through 12 | 9,492,000 |
| Sabine Bank Channel | 95+734 to 53+000 | 1 | PA 1 (Offshore) | 1,508,000 | 4 | 12 | Cycle 1 through 12 | 18,096,000 |
| Sabine Bank Channel | 53+000 to 18+000 | 2 | PA 2 (Offshore) | 3,131,000 | 2 | 25 | Cycle 1 through 25 | 78,275,000 |
| Sabine Outer Bar | 18+000 to 0+000 | 3 | PA 3 (Offshore) | 4,473,000 | 1 | 50 | Cycle 1 through 50 | 223,650,000 |
| Sabine Pass Jetty Channel | –214+88 to 0+00 | 4 | PA 4 (Offshore) | 1,352,700 | 5 | 10 | Cycle 1 through 10 | 13,527,000 |
| Sabine Pass Channel | 0+00 –186+00 | 5 | TX 8-11, | 977,900 | 3 | 16 | LA 5-6: Cycle 1, 3, 5, 7, 9, 11, 13, 15 | 15,646,400 |
| | | | LA 5-6 | | | | TX8-11: Cycle 2, 4, 6, 8, 10, 12, 14, 16 | |
| | 186+00 – 296+25 | 6 | PA 5 (N and S) | 824,700 | 3 | 16 | Cycle 1 through 16 | 13,195,200 |
| | | | PA 5B | 243,700 | 3 | 16 | Cycle 1 through 16 | 3,899,200 |
| | | | PA 5C | 127,500 | 3 | 16 | Cycle 1 through 16 | 2,040,000 |
| Port Arthur Canal | 0+00 – 240+00 | 7 | PA 8 | 2,148,600 | 3 | 16 | Cycle 1 through 16 | 34,377,600 |
| | 240+00 – 325+84 | 8* | PA 8 | 1,317,000 | 2 | 25 | Cycle 1 through 25 | 32,925,000 |
| | | | PA 9A | 311,100 | 2 | 25 | Cycle 1 through 25 | 7,777,500 |
| | | | PA 9B | 311,100 | 2 | 25 | Cycle 1 through 25 | 7,777,500 |
| Sabine-Neches Canal | 0+00 – 170+00 | 9 | PA 8 | 1,317,000 | 2 | 25 | Cycle 1 through 25 | 32,925,000 |
| | 170+00 – 592+91 | 10 | PA 11 | 3,360,000 | 4 | 12 | Cycle 1 through 12 | 40,320,000 |
| Neches River Channel | 0+00 – 96+00 | 11 | PA 12 | 479,800 | 3 | 16 | Cycle 1 through 16 | 7,676,800 |
| | | | PA 13 | 189,200 | 3 | 16 | Cycle 1 through 16 | 3,027,200 |
| | 96+00 – 158+00 | 12 | PA 14 | 432,000 | 3 | 16 | Cycle 1 through 16 | 6,912,000 |
| | 158+00 – 292+00 | 13 | PA 16, TX 5-2 | 445,400 | 3 | 16 | TX 5-2: Cycle 1–9, PA 16: Cycle 10–16 | 7,126,400 |
| | | | PA 17, TX 5-2 | 488,600 | 3 | 16 | TX 5-2: Cycle 1–9, PA 17: Cycle 10–16 | 7,817,600 |
| | 292+00 – 422+00 | 14 | PA 18, TX 5-2 | 740,500 | 4 | 12 | TX 5-2: Cycle 1–7, PA 18: Cycle 8–12 | 8,886,000 |
| | | | PA 18A, TX 5-2 | 145,600 | 4 | 12 | TX 5-2: Cycle 1–7, PA 18A: Cycle 8–12 | 1,747,200 |

| Chan. Reach | Channel Stations | Water-way Section | Maintenance Material Designation | Dredge Quantity Per Cycle (cy) | Years Per Cycle | Total # of Cycles | Dredging Cycle Schedule | 50-Year Maint-enance Material Total (CY) |
|---|---|---|---|---|---|---|---|---|
| | | | PA 21, TX 5-2 | 276,900 | 4 | 12 | TX 5-2: Cycle 1–7, PA 21: Cycle 8–12 | 3,322,800 |
| | 422+00 – 522+00 | 15 | PA 23, TX 5-2 | 629,200 | 6 | 8 | TX 5-2: Cycle 1–4, PA 23: Cycle 5–8 | 5,033,600 |
| | | | PA 23A, TX 5-2 | 335,800 | 6 | 8 | TX 5-2: Cycle 1–4, PA 23A: Cycle 5–8 | 2,686,400 |
| | 522+00 – 716+00 | 16 | PA 24 | 1,267,900 | 6 | 8 | Cycle 1 through 8 | 10,143,200 |
| | | | PA 24A | 611,100 | 6 | 8 | Cycle 1 through 8 | 4,888,800 |
| | 716+00 – 776+00 | 17 | PA 25 | 581,000 | 6 | 8 | Cycle 1 through 8 | 4,648,000 |
| | 776+00 – 980+00 | 18 | PA 25A, TX 3-1E | 542,900 | 6 | 8 | TX 3-1E: Cycle 1, PA 25A: Cycle 2–8 | 4,343,200 |
| | | | PA 26, TX 3-1E | 595,600 | 6 | 8 | TX 3-1E: Cycle 1, PA 26: Cycle 2–8 | 4,764,800 |
| | | | PA 27A, TX 3-1E | 397,100 | 6 | 8 | TX 3-1E: Cycle 1, PA 27A: Cycle 2–8 | 3,176,800 |
| | | | PA 27C, TX 3-1E | 269,900 | 6 | 8 | TX 3-1E: Cycle 1, PA 27C: Cycle 2–8 | 2,159,200 |
| | | | PA 27D, TX 3-1E | 170,600 | 6 | 8 | TX 3-1E: Cycle 1, PA 27D: Cycle 2–8 | 1,364,800 |
| | | | | | | | **50-Year Maintenance Material Total** | **650,372,200** |

* Includes maintenance material from Taylor Bayou (0+00 to 106+25)

The CIP would also incorporate BU areas as part of the DMMP; the Preferred Alternative includes two BU features: Neches River BU Feature (includes Rose City East, Bessie Heights East, and Old River Cove West Marsh Restoration sites) and the Gulf Shore BU Feature (Texas and Louisiana Point Shoreline Nourishment). For detailed information, refer to the DMMP (Appendix D of the FEIS, tables 4-1 and 5-3), which depicts all discharge locations which include all PAs, and BU features.

**(2) Size**

Discharges within the 16 PAs would cover approximately 11,730 acres. BU features include restoration of 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow water habitat (Neches River BU Feature), and regularly renourish approximately 6 miles of shoreline (Gulf Shore BU Feature). Detailed information can be found in the DMMP (Appendix D of the FEIS, tables 5-1 and 5-3).

**(3) Type of Site and Habitat**

Placement would occur on subsided marsh (BU feature and mitigation), eroding beach shoreline along Texas and Louisiana Points (BU feature), and existing and confined PAs.

**(4) Time and Duration of Discharge**

Fifteen construction contracts are planned for dredging and discharging. Contracts 1–5 would be constructed with hopper dredges and contracts 6–12 with hydraulic pipeline dredges. The dredging contracts would be accomplished over a period of about 6 years. The ecological mitigation contracts (13–15) would be accomplished throughout the construction sequence. Dredging for the mitigation contracts does not involve the use of new work or maintenance material from the SNWW CIP. Refer to the FEIS for a description of this work. The proposed sequence for dredge and construction is shown in the following table.

| Contract Number | Contract Schedule | Construction Start (month/fiscal year) | Construction Finish (month/fiscal year) |
|---|---|---|---|
| | **Hopper Dredging:** | | |
| 1 | **Sabine Bank Extension** | October 2012 | January 2013 |
| | Section D Station 165+000 to 165+443 | | |
| | Section C Station 165+443 to 132+000 | | |
| 2 | Section B Station 132+000 to 114+000 | February 2013 | July 2014 |
| | Section A Station 114+000 to 95+734 | | |
| 3 | **Sabine Bank Channel** | October 2015 | August 2015 |
| | Section 1 Station 95+734 to 53+000 | | |
| 4 | **Sabine Pass Outer Bar & Bank Channels** | October 2016 | March 2017 |
| | Section 2 Station 53+000 to 18+000 | | |
| | Section 3 Station 18+000 to 0+000 | | |
| 5 | **Sabine Pass Jetty Channel** | April 2017 | September 2017 |
| | Section 4 Station -214+88 to 0+00 | | |
| | **Pipeline Dredging:** | | |
| 6 | **Sabine Pass Channel** | October 2016 | January 2018 |
| | Section 5 Station 0+00 to 186+00 | | |
| | Section 6 Station 186+00 to 296+25 | | |
| 7 | **Port Arthur Canal** | October 2012 | August 2015 |
| | Section 7 Station 0+00 to 240+00 | | |
| | Section 8 Station 240+00 to 325+84 | | |
| 8 | **Taylor Bayou Basin Area:** | | |
| | **Sabine-Neches Canal** | April 2017 | September 2018 |
| | Section 9 Station 0+00 to 170+00 | | |
| 9 | Section 10 Station 170+00 to 592+94 | April 2014 | May 2017 |
| 10 | **Neches River Channel** | October 2012 | March 2014 |
| | Section 11 Station 0+00 to 96+00 | | |
| | Section 12 Station 95+00 to 158+00 | | |
| | Section 13 Station 158+00 to 292+00 | | |
| 11 | Section 14 Station 292+00 to 422+00 | April 2015 | July 2018 |
| | Section 15 Station 422+00 to 522+00 | | |
| | Section 16 Station 522+00 to 716+00 | | |
| 12 | Section 17 Station 716+00 to 776+00 | October 2012 | March 2015 |
| | Section 18 Sta. 776+00 to 980+00 | | |
| 13 | **Mitigation for Willow Bayou, Louisiana** | October 2015 | May 2018 |
| 14 | **Mitigation for West Black Bayou, Louisiana** | October 2012 | February 2014 |
| 15 | **Mitigation for East Black Bayou, Louisiana** | October 2014 | May 2015 |

**f. Description of Disposal Method**

The construction would utilize a combination of traditional and relatively new dredging techniques. Equipment used to dredge the channels would be those traditionally employed: hopper dredges in the offshore reaches, and hydraulic pipeline dredges in the other reaches. Disposal of the new work material

would be in conventional upland PAs and offshore PAs, as well as innovative, nontraditional dredging techniques of placement into marshes and adjacent shorelines. These techniques are mandated due to the requirements of the mitigation and DMMP restoration and nourishment features. Contracts would be written to not only emphasize the removal of material from the channel, but also emphasize successful completion of mitigation and restoration features so that they would perform to intended purposes. Best Management Practices (BMPs), such as silt curtains, may be implemented where appropriate to control and reduce turbidity during dredging and placement. BMPs would also be employed during construction of temporary containment levees and spill boxes for restoration sites. The DMMP (Appendix D of the FEIS) provides more information.

## II. Factual Determinations

### a. Physical Substrate Determinations

#### (1) Substrate Elevation and Slope

Substrate elevations in BU features and mitigation areas would be approximately mean sea level. In PAs where new levees are required, hydraulic fill levees would be constructed using new work material. The design template provides a 100-foot crest width, 3:1 side slopes, and a 6-foot height.

#### (2) Sediment Type

From historical dredging records of the SNWW, dredged materials are expected to be composed of 51 percent silt, 31 percent clay, and 18 percent sand. Recent sediment tests for the Entrance Channel Extension, which consisted of grab samples from about the top foot of shore sediments, revealed predominantly sand: 26 percent of the samples contained >90 percent sand, 41 percent contained >80 percent sand, and only two samples had a sand content less than 50 percent. The maximum sand content was 99.1 percent. Section 3.4 of the FEIS discusses sediments further.

#### (3) Dredged/Fill Material Movement

Upland PAs would have containment levees to control fill movement after deposition; minor amounts of suspended solids may occur during construction, placement within BU features, or during mitigation efforts. BU marsh restoration areas would be protected from erosion by low levees, and BMPs may be implemented to control and reduce turbidity during discharge. The restored marshes would be stabilized initially by the planting of estuarine plants species (e.g., *Spartina* spp.); rapid natural colonization of marsh vegetation would also be expected based upon previous experience in the area. BU features targeting shoreline stabilization at Texas and Louisiana Points would include regular, unconfined discharge by hydraulic pipeline dredge. Section 2.5.3.2.2 of the FEIS describes predicted movement.

#### (4) Physical Effects on Benthos

Temporary and localized impacts to benthic organisms and their Gulf, estuarine and riverine water-bottom habitats would occur; however, benthic organisms are expected to quickly rebound from the short-term impacts from marsh restoration and shoreline nourishment. BMPs would be used where appropriate

to contain and control sediment and dredged material movement. Effects on aquatic organisms are discussed in Section 4.11 of the FEIS.

**(5) Other Effects**

None known.

**(6) Actions Taken to Minimize Impacts**

This project was fully coordinated with State and Federal resource agencies. Their recommendations were considered, incorporated, and described in the DMMP. Any unavoidable losses were mitigated. The BU features and mitigation sites are expected to lead to an overall increase in the diversity and productivity of estuarine and benthic habitat in the project area.

**b. Water Circulation, Fluctuation, and Salinity Determinations**

**(1) Water**

The dredging and placement operations are expected to have only minor, short-term impacts on water quality in the area. Impacts to water quality are discussed more fully in Section 4.4 of the FEIS. BMPs would be implemented where appropriate.

**(a) Salinity**

The Preferred Alternative would provide a deeper navigation channel that would allow a greater amount of tidal circulation and exchange with the Gulf than is currently the case. Changes in salinities over the SNWW estuarine system were projected with the hydrodynamic salinity (HS) model (Brown and Stokes, 2009) described in sections 4.1 and 4.2 of the FEIS, where the modeling efforts included mitigation measures, relative sea level rise, and alternatives. The HS model determined that approximately 211,500 acres will be impacted by the slight increase in salinity in Texas and Louisiana. The average water surface elevation through most of the study area would largely be unaffected by the 48-foot channel. However, both the amplitude and average elevation of the tide on the upper Neches River near the saltwater barrier could exhibit a measurable increase, on the order of an average increase in water surface elevation of 0.8 inch.

**(b) Water Chemistry**

Aside from a temporary increase in local suspended solids, no impacts are expected (Section 4.4 of the FEIS describes water quality impacts).

**(c) Clarity**

There may be a local and temporary increase in turbidity during dredging and placement operations. BMPs such as temporary containment levees and spill boxes would be implemented where appropriate to control and reduce turbidity during dredging and discharges into confined PAs, BU features, and

mitigation areas during construction. Water clarity is expected to return to normal background levels shortly after operations are completed.

**(d) Color**

Water immediately surrounding the construction area may become discolored temporarily due to disturbance of the sediment. BMPs would be implemented to reduce and control turbidity.

**(e) Odor**

The new work material is not expected to be anoxic, so there should be no odors associated with dredging and placement.

**(f) Taste**

No detectable impacts in the estuarine environment.

**(g) Dissolved Gas Levels**

No dissolved gas levels except, perhaps, minor amounts of hydrogen sulfide are expected.

**(h) Nutrients**

Nutrient levels may be elevated near the PAs during discharge but these increases would be local and temporary.

**(i) Eutrophication**

Nutrients are not expected to reach levels high enough for periods long enough to lead to eutrophication of the surrounding waters.

**(j) Others as Appropriate**

None known.

**(2) Current Patterns and Circulation**

Components of the Preferred Alternative (e.g., shoreline nourishment, marsh nourishment, and restoration) were not shown to significantly affect currents or circulation patterns (sections 4.4 and 4.6 of the FEIS describe currents and flows).

**(a) Current Patterns and Flow**

The Preferred Alternative would not have an effect on freshwater inflows to the system. The 48-foot project would not change large-scale circulation estuarine patterns, but it would cause the leading edge of the salinity wedge to intrude farther upstream.

**(b) Velocity**

The channel deepening would result in general increases in velocity along the entire channel; however, magnitudes are relatively minor, with less than 0.5 foot/second in most cases (Parchure et al., 2005). The largest changes would occur in the Sabine-Neches Channel, but the absolute magnitude is small.

**(c) Stratification**

No increase in stratification would be expected with the Preferred Alternative. The SNWW navigation channels would remain highly stratified with channel deepening.

**(d) Hydrologic Regime**

Although the Preferred Alternative would increase tidal exchange and slightly increase salinity levels, hydrologic and tidal regimes would not be altered on a large scale.

**(3) Normal Water Level Fluctuations**

The average water surface elevation through most of the study area would largely be unaffected by the 48-foot channel, and no significant increase in tidal amplitude would be expected.

**(4) Salinity Gradients**

The Preferred Alternative would provide a deeper navigation channel that would allow a greater amount of tidal circulation and exchange with the Gulf than is currently the case. Changes in salinities over the SNWW estuarine system were projected with the HS model (Brown and Stokes, 2009) described in sections 4.1 and 4.2 of the FEIS, where the modeling efforts included mitigation measures, relative sea level rise, and alternatives. During median flows, the transition would shift to near Bessie Heights on the Neches River, to Keith Lake on the Sabine-Neches Canal, and Johnson's Bayou on Sabine Lake. During low flows, the transition would shift to near Rose City on the Neches River, the Sabine River near Orange, Texas, and Willow Bayou on Sabine Lake. The 48-foot project would cause the leading edge of the salinity wedge to intrude further upstream.

**(5) Actions That Will Be Taken to Minimize Impacts**

The following objectives were established to offset or minimize impacts from the SNWW CIP. The objectives were developed by USACE in consultation with the Interagency Coordination Team (ICT).

- Minimize salinity impacts to the SNWW affected area
- Maximize the use of dredged material in marsh restoration measures
- Meet goal of no net loss of wetlands
- Replace lost habitat quality on a 1:1 ratio
- Replace habitats in-kind to the extent practicable
- offset or minimize losses in the state where they occur

- Share dredged material from Sabine Pass equally between Louisiana and Texas

Ultimately, unavoidable impacts of the Preferred Alternative in Texas are more than offset by benefits of the DMMP (which includes BU features); impacts in Louisiana, however, required compensatory mitigation. Therefore, the mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. The amount of impacts avoidance, minimization, or mitigation is based upon the amount of marsh acreage that could be lost as a result of the project, and the additional amount that would need to be restored in order to fully compensate for adverse changes to biological function of the remaining marsh throughout the affected area over the 50-year period of analysis. Mitigation is fully described in Chapter 5 of the FEIS.

The Neches River BU Feature would offset or minimize impacts to Texas wetlands on the Sabine and Neches rivers by restoring 2,853 acres of emergent marsh, improve 871 acres of shallow-water habitat, and nourish 1,234 acres of existing marsh. The BU feature also offsets direct impacts from connecting 86 acres of freshwater marsh to a confined PA.

**c. Suspended Particulate/Turbidity Determination**

**(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site**

A temporary and localized increase in suspended particulates and turbidity levels is expected during dredging and placement operations of new work and maintenance material. BMPs would be implemented where appropriate.

**(2) Effects on Chemical and Physical Properties of the Water Column**

**(a) Light Penetration**

Turbidity levels would be temporarily increased during dredging and placement operations of new work and maintenance material.

**(b) Dissolved Oxygen**

No adverse impacts to dissolved oxygen (DO) are expected; a reduction in DO may occur at localized and temporary events during placement.

**(c) Toxic metals and organics**

Suspended particles resulting from placement would not result in detrimental effects to chemical and physical properties of the water column. Extensive chemical analyses, bioassays, and bioaccumulation studies of offshore sediment material were conducted in accordance with EPA Regulations and the *Ocean*

*Testing Manual*. Results indicate that there are no causes for concern related to chemical contaminants and that these sediments are suitable for ocean placement. Similar testing was performed numerous times on maintenance material dredged from the 22-mile existing SNWW Entrance Channel, and these sediments were always found to be acceptable for ocean placement. Section 4.5 of the FEIS discusses sediment testing results.

An examination of the sediment data presented in PBS&J (2004) and sediment data recently collected in March 2008 and April 2009 indicates no cause for concern, with the possible exception of elevated polycyclic aromatic hydrocarbons (PAHs) in one reach of the Neches River. There are nine sites listed in Table 3.3-1 in the FEIS that are considered to be priority Hazardous, Toxic, and Radioactive Waste (HTRW) sites, and there is a reach of the Neches River (stations 750 + 000 to 950 + 000, Figure 2.4-1g in the FEIS) that has higher sediment PAH concentrations than other reaches of the SNWW, but the location of the sites in Table 3.3-1 in the FEIS do not correlate to the higher-PAH reach of the Neches River. Additionally, none of those PAHs are found in the elutriate samples from the higher-PAH reach of the Neches River (Section 3.3 in the FEIS), so there is no indication that those PAHs would be released during dredging and/or placement. Taking all of this information into account, there appear to be no reaches of the SNWW that exhibit a cause for concern.

**(d) Pathogens**

None expected or found.

**(e) Aesthetics**

The PAs, BU features, and mitigation areas have been designed and selected with coordination between necessary and interested resource agencies to minimize environmental impacts and reduce or eliminate adverse aesthetic qualities.

**(f) Others as Appropriate**

None known.

**(3) Effects on Biota**

No impacts are expected on photosynthesis, suspension/filter feeders, and sight feeders, except for temporary and localized impacts from placement operations (e.g., burial of benthos or temporary increase of local turbidity levels).

Creating benefits for estuarine biota (species depend on estuaries at some time in their life cycle for protection, food, and as a nursery site), the Neches River BU Feature (comprised of Rose City East, Bessie Heights East, and Old River Cove West) would restore 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat. The Gulf Shore BU Feature (Texas and Louisiana Points) involve regular nourishment of approximately 6 miles of shoreline. Additionally, the mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near

Willow and Black bayous, Louisiana. This mitigation measure would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. Chapter 5 of the FEIS discusses mitigation for habitats.

**(4) Actions Taken to Minimize Impacts**

Construction and placement plans for the dredged materials have been closely coordinated with the resource agencies to assure minimal impacts to aquatic habitats. Additionally, a Wetland Value Assessment was performed for SNWW CIP impacts to ensure proper mitigation or replacement of estuarine vegetation communities. Dredged material has been used beneficially to the maximum extent possible, resulting in the offsetting of all project impacts in Texas, and offsetting of some impacts in Louisiana. In addition, new upland PAs were sited to avoid impacts to wetlands to the greatest extent possible. BMPs would include construction of temporary containment levees/spill boxes for restoration sites and could include silt curtains during discharges in BU features.

**d. Contaminant Determinations**

The USACE has collected and archived a significant amount of water and sediment chemistry data as well as elutriate data that provide information on those constituents that are dissolved into the water column during dredging and placement. The water and elutriate study results are summarized by channel station in Section 3.3.1 of the FEIS. Based on available data, there is no indication of current water or elutriate contaminant problems along the SNWW. In consideration of Louisiana Department of Environmental Quality (LDEQ) requirements, Sabine Pass sediment was compared to Louisiana's RECAP non-industrial Screening Standards. All detected analytes were below the lowest value for the respective standard. PBS&J also compared water and elutriate results to the Louisiana Surface Water Quality Standard (LWQS), and found no exceedances.

An examination of the sediment data presented in PBS&J (2004), and sediment data recently collected in March 2008 and April 2009, indicates no cause for concern, with the possible exception of elevated PAHs in one reach of the Neches River. There are nine sites listed in Table 3.3-1 in the FEIS that are considered to be priority HTRW sites, and there is a reach of the Neches River (stations 750 + 000 to 950 + 000, Figure 2.4-1g in the FEIS) that has higher sediment PAH concentrations than other reaches of the SNWW, but the location of the sites in Table 3.3-1 in the FEIS do not correlate to the higher-PAH reach of the Neches River. Additionally, none of those PAHs are found in the elutriate samples from the higher-PAH reach of the Neches River (Section 3.3 in the FEIS), so there is no indication that those PAHs would be released during dredging and/or placement. Taking all of this information into account, there appear to be no reaches of the SNWW that exhibit a cause for concern.

**e. Aquatic Ecosystem and Organism Determinations**

**(1) Effects on Plankton**

Construction and placement operations are expected to have only minor temporary, local impacts on plankton from increased turbidity levels.

**(2) Effects on Benthos**

Temporary and localized impacts to benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats would occur; however, benthic organisms are expected to quickly rebound from the short-term impacts from marsh restoration and shoreline nourishment.

**(3) Effects on Nekton**

Wright (1978) indicates that nekton is not directly affected by dredged material placement for marsh restoration in shallow, open-water areas and shoreline nourishment since they can avoid areas of high turbidity. The benthos within BU features, which would have been used as a food source, may be temporarily and detrimentally affected, but the restored marshes would ultimately improve habitat for benthic organisms. The elutriate analyses and bioassessments with undisturbed virgin sediment yielded no expectation of short-term water column or benthic toxicity from dredging or placement operations, except from increased turbidity. Therefore, no significant impacts to the nekton of the area from the proposed dredging and placement operations are expected.

**(4) Effects on Aquatic Food Web**

The estuarine and Gulf food web would benefit from greater productivity associated with marsh restoration in shallow, open-water areas and shoreline nourishment. Reductions in primary productivity from turbidity would be localized around the immediate area of the construction and maintenance dredge operations and would be limited to the duration of the plume at a given site.

**(5) Effects on Special Aquatic Sites**

The Preferred Alternative is not expected to have detrimental effects on special aquatic sites (i.e., sanctuaries and refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle and pool complexes) in the study area. The Neches River BU Feature would offset impacts to Texas wetlands on the Sabine and Neches rivers by restoring 2,853 acres of emergent marsh, improving 871 acres of shallow-water habitat, and nourishing 1,234 acres of existing marsh. The BU feature also offsets direct impacts from connecting 86 acres of freshwater marsh to a confined PA. In addition, new upland PAs were sited to avoid impacts to wetlands to the greatest extent possible.

The mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in

and around the marsh restoration zone. The amount of recommended mitigation is based upon the amount of marsh acreage that could be lost as a result of the project, and the additional amount that would need to be restored in order to fully compensate for adverse changes to biological function of the remaining marsh throughout the affected area over the 50-year period of analysis. Chapter 5 of the FEIS discusses mitigation for estuarine habitats.

**f. Proposed Disposal Site Determinations**

**(1) Mixing Zone Determination**

Preferred Alternative PAs would not require mixing zones as they include levees and dewatering designs. Mixing zones would occur during marsh restoration or shoreline nourishment; however, testing of elutriates prepared with maintenance material has not demonstrated contaminants or other causes for concern.

**(2) Determination of Compliance with Applicable Water Quality Standards**

Sediment analyses of new work material have been performed, and testing of elutriates prepared with maintenance material has not demonstrated any violation of applicable water quality standards. The State of Texas has issued a water quality certificate for current maintenance dredging of the SNWW, indicating that water quality standards are being met.

**(3) Potential Effects on Human Use Characteristics**

**(a) Municipal and Private Water Supply**

The proposed project would not impact any municipal or private water supplies. On the Neches River, water intakes are located upstream of the Neches River Saltwater Barrier; on the Sabine River, water intakes are located well upstream of the projected saltwater intrusion.

**(b) Recreational and Commercial Fisheries**

Recreational and commercial fishing in Sabine Pass areas and the immediate Gulf may benefit as a result of the marsh restoration efforts, which would increase estuarine habitats that are critical to the marine food web.

**(c) Water-related Recreation**

The project would improve navigation, which may improve water-related recreation.

**(d) Aesthetics**

The project is designed to minimize any adverse impacts to the environment and aesthetic qualities in the area.

**(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves**

No special sites would be negatively impacted by the project.

**g. Determination of Cumulative Effects on the Aquatic Ecosystem**

The project is expected to result in net benefits to the environment without adding to negative cumulative impacts in the aquatic ecosystem. A Wetland Value Assessment was performed to ensure adequate replacement of wetlands and ecological functions.

**h. Determination of Secondary Effects on the Aquatic Ecosystem**

No adverse significant secondary effects on the aquatic ecosystem should occur as a result of the recommended project, but secondary beneficial effects are expected from marsh restoration and shoreline nourishment efforts.

## Literature Cited

Brown, G.L., and J. Stokes. 2009. Numerical Model Study of Potential Salinity Impacts Due to Proposed Navigation Improvements to the Sabine-Neches Waterway, Texas (August 2009 draft report). U.S. Army Engineer Research Development Center – Coastal and Hydraulics Laboratory (ERDC-CHL), Vicksburg, Mississippi.

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U.S. Army Corps of Engineers (USACE). 1982. Sabine-Neches Waterway, Texas: feasibility report and environmental impact statement for channel improvements for navigation. U.S. Army Engineer District, Galveston, Texas.

Wright, T.C. 1978. Aquatic dredged material disposal impacts. U.S. Army Eng. Water Experiment Station Environmental Laboratory, Vicksburg, Mississippi, Technical Report DS-78-1.

**FINDINGS OF COMPLIANCE WITH**
**SECTION 404(b)(1) GUIDELINES**
**FOR SABINE–NECHES WATERWAY – CHANNEL IMPROVEMENT PROJECT**
**JEFFERSON AND ORANGE COUNTIES, TEXAS**

1. No significant adaptations of the Guidelines were made relative to the evaluation for this project.

2. The recommended plan is the result of thorough evaluation of seven proposed alternatives (including the No-Action Alternative).

3. The recommended plan would not violate any applicable State or Federal water quality criteria or toxic effluent standards of Section 307 of the Clean Water Act.

4. The recommended plan would not adversely affect any federally or State-listed threatened or endangered species or their critical habitat or violate any protective measures for any sanctuary. Various resource agencies, including FWS and NMFS, have been consulted regarding potential issues of any federally or State-listed threatened or endangered species or their critical habitat (e.g., sea turtle avoidance measures would be implemented during operations).

5. The recommended plan would not result in adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The PAs, BU features, and mitigation sites would provide additional habitat for life stages of marine species and additional habitat for colonial waterbirds. There are no significant adverse impacts expected to the estuarine ecosystem diversity, productivity and stability, or recreational, aesthetic, and economic values.

6. Appropriate steps to minimize potential adverse impacts on the estuarine system include close coordination with State and Federal resource agencies during final design prior to construction to incorporate all valid suggestions. Special aquatic sites or sensitive habitat affected by channel deepening and expansion would be mitigated.

7. Based on the guidelines, the preferred alternative is specified as complying with the requirements of the Section 404(b)(1) guidelines.

Dolan Dunn — 4/29/10

Mr. Dolan Dunn — Date
Chief–Planning, Environmental, and Regulatory Division
U.S. Army Corps of Engineers, Galveston District

# Appendix F

# Final General Conformity Determination

Document No. 070057
PBS&J Job No. 100007609

# FINAL
# GENERAL CONFORMITY DETERMINATION
# SABINE-NECHES CHANNEL IMPROVEMENT PROJECT
# PORT OF BEAUMONT AND PORT OF PORT ARTHUR TEXAS

Prepared for:

U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Prepared by:

PBS&J
6504 Bridge Point Parkway
Suite 200
Austin, Texas 78730

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PBSJ
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## PROFESSIONAL ENGINEER STATEMENT

This Final General Conformity Determination Document and estimate of air contaminant emissions is released on September 8, 2010, under the authority of Ruben I. Velasquez, P.E., Registration No. 69126, for the purpose of evaluation and discussion. This preliminary document is not to be used for construction or bidding purposes.

STATE OF TEXAS
RUBEN I. VELASQUEZ
69126
REGISTERED
PROFESSIONAL ENGINEER

9-8-2010

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## Acronyms and Abbreviations

| | |
|---|---|
| AQCR | Air Quality Control Region |
| BPA | Beaumont-Port Arthur Nonattainment Area |
| CAA | Clean Air Act |
| CFR | Code of Federal Regulations |
| CIP | Channel Improvement Project |
| DOT | U.S. Department of Transportation |
| EIS | Environmental Impact Statement |
| EPA | U.S. Environmental Protection Agency |
| FEIS | Final Environmental Impact Statement |
| MVEB | Motor Vehicle Emissions Budget |
| NAAQS | National Ambient Air Quality Standards |
| NEPA | National Environmental Policy Act |
| $NO_x$ | nitrogen oxides |
| ROP | Rate-of-Progress |
| SIP | State Implementation Plan |
| SNWW | Sabine-Neches Waterway |
| TAC | Texas Administrative Code |
| TCEQ | Texas Commission on Environmental Quality |
| tpy | tons per year |
| USACE | U.S. Army Corps of Engineers |
| VOC | volatile organic compound |

# 1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) has joined in an agreement with the Sabine Neches Navigation District to prepare a Final Feasibility Report and a Final Environmental Impact Statement (FEIS) for proposed improvements to the Sabine-Neches Waterway (SNWW). The proposed SNWW Channel Improvement Project (CIP) is intended to improve the efficiency of the deep-draft navigation system while protecting the area's coastal and estuarine resources. As authorized by the Senate Committee on Environment and Public Works Resolution, dated June 5, 1997, the USACE has reviewed previous USACE reports on the SNWW and other pertinent reports to determine the feasibility of modifying the channels serving the Port of Beaumont and the Port of Port Arthur, Texas, in the interests of commercial navigation. These channels are collectively named the SNWW. The lead agency for the FEIS is the USACE, with several cooperating agencies. An FEIS was prepared as required by the National Environmental Policy Act (NEPA) to present an evaluation of potential impacts associated with the proposed CIP.

The proposed SNWW CIP will be located on the upper Texas Gulf Coast at the Texas-Louisiana state boundary within Jefferson and Orange counties in Texas and Cameron and Calcasieu parishes in Louisiana. Sabine Pass, Sabine Lake, and the Sabine River together form the southern boundary between the two states. The area surrounding the waterway is generally referred to as the "Golden Triangle," which refers to the metropolitan area's three major cities and their ports—Beaumont, Port Arthur, and Orange, Texas. The project area is defined as those areas that would be directly affected by construction of the CIP as detailed in the FEIS.

The counties of Jefferson and Orange are within an area designated as the Beaumont-Port Arthur (BPA) Air Quality Control Region (AQCR). Ozone is the only criteria pollutant from which the BPA fails to meet the National Ambient Air Quality Standards (NAAQS). The U.S. Environmental Protection Agency (EPA) has classified the BPA area as a "serious" nonattainment area under the 1-hour NAAQS for ozone and a "moderate" nonattainment area with regard to the 8-hour NAAQS for ozone. Under the current attainment classification, the BPA has until June 15, 2010, to attain the 8-hour NAAQS for ozone. However, 8-hour ozone data for 2005, 2006, and 2007 indicate that the BPA area is monitoring attainment of the standard. As a result, the Texas Commission on Environmental Quality (TCEQ) adopted a Texas State Implementation Plan (SIP) revision that includes a Redesignation Request and a Maintenance Plan under Section 175A of the Federal Clean Air Act (CAA) Amendments of 1990 for the BPA area (TCEQ, 2008). This maintenance plan is currently pending review by the EPA.

Calcasieu Parish is in the Lake Charles AQCR and Cameron Parish is in the Southern Louisiana-Southeast Texas AQCR. These parishes are currently classified as being in attainment with the NAAQS for all criteria pollutants.

For a nonattainment area, a General Conformity Determination is required when the total air contaminant emissions caused by the proposed project would equal or exceed a specific threshold for nitrogen oxides ($NO_x$) or volatile organic compounds (VOCs). Based on an evaluation of air contaminant emissions from the construction activities associated with the proposed SNWW CIP Preferred Alternative, it has been determined that a General Conformity Determination for $NO_x$ emissions is required. Emissions of VOC for the project are exempt from a General Conformity Determination because they are below the emissions threshold requiring such an analysis.

This document represents the Final General Conformity Determination prepared on behalf of the USACE, Galveston District, pursuant to the CAA to document that emissions that would result from the USACE action in approving the proposed SNWW CIP Project are in conformity with the SIP for the BPA ozone nonattainment area.

# 2.0 REGULATORY BACKGROUND – GENERAL CONFORMITY

General conformity refers to the process of evaluating plans, programs, and projects to determine and demonstrate they meet the requirements of the CAA and the SIP. The General Conformity Rule requires conformity in coordination with and as part of the NEPA process. The proposed CIP project, as a Federal action, is subject to the General Conformity Rule (40 CFR Part 51, Subpart W). This rule implements the Federal CAA conformity provision in Title I, Section 176(c)(1), "Limitation on Certain Federal Assistance," which mandates that the Federal government not engage, support, or provide financial assistance for licensing or permitting, or approving any activity not conforming to an approved CAA implementation plan. In Texas, the applicable implementation plan is the Texas SIP, an EPA-approved plan for the regulation and enforcement of the NAAQS in each air quality region within the state. The General Conformity Rule is designed to ensure that Federal actions do not cause or contribute to degradation in air quality in an area that is designated as being a "nonattainment" area or a "maintenance" area with regard to meeting the NAAQS, thus supporting the achievement of State and Federal air quality goals. The General Conformity Rule is codified at Title 40 Code of Federal Regulations (CFR) Part 51, Subpart W, "Determining Conformity of Federal Actions to State or Federal Implementation Plans."

The TCEQ has promulgated a corresponding General Conformity Rule in 30 Texas Administrative Code (TAC) §101.30, "Conformity of General Federal Actions to State Implementation Plans." This rule applies to all Federal actions except programs and projects requiring funding or approval from the U.S. Department of Transportation (DOT), the Federal Highway Administration, the Federal Transit Administration, or the Metropolitan Planning Organization. These types of programs and projects must instead comply with the conformity provisions implemented in the Transportation Conformity Rule issued by the DOT on November 24, 1993.

The CAA defines conformity to the SIP as the upholding of "an implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards." Conforming activities or actions should not, through additional air pollutant emissions, result in the following:

- Cause or contribute to new violations of any NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS in any area; or
- Delay timely attainment of any NAAQS or interim emission reductions or other milestones in any area.

Pursuant to the General Conformity Rule, a Federal agency must make a General Conformity Determination for all Federal actions in nonattainment or maintenance areas where the total of direct and indirect emissions of a nonattainment pollutant or its precursors exceeds levels established by this rule.

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# 3.0 APPLICABILITY

Consistent with Section 176(c)(1) of the CAA, a Federal action is generally defined as any activity engaged in or supported in any way by any department, agency, or instrumentality of the Federal government (40 CFR § 51.852). Federal actions include providing Federal financial assistance or issuing a Federal license, permit, or approval. Where the Federal action is a permit, license, or other approval for some aspect of a non-Federal undertaking, the relevant activity is the part, portion, or phase of the non-Federal undertaking that requires the Federal permit, license, or approval.

The proposed SNWW CIP requires approval from the USACE, as the lead agency, for dredge and fill activities related to the project. Only project activities subject to the jurisdiction of the USACE and within the boundaries of Texas would be subject to this conformity determination. Because the project alternatives are subject to the approval of the USACE, it constitutes a Federal action, and therefore, air contaminant emissions resulting from the Preferred Alternative must be evaluated under the General Conformity rules.

The BPA ozone nonattainment area is classified as "moderate" in terms of its degree of compliance with the current 8-hour ozone standard. This area is in attainment with all other criteria pollutants. Pursuant to the General Conformity rules, a General Conformity Determination is required for each year when the total of direct or indirect emissions caused by the CIP would equal or exceed 100 tons per year (tpy) of $NO_x$ or 100 tpy of VOC (40 CFR §51.853). The rule does not apply (i.e., a General Conformity Determination is not required) to actions where the total of direct or indirect emissions is below these emissions levels. In addition, even if the total of direct and indirect emissions of VOC or $NO_x$ do not exceed the 100 tpy threshold levels, when the total of direct and indirect emissions of any pollutant from the Federal action represents 10 percent or more of a nonattainment or maintenance area's total emissions of those pollutants, then the action is defined as a regionally significant action and a conformity determination would be still be applicable.

For purposes of the General Conformity Determination, the relevant direct and indirect emissions are those associated with the construction of the widening and deepening of the Sabine-Neches channel including emissions from dredging activities, construction equipment, and temporary employee vehicles. The General Conformity analysis would include only air emissions from project activities occurring within the Texas state line out to the boundary considered the natural resources limit, i.e., 9 miles out into the Gulf of Mexico.

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# 4.0 AIR EMISSIONS INVENTORY

The evaluation of an air emissions inventory associated with the proposed SNWW CIP was based on the identification of air contaminants and estimated emission rates for the Preferred Alternative. For purposes of this Draft General Conformity Determination, an air emissions inventory was prepared for project-related construction based on the construction schedule and other assumptions as developed for this project. Air emissions estimates were calculated using techniques appropriate for a specific emissions-generating activity or source. The basis, emission factors, and summary of emissions are provided in Appendix A.

## 4.1 Project Emissions

Project emissions were estimated for the projected years of construction, 2011 through 2018. The estimated emissions were based on projected equipment use and scheduling for offshore and onshore construction activities. The construction emissions inventory included emissions associated with dredging vessels and equipment, nonroad construction equipment, and on-road mobile sources, as follows:

- Dredging vessels and equipment – included dredges and support marine vessels;
- Nonroad construction equipment – included amphibious trackhoe, dozer, dragline, excavator, and rolligon; and
- On-road mobile sources – included employee commuter vehicles

### 4.1.1 Dredging Vessels and Equipment

Dredging emissions included those that would be expected to result from the use of tugboats and miscellaneous marine vessels in support of the dredging activities. Air emissions directly related with the dredging equipment were calculated on an annual basis based on the anticipated type of engine, activity, horsepower, and anticipated hours of operation. Estimated emissions from the use of dredging equipment were based on the emission factor algorithms referenced in EPA's technical report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data," EPA 420-R-00-002, February 2000. This technical report is a compilation of engine- and fuel-usage test data from various types of marine vessels including bulk carriers, container ships, dredges, tankers, and tugboats. This report was utilized to determine the load factors and emission factors for the various combustion engines that would be used in support of the dredging activities for the project. Emission factors were determined based on an emission factor algorithm that may be used to calculated air contaminant emission rates for these emission sources. The emission factor algorithm is applicable to all engine sizes since, according to the EPA's document, the emissions data showed no statistically significant difference across engine sizes.

### 4.1.2 Nonroad Construction Equipment

Air contaminant emissions from nonroad construction equipment used for onshore dredged material placement; i.e., filling, working, and compacting of dredged material, were calculated on an annual basis based on the anticipated type of equipment, activity, horsepower, and anticipated hours of operation. The operation of construction vehicles (e.g., amphibious trackhoe, dozer, dragline, excavator, and rolligon) will generate air emissions typical of vehicles powered by diesel-fueled internal combustion engines. The estimate of emissions for this equipment was based on emission factors generated using the EPA's NONROAD2005. This computer model may be used to calculate emissions for many nonroad equipment types, categorizing them by horsepower rating and fuel type available for specific years, for a specific geographic area, state, or county. The NONROAD model was run for the amphibious trackhoe, dozer, dragline, and excavator equipment from the population that may be found in Jefferson and Orange counties for each year of anticipated construction.

### 4.1.3 On-road Mobile Sources

Mobile source emissions associated with the SNWW CIP construction will be generated from employee commuter vehicles. Mobile on-road emissions associated with employee vehicles were calculated using EPA MOBILE6, a mobile source emissions model. A mix of light-duty gasoline vehicles and light-duty gasoline trucks was assumed for the makeup of the employee vehicles. An average commute of 25 miles each way was assumed for each vehicle. The total number of miles traveled was estimated by multiplying the number of miles per trip by the total number of days of construction activity for each year times the number of vehicles.

## 4.2 Summary of $NO_X$ and VOC Emissions

For comparison with the thresholds defined in the General Conformity Rule, the average emissions of $NO_x$ and VOC are summarized in tables 1 and 2 for each year of the anticipated construction activities. Emissions of carbon monoxide, sulfur dioxide, and particulate matter are not considered in the General Conformity evaluation as the study area is in attainment with the NAAQS for each of those pollutants.

As shown in Table 1, $NO_x$ emissions for activities subject to USACE responsibility show the project would exceed the conformity threshold, i.e., greater than 100 tpy. Therefore, a General Conformity Determination for $NO_x$ emissions would be required.

Table 1

Summary of Estimated Project $NO_x$ Emissions (tpy)

| Year | Dredge & Support Equipment | Nonroad Construction Equipment | On-road Mobile Emissions | Total |
|---|---|---|---|---|
| 2011 | 217.77 | 34.05 | 0.29 | 252.11 |
| 2012 | 1,106.59 | 126.17 | 1.25 | 1,234.01 |
| 2013 | 1,120.03 | 120.72 | 1.29 | 1,242.05 |
| 2014 | 1,222.80 | 116.52 | 1.27 | 1,340.59 |
| 2015 | 1,208.15 | 104.22 | 1.28 | 1,313.65 |
| 2016 | 1,212.23 | 90.55 | 1.26 | 1,304.05 |
| 2017 | 1,312.36 | 87.97 | 1.32 | 1,401.65 |
| 2018 | 467.93 | 34.07 | 0.45 | 502.45 |

As shown in Table 2, VOC emissions for the activities subject to USACE responsibility are exempt from a General Conformity Determination because they are below the 100-tpy threshold.

Table 2

Summary of Estimated Project VOC Emissions (tpy)

| Year | Dredge & Support Equipment | Nonroad Construction Equipment | On-road Mobile Emissions | Total |
|---|---|---|---|---|
| 2011 | 2.57 | 3.12 | 0.42 | 6.10 |
| 2012 | 12.38 | 11.43 | 1.84 | 25.65 |
| 2013 | 12.54 | 10.99 | 1.91 | 25.44 |
| 2014 | 13.82 | 10.86 | 1.88 | 26.57 |
| 2015 | 13.94 | 9.90 | 1.89 | 25.73 |
| 2016 | 14.22 | 8.69 | 1.87 | 24.78 |
| 2017 | 15.40 | 8.73 | 1.94 | 26.07 |
| 2018 | 5.47 | 34.89 | 0.66 | 41.02 |

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# 5.0 ISSUANCE OF DRAFT GENERAL CONFORMITY DETERMINATION AND AGENCY RESPONSE

On December 16, 2009, the USACE, Galveston District issued a Draft General Conformity Determination concurrently with the Draft Environmental Impact Statement (EIS) for the proposed SNWW CIP. Copies of these documents were provided to various Federal and State agencies including the TCEQ and the EPA, Region VI. The USACE published the notice of availability of the Draft General Conformity Determination in newspapers of general circulation for the BPA and the Sulphur and Lake Charles, Louisiana, areas on January 21, 2010, in the *Beaumont Enterprise*, Beaumont, Texas; on January 20, 21, and 22, 2010, in the *Port Arthur News*, City of Port Arthur, Texas; on January 19, 20, 21, and 22, 2010, in the *Southwest Daily News*, Sulphur, Louisiana; and on January 21, 22, and 23, 2010, in the *Lake Charles American Press*, Lake Charles, Louisiana. Copies of these publications and publisher's affidavits are provided in Appendix B.

After the issuance of the Draft General Conformity Determination in December 2009, the TCEQ provided a General Conformity Concurrence letter dated April 15, 2010. A copy of this letter is provided in Appendix C.

In its letter, the TCEQ provided its General Conformity concurrence for the proposed SNWW CIP and a determination that emissions from the project would not exceed the emissions from the applicable SIP, the BPA Rate-of-Progress, adopted by the TCEQ on October 27, 2004, and approved by the EPA on February 22, 2006. In addition, the TCEQ suggested that the USACE adopt pollution prevention and/or reduction measures in conjunction with this and future projects including the following:

- Encourage construction contractors to apply for Texas Emission Reduction Plan grants;
- Establish bidding conditions that give preference to clean contractors;
- Direct construction contractors to exercise air quality best management practices;
- Direct contractors that will use tugboats during construction to use clean fuels;
- Direct operators of the assist tugboats used in maneuvering dredge vessels to use clean fuels;
- Select assist tugs based on lowest $NO_x$ emissions instead of lowest price; or
- Purchase and permanently retire surplus $NO_x$ offsets prior to commencement of operations.

No additional comments related to the Draft General Conformity Determination were received by the USACE.

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# 6.0 FINAL GENERAL CONFORMITY DETERMINATION

Based on the evaluation of the proposed project description, estimated air quality emissions, and with consideration of the General Conformity concurrence letter from the TCEQ, the USACE has determined that its approval of the proposed SNWW CIP will meet the General Conformity requirements of TCEQ Chapter 101, §101.30(h)(1)(E)(i)(I). This section of the TCEQ's General Conformity Rule applies to an ozone nonattainment area, where the EPA has approved a revision to an area's attainment demonstration after 1990, and the TCEQ makes a determination that the estimated air contaminant emissions from a proposed Federal action will not exceed the emissions budget in the SIP.

The emissions budget for General Conformity purposes is defined in the TCEQ General Air Quality Rules §101.30(8). The budget is established by the allowable emissions allocated to a subcategory of the emissions inventory in the applicable SIP revision. The applicable SIP for General Conformity purposes is the most recent revision of the SIP that has been approved by the EPA. For the BPA nonattainment area, the most recently approved SIP revision is entitled "Post 1996 Rate-of-Progress Demonstration for the Beaumont-Port Arthur Nonattainment Area" adopted by the TCEQ on October 27, 2004, and approved by the EPA on February 22, 2006. For the BPA nonattainment area, the attainment year used for analyses should be 2010. However, the emissions inventory budgets used in the development of the 1999 Rate-of-Progress (ROP) SIP are based on the attainment year 2005, and therefore, emissions budgets for $NO_x$ and VOC are based on emissions inventories projected to 2005.

The total inventory of emissions of $NO_x$ and VOC is summarized in information provided in support of the 1999 ROP SIP for four general categories of emission sources: stationary point, area, on-road mobile, and off-road (nonroad) mobile. The inventory of nonroad emissions of $NO_x$ and VOC includes five general categories of emission sources: aircraft, ground support equipment, commercial marine vessels, locomotives, and NONROAD Model categories. The SIP also provides a summary of the 2005 ROP Motor Vehicle Emissions Budget (MVEB) for the BPA nonattainment area.

Based on information provided in the 1999 ROP SIP, the 2005 Nonroad Mobile emissions budget, inclusive of landside construction equipment and commercial marine vessels, is 27.43 tons per day (about 10,011 tpy) of $NO_x$. The 2005 MVEB in the 1999 ROP SIP for the BPA nonattainment area is 33.97 tons per day (12,399 tpy) of $NO_x$. For comparison to these emission budgets, the highest annual $NO_x$ emission rates for the SNWW CIP Preferred Alternative are broken down as shown in Table 3. The basis, emission factors, and summary of emissions are provided in Appendix A.

Table 3

Project $NO_X$ Emissions Compared to 1999 ROP SIP Emissions Inventory Budgets (tpy)

| SIP Emissions Category | Project Activity | Maximum Annual $NO_x$ Emissions (tons/year of maximum occurrence) | Maximum Daily $NO_x$ Emissions (tons/day) | SIP Emissions Budget (tons/day) | % of SIP Emissions Budget |
|---|---|---|---|---|---|
| Nonroad Mobile | Dredging Vessel Equipment, Dredging Support Vessels, and Land-side Construction Equipment | 1400.33 (2017) | 0.80 | 27.43 | 2.9 |
| On-road Mobile | On-Road – Employee Commuter Vehicles | 1.32 (2017) | 0.0008 | 33.97 | 0.002 |

As shown in Table 3, $NO_x$ emissions from the project dredging activities during the project year 2017 would represent about 2.9 percent of the 2005 BPA Nonroad Mobile emissions budget. Air emissions from employee commuter vehicles would represent about 0.002 percent of the SIP 2005 MVEB.

Based on an evaluation of the proposed project emissions, the total emissions of $NO_x$ resulting from the SNWW CIP Preferred Alternative would result in a level of emissions that is within the 2005 Nonroad Mobile emissions budget and the 2005 MVEB as shown in the 1999 ROP SIP for the BPA nonattainment area. Considering the inventory of other emission sources in the BPA area, it is anticipated that emissions from each year of the project would be less than an increase of 10 percent of the VOC and $NO_x$ emissions inventories for the entire BPA nonattainment area. As such, emissions from the activities subject to the USACE action are not considered regionally significant for purposes of General Conformity. Therefore, it is expected that emissions from the project construction would not:

- Cause or contribute to new violation of any NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS in any area; or
- Delay timely attainment of any NAAQS or interim emission reductions or other milestones in any area.

Based on a review of the Draft General Conformity Determination, the TCEQ has determined, pursuant to 30 TAC §101.30(h)(1)(E)(i)(I), that emissions from the proposed project will not exceed the emissions from the applicable SIP, the BPA Rate-of-Progress, adopted by the TCEQ on October 27, 2004, and approved by the EPA on February 22, 2006. Therefore, the USACE has determined that the proposed project complies with the requirements of the General Conformity Rule; Section 176 of the CAA, and the State regulations promulgated pursuant to this rule, and is in conformity with the currently approved BPA SIP.

# 7.0 REFERENCES

40 Code of Federal Regulations (CFR) Part 51, Subpart W (58 Federal Register (FR) 63,214). 1993. Preamble to the adoption of the Federal conformity requirements, November 30, 1993.

40 CFR Part 93, Subpart B. (58 Federal Register (FR) 63,253). 1993. Determining Conformity of General Federal Actions to State or Federal Implementation Plans, November 30, 1993.

Texas Commission on Environmental Quality (TCEQ). 1999. General Air Quality Rules, Chapter 101, §101.30, "Conformity of General Federal Actions to State Implementation Plan," Effective December 23, 1999.

———. 2004. Post 1996 Rate-of-Progress Demonstration for the Beaumont-Port Arthur Nonattainment Area. Texas Commission on Environmental Quality. Austin, Texas, Adopted October 27, 2004.

———. 2008. "Revisions to the State Implementation Plan (SIP) for the Control of Ozone Air Pollution: Eight-Hour Ozone Redesignation Request and Maintenance Plan for the Beaumont-Port Arthur Ozone Nonattainment Areas. Adopted December 10, 2008.

U.S. Environmental Protection Agency (EPA). 2000. Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data. EPA 420-R-00-002. February 2000.

———. 2006. Approval and Promulgation of State Implementation Plans; Texas; Revision to the Rate of Progress Plan for the Beaumont/Port Arthur Ozone Nonattainment Area. February 22, 2006. Federal Register, Volume 71, No. 35, pages 8962–8965.

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# Appendix A

# Summary of Estimated Air Emissions

# Operating Hours

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2011** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | 1,500.00 | 772.50 | 750.00 | 1,500.00 | 516.00 | 300.00 | 103.13 | 2,100.00 | 722.25 | | | | | 8,264 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 1,212.77 | | | | 545.74 | | | | | 606.38 | 2,910.64 | 242.55 | 242.55 | 5,761 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 900.00 | | | | 405.00 | | | | | | 2,160.00 | 180.00 | 180.00 | 3,825 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1,000.00 | | | | 450.00 | | | | | 500.00 | 2,400.00 | 200.00 | 200.00 | 4,750 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2011 TOTAL** | | 4,612.77 | 772.50 | 750.00 | 1,500.00 | 1,916.74 | 300.00 | 103.13 | 2,100.00 | 722.25 | 1,106.38 | 7,470.64 | 622.55 | 622.55 | **22,600** |
| **YEAR 2012** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | 6,000.00 | 3,090.00 | 3,000.00 | 6,000.00 | 2,064.00 | 1,200.00 | 412.50 | 8,400.00 | 2,889.00 | | | | | 33,056 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 4,851.06 | | | | 2,182.98 | | | | | 2,425.53 | 11,642.55 | 970.21 | 970.21 | 23,043 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 3,600.00 | | | | 1,620.00 | | | | | | 8,640.00 | 720.00 | 720.00 | 15,300 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 4,000.00 | | | | 1,800.00 | | | | | 2,000.00 | 9,600.00 | 800.00 | 800.00 | 19,000 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2012 TOTAL** | | 18,451.06 | 3,090.00 | 3,000.00 | 6,000.00 | 7,666.98 | 1,200.00 | 412.50 | 8,400.00 | 2,889.00 | 4,425.53 | 29,882.55 | 2,490.21 | 2,490.21 | **90,398** |
| **YEAR 2013** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | 500.00 | 257.50 | 250.00 | 500.00 | 172.00 | 100.00 | 34.38 | 700.00 | 240.75 | | | | | 2,755 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | 5,500.00 | 2,832.50 | 2,750.00 | 5,500.00 | 1,892.00 | 1,100.00 | 378.28 | 7,700.00 | 2,648.56 | | | | | 30,301 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 4,851.06 | | | | 2,182.98 | | | | | 2,425.53 | 11,642.55 | 970.21 | 970.21 | 23,043 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 3,600.00 | | | | 1,620.00 | | | | | | 8,640.00 | 720.00 | 720.00 | 15,300 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 4,000.00 | | | | 1,800.00 | | | | | 2,000.00 | 9,600.00 | 800.00 | 800.00 | 19,000 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 225.00 | | | | 101.25 | | | | | 112.50 | 225.00 | 210.00 | 210.00 | 1,084 |
| | **YEAR 2013 TOTAL** | | 18,676.06 | 3,090.00 | 3,000.00 | 6,000.00 | 7,768.23 | 1,200.00 | 412.65 | 8,400.00 | 2,889.31 | 4,538.03 | 30,107.55 | 2,700.21 | 2,700.21 | **91,482** |

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# Operating Hours

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2014** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | 3,500.00 | 1,802.50 | 1,750.00 | 3,500.00 | 1,204.00 | 700.00 | 240.72 | 4,900.00 | 1,685.44 | | | | | 19,283 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | 1,500.00 | 772.50 | 750.00 | 1,500.00 | 516.00 | 300.00 | 103.09 | 2,100.00 | 722.18 | | | | | 8,264 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 4,851.06 | | | | 2,182.98 | | | | | 2,425.53 | 11,642.55 | 970.21 | 970.21 | 23,043 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 3,434.21 | | | | 1,545.39 | | | | | | 8,242.11 | 686.84 | 686.84 | 14,595 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 900.00 | | | | 405.00 | | | | | | 2,160.00 | 180.00 | 180.00 | 3,825 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 4,000.00 | | | | 1,800.00 | | | | | 2,000.00 | 9,600.00 | 800.00 | 800.00 | 19,000 |
| 13 | Sabine Lake | 24" Cutter Suction | 102.27 | | | | 46.02 | | | | | 51.14 | 2,863.64 | 238.64 | 238.64 | 3,540 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 900.00 | | | | 405.00 | | | | | 450.00 | 900.00 | 840.00 | 840.00 | 4,335 |
| | **YEAR 2014 TOTAL** | | 19,187.55 | 2,575.00 | 2,500.00 | 5,000.00 | 8,104.40 | 1,000.00 | 343.81 | 7,000.00 | 2,407.63 | 4,926.67 | 35,408.29 | 3,715.69 | 3,715.69 | **95,885** |
| **YEAR 2015** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | 4,000.00 | 2,060.00 | 2,000.00 | 4,000.00 | 1,376.00 | 800.00 | 274.91 | 5,600.00 | 1,925.82 | | | | | 22,037 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | 1,500.00 | 772.50 | 750.00 | 1,500.00 | 516.00 | 300.00 | 103.17 | 2,100.00 | 722.33 | | | | | 8,264 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 964.29 | | | | 433.93 | | | | | | 2,314.29 | 192.86 | 192.86 | 4,098 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 3,234.04 | | | | 1,455.32 | | | | | 1,617.02 | 7,761.70 | 646.81 | 646.81 | 15,362 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 4,578.95 | | | | 2,060.53 | | | | | | 10,989.47 | 915.79 | 915.79 | 19,461 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 3,118.05 | | | | 1,403.12 | | | | | 1,559.02 | 7,483.32 | 623.61 | 623.61 | 14,811 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1,000.00 | | | | 450.00 | | | | | 500.00 | 2,400.00 | 200.00 | 200.00 | 4,750 |
| 13 | Sabine Lake | 24" Cutter Suction | 409.09 | | | | 184.09 | | | | | 204.55 | 11,454.55 | 954.55 | 954.55 | 14,161 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 375.00 | | | | 168.75 | | | | | 187.50 | 375.00 | 350.00 | 350.00 | 1,806 |
| | **YEAR 2015 TOTAL** | | 19,179.42 | 2,832.50 | 2,750.00 | 5,500.00 | 8,047.74 | 1,100.00 | 378.08 | 7,700.00 | 2,648.15 | 4,068.09 | 42,778.33 | 3,883.61 | 3,883.61 | **104,750** |

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# Operating Hours

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2016** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | 6,000.00 | 3,090.00 | 3,000.00 | 6,000.00 | 2,064.00 | 1,200.00 | 412.67 | 8,400.00 | 2,889.33 | | | | | 33,056 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 3,857.14 | | | | 1,735.71 | | | | | | 9,257.14 | 771.43 | 771.43 | 16,393 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 4,578.95 | | | | 2,060.53 | | | | | | 10,989.47 | 915.79 | 915.79 | 19,461 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 4,157.40 | | | | 1,870.83 | | | | | 2,078.70 | 9,977.76 | 831.48 | 831.48 | 19,748 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 409.09 | | | | 184.09 | | | | | 204.55 | 11,454.55 | 954.55 | 954.55 | 14,161 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2016 TOTAL** | | 19,002.58 | 3,090.00 | 3,000.00 | 6,000.00 | 7,915.16 | 1,200.00 | 412.67 | 8,400.00 | 2,889.33 | 2,283.25 | 41,678.92 | 3,473.24 | 3,473.24 | **102,818** |
| **YEAR 2017** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | 1,500.00 | 772.50 | 750.00 | 1,500.00 | 516.00 | 300.00 | 103.17 | 2,100.00 | 722.33 | | | | | 8,264 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | 3,000.00 | 1,545.00 | 1,500.00 | 3,000.00 | 1,032.00 | 600.00 | 206.00 | 4,200.00 | 1,444.00 | | | | | 16,527 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 3,857.14 | | | | 1,735.71 | | | | | | 9,257.14 | 771.43 | 771.43 | 16,393 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 3,256.03 | | | | 1,465.21 | | | | | | 7,814.47 | 651.21 | 651.21 | 13,838 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 1,907.89 | | | | 858.55 | | | | | | 4,578.95 | 381.58 | 381.58 | 8,109 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 4,157.40 | | | | 1,870.83 | | | | | 2,078.70 | 9,977.76 | 831.48 | 831.48 | 19,748 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 409.09 | | | | 184.09 | | | | | 204.55 | 11,454.55 | 954.55 | 954.55 | 14,161 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2017 TOTAL** | | 18,087.56 | 2,317.50 | 2,250.00 | 4,500.00 | 7,662.40 | 900.00 | 309.17 | 6,300.00 | 2,166.33 | 2,283.25 | 43,082.87 | 3,590.24 | 3,590.24 | **97,040** |
| **YEAR 2018** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 321.43 | | | | 144.64 | | | | | | 771.43 | 64.29 | 64.29 | 1,366 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 3,243.97 | | | | 1,459.79 | | | | | | 7,785.53 | 648.79 | 648.79 | 13,787 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 2,067.15 | | | | 930.22 | | | | | 1,033.58 | 4,961.16 | 413.43 | 413.43 | 9,819 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 170.45 | | | | 76.70 | | | | | 85.23 | 4,772.73 | 397.73 | 397.73 | 5,901 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2018 TOTAL** | | 5,803.00 | | | | 2,611.35 | | | | | 1,118.80 | 18,290.85 | 1,524.24 | 1,524.24 | **30,872** |

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# Operating Hours

TOTAL

| Contract No. | Location/Disposal Site | Dredge | Dredge: Dredging | Dredge: Propelling | Dredge: Pumping | Dredge: Generating | Dredge: Idling | Survey Boat: Propelling | Survey Boat: Idling | Trawler: Propelling | Trawler: Idling | Floating: Pumping | Tug: Propelling | Spill Barge: Main Engine | Crew Boat: Propelling | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | 9,000 | 4,635 | 4,500 | 9,000 | 3,096 | 1,800 | 619 | 12,600 | 4,334 | | | | | 49,584 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | 5,500 | 2,833 | 2,750 | 5,500 | 1,892 | 1,100 | 378 | 7,700 | 2,648 | | | | | 30,301 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | 9,000 | 4,635 | 4,500 | 9,000 | 3,096 | 1,800 | 619 | 12,600 | 4,334 | | | | | 49,584 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | 3,000 | 1,545 | 1,500 | 3,000 | 1,032 | 600 | 206 | 4,200 | 1,444 | | | | | 16,527 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | 9,000 | | | | 4,050 | | | | | | 21,600 | 1,800 | 1,800 | 38,250 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 19,000 | | | | 8,550 | | | | | 9,500 | 45,600 | 3,800 | 3,800 | 90,250 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 6,500 | | | | 2,925 | | | | | | 15,600 | 1,300 | 1,300 | 27,625 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 14,500 | | | | 6,525 | | | | | | 34,800 | 2,900 | 2,900 | 61,625 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 9,000 | | | | 4,050 | | | | | | 21,600 | 1,800 | 1,800 | 38,250 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 13,500 | | | | 6,075 | | | | | 6,750 | 32,400 | 2,700 | 2,700 | 64,125 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 14,000 | | | | 6,300 | | | | | 7,000 | 33,600 | 2,800 | 2,800 | 66,500 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1,500 | | | | 675 | | | | | 750 | 42,000 | 3,500 | 3,500 | 51,925 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | 1,500 | | | | 675 | | | | | 750 | 1,500 | 1,400 | 1,400 | 7,225 |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 123,000 | 17,768 | 17,250 | 34,500 | 51,693 | 6,900 | 2,372 | 48,300 | 16,612 | 24,750 | 248,700 | 22,000 | 22,000 | 635,845 |
| | | **TOTAL** | **238,000** | **31,415** | **30,500** | **61,000** | **100,634** | **12,200** | **4,194** | **85,400** | **29,372** | **49,500** | **497,400** | **44,000** | **44,000** | **1,227,615** |

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2289

**Marine Engine Emission Factors and Fuel Consumption Algorithms**
**(in g/kW-hr, for all marine engines)**

| Statistical Parameter | Exponent (x) | Intercept (b) | Coefficient (a) |
|---|---|---|---|
| **CO** | 1 | 0 | 0.8378 |
| **$NO_X$** | 1.5 | 10.4496 | 0.1255 |
| **PM** | 1.5 | 0.2551 | 0.0059 |
| **PM2.5** | 1.5 | 0.2551 | 0.0059 |
| **PM10** | 1.5 | 0.2551 | 0.0059 |
| **$SO_X$** | n/a | 0 | 2.3735 |
| **VOC (HC)** | 1.5 | 0 | 0.0667 |

**Notes:**

1.) All regressions but $SO_2$ are in the form of:

**Emissions Rate (g/hp-hr) = (a*(Fractional Load)$^{-X}$ + b) * 0.7457**
where the conversion factor of 0.7457 kW/hp is used to calculate the emission factor in g/hp-hr

2.) Fractional Load is equal to actual engine output divided by rated engine output.

3.) The $SO_2$ regression is the form of:

**Emissions Rate (g/hp-hr) = a*(Fuel Sulfur Flow in g/hp-hr) + b**
where Fuel Sulfur Flow is the Fuel Consumption times the sulfur content of the fuel;
The sulfur content for the fuel consumption regression was set to 3300 parts per million (0.33 wt%)

4.) **Fuel Consumption (g/hp-hr) = (14.12 / (Fractional Load) + 205.717) * 0.7457**

5.) n/a is not applicable, n/s is not statistically significant.

6.) All information shown above is detailed in Table 5-1 of the EPA technical report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data", EPA 420-R-00-002, February 2000.

## Marine Equipment Load Factors and Emission Factors

| | Dredge | | | | | Crew Boat | | Trawler | | Floating Booster | Tug | Spill Barge | Crew Boat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Operating Mode** | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling |
| **Load Factor** | 0.8 | 0.8 | 0.8 | 0.8 | 0.2 | 0.4 | 0.2 | 0.4 | 0.2 | 0.8 | 0.4 | 0.4 | 0.4 |
| **EF (Gram/hp-hr)** | | | | | | | | | | | | | |
| **CO** | 0.780934 | 0.780934 | 0.780934 | 0.780934 | 3.123737 | 1.561869 | 3.123737 | 1.561869 | 3.123737 | 0.780934 | 1.561869 | 1.561869 | 1.561869 |
| **$NO_X$** | 7.923056 | 7.923056 | 7.923056 | 7.923056 | 8.838583 | 8.162195 | 8.838583 | 8.162195 | 8.838583 | 7.923056 | 8.162195 | 8.162195 | 8.162195 |
| **PM** | 0.196377 | 0.196377 | 0.196377 | 0.196377 | 0.239417 | 0.207619 | 0.239417 | 0.207619 | 0.239417 | 0.196377 | 0.207619 | 0.207619 | 0.207619 |
| **PM2.5** | 0.178703 | 0.178703 | 0.178703 | 0.178703 | 0.217870 | 0.188933 | 0.217870 | 0.188933 | 0.217870 | 0.178703 | 0.188933 | 0.188933 | 0.188933 |
| **PM10** | 0.188522 | 0.188522 | 0.188522 | 0.188522 | 0.229841 | 0.199314 | 0.229841 | 0.199314 | 0.229841 | 0.188522 | 0.199314 | 0.199314 | 0.199314 |
| **$SO_X$** | 1.304627 | 1.304627 | 1.304627 | 1.304627 | 1.613894 | 1.407716 | 1.613894 | 1.407716 | 1.613894 | 1.304627 | 1.407716 | 1.407716 | 1.407716 |
| **VOC (HC)** | 0.069511 | 0.069511 | 0.069511 | 0.069511 | 0.556090 | 0.196607 | 0.556090 | 0.196607 | 0.556090 | 0.069511 | 0.196607 | 0.196607 | 0.196607 |

**Notes:**

1.) The dredge type, engine type, horsepower, and fuel type were based on information provided by project sponsors.

2.) The engine load factors for the dredges and support equipment were determined from Table 5-2 of the EPA Report"Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data", February 2000.

A survey of dredge engine sizes along with input from project sponsors was used to determine which operating mode and hence which load factor applied to each engine. The following assumptions applied to the load factor determination:

A.) The main engines on the dredges were assumed to operate at full power (e.g. 0.8 "cruise" load factor from Table 5-2 of EPA report) for all hours of operation.

B.) The generators on the dredges were assumed to operate at 0.2 load factor during idling.

C.) The main engines or propulsion engines on the support equipment were assumed to operate at intermittent times during the dredging operations and were also determined to operate at the 0.4 "slow cruise" load factor.

D.) The auxiliary engines, if any, on the support equipment were assumed to operate sparingly during idling and were determined to operate at the 0.2 "maneuvering" load factor.

3.) The emission factors were calculated according to the algorithm table and formulas detailed on page 5-3 of the EPA report. The emissions Rate formula and algorithm table are also shown on Table A-4, "Marine Engine Emission Factor and Fuel Consumption Data", February 2000.

4.) The Emission Rate in tons/hr is based on the following formula: Emission Rate = hp*LF*EF*(0.0022046 lbs/gram)*(1 ton/2000 lbs).

# CO (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2011** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 4.79 | 1.55 | 2.07 | 0.71 | 0.41 | 0.14 | 0.87 | 0.30 | | | | | 10.84 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 7.52 | | | | 1.13 | | | | | 3.13 | 1.00 | 0.03 | 0.07 | 12.87 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 5.58 | | | | 0.84 | | | | | | 0.74 | 0.02 | 0.05 | 7.23 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 6.20 | | | | 0.93 | | | | | 2.58 | 0.83 | 0.02 | 0.06 | 10.62 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2011 TOTAL** | | **19.30** | **4.79** | **1.55** | **2.07** | **3.61** | **0.41** | **0.14** | **0.87** | **0.30** | **5.72** | **2.57** | **0.07** | **0.17** | **41.56** |
| **YEAR 2012** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 19.15 | 6.20 | 8.27 | 2.84 | 1.65 | 0.57 | 3.47 | 1.19 | | | | | 43.35 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 30.07 | | | | 4.51 | | | | | 12.53 | 4.01 | 0.11 | 0.27 | 51.50 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 22.32 | | | | 3.35 | | | | | | 2.98 | 0.08 | 0.20 | 28.92 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 24.80 | | | | 3.72 | | | | | 10.33 | 3.31 | 0.09 | 0.22 | 42.46 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2012 TOTAL** | | **77.18** | **19.15** | **6.20** | **8.27** | **14.42** | **1.65** | **0.57** | **3.47** | **1.19** | **22.86** | **10.29** | **0.28** | **0.69** | **166.23** |
| **YEAR 2013** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 1.60 | 0.52 | 0.69 | 0.24 | 0.14 | 0.05 | 0.29 | 0.10 | | | | | 3.61 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 17.56 | 5.68 | 7.58 | 2.61 | 1.52 | 0.52 | 3.18 | 1.09 | | | | | 39.74 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 30.07 | | | | 4.51 | | | | | 12.53 | 4.01 | 0.11 | 0.27 | 51.50 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 22.32 | | | | 3.35 | | | | | | 2.98 | 0.08 | 0.20 | 28.92 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 24.80 | | | | 3.72 | | | | | 10.33 | 3.31 | 0.09 | 0.22 | 42.46 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.53 | | | | 0.08 | | | | | 0.58 | 0.08 | 0.24 | 0.06 | 1.57 |
| | **YEAR 2013 TOTAL** | | **77.71** | **19.15** | **6.20** | **8.27** | **14.50** | **1.65** | **0.57** | **3.47** | **1.19** | **23.44** | **10.37** | **0.52** | **0.74** | **167.80** |

# CO (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2014** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 11.17 | 3.62 | 4.82 | 1.66 | 0.96 | 0.33 | 2.02 | 0.70 | | | | | 25.29 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 4.79 | 1.55 | 2.07 | 0.71 | 0.41 | 0.14 | 0.87 | 0.30 | | | | | 10.84 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 30.07 | | | | 4.51 | | | | | 12.53 | 4.01 | 0.11 | 0.27 | 51.50 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 21.29 | | | | 3.19 | | | | | | 2.84 | 0.08 | 0.19 | 27.59 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 5.58 | | | | 0.84 | | | | | | 0.74 | 0.02 | 0.05 | 7.23 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 24.80 | | | | 3.72 | | | | | 10.33 | 3.31 | 0.09 | 0.22 | 42.46 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.24 | | | | 0.04 | | | | | 0.26 | 0.99 | 0.03 | 0.07 | 1.62 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 2.11 | | | | 0.33 | | | | | 2.32 | 0.31 | 0.96 | 0.23 | 6.27 |
| | **YEAR 2014 TOTAL** | | **84.08** | **15.96** | **5.17** | **6.89** | **15.00** | **1.38** | **0.47** | **2.89** | **0.99** | **25.45** | **12.19** | **1.29** | **1.02** | **172.79** |
| **YEAR 2015** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 12.77 | 4.13 | 5.51 | 1.90 | 1.10 | 0.38 | 2.31 | 0.80 | | | | | 28.90 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 4.79 | 1.55 | 2.07 | 0.71 | 0.41 | 0.14 | 0.87 | 0.30 | | | | | 10.84 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 5.98 | | | | 0.90 | | | | | | 0.80 | 0.02 | 0.05 | 7.75 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 20.05 | | | | 3.01 | | | | | 8.35 | 2.67 | 0.07 | 0.18 | 34.33 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 28.38 | | | | 4.26 | | | | | | 3.78 | 0.10 | 0.25 | 36.78 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 19.33 | | | | 2.90 | | | | | 8.05 | 2.58 | 0.07 | 0.17 | 33.10 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 6.20 | | | | 0.93 | | | | | 2.58 | 0.83 | 0.02 | 0.06 | 10.62 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.96 | | | | 0.15 | | | | | 1.06 | 3.94 | 0.11 | 0.26 | 6.48 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.88 | | | | 0.14 | | | | | 0.97 | 0.13 | 0.40 | 0.10 | 2.61 |
| | **YEAR 2015 TOTAL** | | **81.77** | **17.56** | **5.68** | **7.58** | **14.89** | **1.52** | **0.52** | **3.18** | **1.09** | **21.01** | **14.73** | **0.80** | **1.07** | **171.41** |
| **YEAR 2016** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 19.15 | 6.20 | 8.27 | 2.84 | 1.65 | 0.57 | 3.47 | 1.19 | | | | | 43.35 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 23.91 | | | | 3.59 | | | | | | 3.19 | 0.09 | 0.21 | 30.98 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 28.38 | | | | 4.26 | | | | | | 3.78 | 0.10 | 0.25 | 36.78 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 25.77 | | | | 3.87 | | | | | 10.74 | 3.44 | 0.09 | 0.23 | 44.13 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.96 | | | | 0.15 | | | | | 1.06 | 3.94 | 0.11 | 0.26 | 6.48 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2016 TOTAL** | | **79.02** | **19.15** | **6.20** | **8.27** | **14.70** | **1.65** | **0.57** | **3.47** | **1.19** | **11.79** | **14.35** | **0.39** | **0.96** | **161.73** |

# CO (tpy)

## YEAR 2017

| Contract No. | Location/Disposal Site | Dredge | Dredge: Dredging | Dredge: Propelling | Dredge: Pumping | Dredge: Generating | Dredge: Idling | Survey Boat: Propelling | Survey Boat: Idling | Trawler: Propelling | Trawler: Idling | Floating: Pumping | Tug: Propelling | Spill Barge: Main Engine | Crew Boat: Propelling | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 4.79 | 1.55 | 2.07 | 0.71 | 0.41 | 0.14 | 0.87 | 0.30 | | | | | 10.84 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 9.58 | 3.10 | 4.13 | 1.42 | 0.83 | 0.28 | 1.74 | 0.60 | | | | | 21.67 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 23.91 | | | | 3.59 | | | | | | 3.19 | 0.09 | 0.21 | 30.98 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 20.18 | | | | 3.03 | | | | | | 2.69 | 0.07 | 0.18 | 26.16 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 11.83 | | | | 1.77 | | | | | | 1.58 | 0.04 | 0.11 | 15.33 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 25.77 | | | | 3.87 | | | | | 10.74 | 3.44 | 0.09 | 0.23 | 44.13 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.96 | | | | 0.15 | | | | | 1.06 | 3.94 | 0.11 | 0.26 | 6.48 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2017 TOTAL** | | **82.65** | **14.37** | **4.65** | **6.20** | **14.54** | **1.24** | **0.43** | **2.60** | **0.90** | **11.79** | **14.84** | **0.41** | **0.99** | **155.59** |

## YEAR 2018

| Contract No. | Location/Disposal Site | Dredge | Dredge: Dredging | Dredge: Propelling | Dredge: Pumping | Dredge: Generating | Dredge: Idling | Survey Boat: Propelling | Survey Boat: Idling | Trawler: Propelling | Trawler: Idling | Floating: Pumping | Tug: Propelling | Spill Barge: Main Engine | Crew Boat: Propelling | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 1.99 | | | | 0.30 | | | | | | 0.27 | 0.01 | 0.02 | 2.58 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 20.11 | | | | 3.02 | | | | | | 2.68 | 0.07 | 0.18 | 26.06 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 12.81 | | | | 1.92 | | | | | 5.34 | 1.71 | 0.05 | 0.11 | 21.94 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.40 | | | | 0.06 | | | | | 0.44 | 1.64 | 0.05 | 0.11 | 2.70 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2018 TOTAL** | | **35.31** | | | | **5.30** | | | | | **5.78** | **6.30** | **0.17** | **0.42** | **53.29** |

## TOTAL

| Contract No. | Location/Disposal Site | Dredge | Dredge: Dredging | Dredge: Propelling | Dredge: Pumping | Dredge: Generating | Dredge: Idling | Survey Boat: Propelling | Survey Boat: Idling | Trawler: Propelling | Trawler: Idling | Floating: Pumping | Tug: Propelling | Spill Barge: Main Engine | Crew Boat: Propelling | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | 25.54 | 8.27 | 11.02 | 3.79 | 2.20 | 0.76 | 4.63 | 1.59 | | | | | 57.80 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 28.73 | 9.30 | 12.40 | 4.26 | 2.48 | 0.85 | 5.21 | 1.79 | | | | | 65.02 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 17.56 | 5.68 | 7.58 | 2.61 | 1.52 | 0.52 | 3.18 | 1.09 | | | | | 39.74 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 28.73 | 9.30 | 12.40 | 4.26 | 2.48 | 0.85 | 5.21 | 1.79 | | | | | 65.02 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 9.58 | 3.10 | 4.13 | 1.42 | 0.83 | 0.28 | 1.74 | 0.60 | | | | | 21.67 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 55.79 | | | | 8.37 | | | | | | 7.44 | 0.20 | 0.50 | 72.30 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 117.78 | | | | 17.67 | | | | | 49.07 | 15.70 | 0.43 | 1.05 | 201.70 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 40.29 | | | | 6.04 | | | | | | 5.37 | 0.15 | 0.36 | 52.21 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 89.88 | | | | 13.48 | | | | | | 11.98 | 0.33 | 0.80 | 116.48 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 55.79 | | | | 8.37 | | | | | | 7.44 | 0.20 | 0.50 | 72.30 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 83.68 | | | | 12.55 | | | | | 34.87 | 11.16 | 0.31 | 0.74 | 143.31 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 86.78 | | | | 13.02 | | | | | 36.16 | 11.57 | 0.32 | 0.77 | 148.62 |
| 13 | Sabine Lake | 24" Cutter Suction | 3.51 | | | | 0.56 | | | | | 3.87 | 14.46 | 0.40 | 0.96 | 23.77 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 3.51 | | | | 0.56 | | | | | 3.87 | 0.52 | 1.61 | 0.39 | 10.45 |
| | **PROJECT TOTAL** | | **537.02** | **110.14** | **35.64** | **47.52** | **96.96** | **9.50** | **3.27** | **19.96** | **6.86** | **127.85** | **85.65** | **3.95** | **6.06** | **1,090** |

| $NO_x$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2011** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 48.58 | 15.72 | 20.96 | 2.01 | 2.16 | 0.40 | 4.54 | 0.84 | | | | | 95.22 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 76.27 | | | | 3.19 | | | | | 31.78 | 5.24 | 0.14 | 0.35 | 116.97 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 56.60 | | | | 2.37 | | | | | | 3.89 | 0.11 | 0.26 | 63.22 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 62.89 | | | | 2.63 | | | | | 26.20 | 4.32 | 0.12 | 0.29 | 96.45 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2011 TOTAL** | | **195.76** | **48.58** | **15.72** | **20.96** | **10.20** | **2.16** | **0.40** | **4.54** | **0.84** | **57.98** | **13.44** | **0.37** | **0.90** | **371.87** |
| **YEAR 2012** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 194.33 | 62.89 | 83.85 | 8.04 | 8.64 | 1.61 | 18.14 | 3.38 | | | | | 380.89 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 305.09 | | | | 12.76 | | | | | 127.12 | 20.95 | 0.58 | 1.40 | 467.89 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 226.41 | | | | 9.47 | | | | | | 15.55 | 0.43 | 1.04 | 252.89 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 251.56 | | | | 10.52 | | | | | 104.82 | 17.28 | 0.48 | 1.15 | 385.81 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2012 TOTAL** | | **783.05** | **194.33** | **62.89** | **83.85** | **40.80** | **8.64** | **1.61** | **18.14** | **3.38** | **231.94** | **53.78** | **1.48** | **3.59** | **1,487.47** |
| **YEAR 2013** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 16.19 | 5.24 | 6.99 | 0.67 | 0.72 | 0.13 | 1.51 | 0.28 | | | | | 31.74 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 178.14 | 57.65 | 76.87 | 7.37 | 7.92 | 1.47 | 16.63 | 3.10 | | | | | 349.15 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 305.09 | | | | 12.76 | | | | | 127.12 | 20.95 | 0.58 | 1.40 | 467.89 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 226.41 | | | | 9.47 | | | | | | 15.55 | 0.43 | 1.04 | 252.89 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 251.56 | | | | 10.52 | | | | | 104.82 | 17.28 | 0.48 | 1.15 | 385.81 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 5.35 | | | | 0.24 | | | | | 5.90 | 0.40 | 1.26 | 0.30 | 13.44 |
| | **YEAR 2013 TOTAL** | | **788.40** | **194.33** | **62.89** | **83.85** | **41.04** | **8.64** | **1.61** | **18.14** | **3.38** | **237.83** | **54.18** | **2.74** | **3.89** | **1,500.92** |

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| $NO_x$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2014** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 113.36 | 36.69 | 48.91 | 4.69 | 5.04 | 0.94 | 10.58 | 1.97 | | | | | 222.18 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 48.58 | 15.72 | 20.96 | 2.01 | 2.16 | 0.40 | 4.54 | 0.84 | | | | | 95.22 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 305.09 | | | | 12.76 | | | | | 127.12 | 20.95 | 0.58 | 1.40 | 467.89 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 215.98 | | | | 9.04 | | | | | | 14.83 | 0.41 | 0.99 | 241.24 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 56.60 | | | | 2.37 | | | | | | 3.89 | 0.11 | 0.26 | 63.22 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 251.56 | | | | 10.52 | | | | | 104.82 | 17.28 | 0.48 | 1.15 | 385.81 |
| 13 | Sabine Lake | 24" Cutter Suction | 2.43 | | | | 0.11 | | | | | 2.68 | 5.15 | 0.14 | 0.34 | 10.86 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 21.38 | | | | 0.95 | | | | | 23.58 | 1.62 | 5.03 | 1.21 | 53.78 |
| | **YEAR 2014 TOTAL** | | **853.04** | **161.94** | **52.41** | **69.88** | **42.45** | **7.20** | **1.34** | **15.12** | **2.82** | **258.20** | **63.72** | **6.74** | **5.35** | **1,540.20** |
| **YEAR 2015** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 129.55 | 41.93 | 55.90 | 5.36 | 5.76 | 1.07 | 12.09 | 2.25 | | | | | 253.92 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 48.58 | 15.72 | 20.96 | 2.01 | 2.16 | 0.40 | 4.54 | 0.84 | | | | | 95.22 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 60.64 | | | | 2.54 | | | | | | 4.16 | 0.11 | 0.28 | 67.74 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 203.39 | | | | 8.51 | | | | | 84.75 | 13.97 | 0.38 | 0.93 | 311.93 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 287.97 | | | | 12.05 | | | | | | 19.78 | 0.54 | 1.32 | 321.66 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 196.10 | | | | 8.20 | | | | | 81.71 | 13.47 | 0.37 | 0.90 | 300.74 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 62.89 | | | | 2.63 | | | | | 26.20 | 4.32 | 0.12 | 0.29 | 96.45 |
| 13 | Sabine Lake | 24" Cutter Suction | 9.72 | | | | 0.43 | | | | | 10.72 | 20.61 | 0.57 | 1.37 | 43.43 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 8.91 | | | | 0.39 | | | | | 9.83 | 0.67 | 2.10 | 0.50 | 22.41 |
| | **YEAR 2015 TOTAL** | | **829.62** | **178.14** | **57.65** | **76.87** | **42.13** | **7.92** | **1.47** | **16.63** | **3.10** | **213.20** | **76.99** | **4.20** | **5.59** | **1,513.49** |

# $NO_x$ (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2016** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 194.33 | 62.89 | 83.85 | 8.04 | 8.64 | 1.61 | 18.14 | 3.38 | | | | | 380.89 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 242.58 | | | | 10.15 | | | | | | 16.66 | 0.46 | 1.11 | 270.95 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 287.97 | | | | 12.05 | | | | | | 19.78 | 0.54 | 1.32 | 321.66 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 261.46 | | | | 10.94 | | | | | 108.94 | 17.96 | 0.49 | 1.20 | 400.99 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 9.72 | | | | 0.43 | | | | | 10.72 | 20.61 | 0.57 | 1.37 | 43.43 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2016 TOTAL** | | **801.73** | **194.33** | **62.89** | **83.85** | **41.61** | **8.64** | **1.61** | **18.14** | **3.38** | **119.66** | **75.01** | **2.06** | **5.00** | **1,417.91** |
| **YEAR 2017** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 48.58 | 15.72 | 20.96 | 2.01 | 2.16 | 0.40 | 4.54 | 0.84 | | | | | 95.22 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 97.17 | 31.45 | 41.93 | 4.02 | 4.32 | 0.80 | 9.07 | 1.69 | | | | | 190.44 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 242.58 | | | | 10.15 | | | | | | 16.66 | 0.46 | 1.11 | 270.95 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 204.77 | | | | 8.57 | | | | | | 14.06 | 0.39 | 0.94 | 228.73 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 119.99 | | | | 5.02 | | | | | | 8.24 | 0.23 | 0.55 | 134.02 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 261.46 | | | | 10.94 | | | | | 108.94 | 17.96 | 0.49 | 1.20 | 400.99 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 9.72 | | | | 0.43 | | | | | 10.72 | 20.61 | 0.57 | 1.37 | 43.43 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2017 TOTAL** | | **838.52** | **145.75** | **47.17** | **62.89** | **41.14** | **6.48** | **1.21** | **13.61** | **2.53** | **119.66** | **77.54** | **2.13** | **5.17** | **1,363.78** |
| **YEAR 2018** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 20.21 | | | | 0.85 | | | | | | 1.39 | 0.04 | 0.09 | 22.58 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 204.01 | | | | 8.53 | | | | | | 14.01 | 0.39 | 0.93 | 227.88 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 130.00 | | | | 5.44 | | | | | 54.17 | 8.93 | 0.25 | 0.60 | 199.38 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 4.05 | | | | 0.18 | | | | | 4.47 | 8.59 | 0.24 | 0.57 | 18.09 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2018 TOTAL** | | **358.28** | | | | **15.00** | | | | | **58.63** | **32.92** | **0.91** | **2.19** | **467.93** |

| $NO_x$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| TOTAL | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 259.11 | 83.85 | 111.81 | 10.73 | 11.52 | 2.14 | 24.19 | 4.50 | | | | | 507.85 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 291.50 | 94.34 | 125.78 | 12.07 | 12.96 | 2.41 | 27.21 | 5.07 | | | | | 571.33 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 178.14 | 57.65 | 76.87 | 7.37 | 7.92 | 1.47 | 16.63 | 3.10 | | | | | 349.14 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 291.50 | 94.34 | 125.78 | 12.07 | 12.96 | 2.41 | 27.21 | 5.07 | | | | | 571.33 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 97.17 | 31.45 | 41.93 | 4.02 | 4.32 | 0.80 | 9.07 | 1.69 | | | | | 190.44 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 566.01 | | | | 23.68 | | | | | | 38.87 | 1.07 | 2.59 | 632.23 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 1,194.92 | | | | 49.99 | | | | | 497.88 | 82.07 | 2.26 | 5.47 | 1,832.58 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 408.79 | | | | 17.10 | | | | | | 28.08 | 0.77 | 1.87 | 456.61 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 911.91 | | | | 38.15 | | | | | | 62.63 | 1.72 | 4.18 | 1,018.58 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 566.01 | | | | 23.68 | | | | | | 38.87 | 1.07 | 2.59 | 632.23 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 849.02 | | | | 35.52 | | | | | 353.76 | 58.31 | 1.60 | 3.89 | 1,302.10 |
| 12 | Neches River Channel 716-960 | 30" Cutter Suction | 880.47 | | | | 36.83 | | | | | 366.86 | 60.47 | 1.66 | 4.03 | 1,350.32 |
| 13 | Sabine Lake | 24" Cutter Suction | 35.64 | | | | 1.58 | | | | | 39.31 | 75.59 | 2.08 | 5.04 | 159.23 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E Of Orange | 24" Cutter Suction | 35.64 | | | | 1.58 | | | | | 39.31 | 2.70 | 8.39 | 2.02 | 89.63 |
| | **PROJECT TOTAL** | | **5,448.40** | **1,117.40** | **361.62** | **482.16** | **274.36** | **49.67** | **9.25** | **104.31** | **19.42** | **1,297.11** | **447.58** | **20.62** | **31.67** | **9,664** |

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# PM (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2010** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 1.20 | 0.39 | 0.52 | 0.05 | 0.05 | 0.01 | 0.12 | 0.02 | | | | | 2.37 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 1.89 | | | | 0.09 | | | | | 0.79 | 0.13 | 0.00 | 0.01 | 2.91 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 1.40 | | | | 0.06 | | | | | | 0.10 | 0.00 | 0.01 | 1.58 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1.56 | | | | 0.07 | | | | | 0.65 | 0.11 | 0.00 | 0.01 | 2.40 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2010 TOTAL** | | **4.85** | **1.20** | **0.39** | **0.52** | **0.28** | **0.05** | **0.01** | **0.12** | **0.02** | **1.44** | **0.34** | **0.01** | **0.02** | **9.26** |
| **YEAR 2011** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 4.82 | 1.56 | 2.08 | 0.22 | 0.22 | 0.04 | 0.46 | 0.09 | | | | | 9.49 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 7.56 | | | | 0.35 | | | | | 3.15 | 0.53 | 0.01 | 0.04 | 11.64 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 5.61 | | | | 0.26 | | | | | | 0.40 | 0.01 | 0.03 | 6.30 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 6.24 | | | | 0.29 | | | | | 2.60 | 0.44 | 0.01 | 0.03 | 9.60 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2011 TOTAL** | | **19.41** | **4.82** | **1.56** | **2.08** | **1.11** | **0.22** | **0.04** | **0.46** | **0.09** | **5.75** | **1.37** | **0.04** | **0.09** | **37.03** |
| **YEAR 2012** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 0.40 | 0.13 | 0.17 | 0.02 | 0.02 | 0.00 | 0.04 | 0.01 | | | | | 0.79 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 4.42 | 1.43 | 1.91 | 0.20 | 0.20 | 0.04 | 0.42 | 0.08 | | | | | 8.70 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 7.56 | | | | 0.35 | | | | | 3.15 | 0.53 | 0.01 | 0.04 | 11.64 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 5.61 | | | | 0.26 | | | | | | 0.40 | 0.01 | 0.03 | 6.30 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 6.24 | | | | 0.29 | | | | | 2.60 | 0.44 | 0.01 | 0.03 | 9.60 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.13 | | | | 0.01 | | | | | 0.15 | 0.01 | 0.03 | 0.01 | 0.34 |
| | **YEAR 2012 TOTAL** | | **19.54** | **4.82** | **1.56** | **2.08** | **1.11** | **0.22** | **0.04** | **0.46** | **0.09** | **5.89** | **1.38** | **0.07** | **0.10** | **37.36** |

# PM (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2013** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 2.81 | 0.91 | 1.21 | 0.13 | 0.13 | 0.03 | 0.27 | 0.05 | | | | | 5.53 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 1.20 | 0.39 | 0.52 | 0.05 | 0.05 | 0.01 | 0.12 | 0.02 | | | | | 2.37 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 7.56 | | | | 0.35 | | | | | 3.15 | 0.53 | 0.01 | 0.04 | 11.64 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 5.35 | | | | 0.24 | | | | | | 0.38 | 0.01 | 0.03 | 6.01 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 1.40 | | | | 0.06 | | | | | | 0.10 | 0.00 | 0.01 | 1.58 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 6.24 | | | | 0.29 | | | | | 2.60 | 0.44 | 0.01 | 0.03 | 9.60 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.06 | | | | 0.00 | | | | | 0.07 | 0.13 | 0.00 | 0.01 | 0.27 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.53 | | | | 0.03 | | | | | 0.58 | 0.04 | 0.13 | 0.03 | 1.34 |
| | **YEAR 2013 TOTAL** | | **21.14** | **4.01** | **1.30** | **1.73** | **1.15** | **0.18** | **0.04** | **0.38** | **0.08** | **6.40** | **1.62** | **0.17** | **0.14** | **38.35** |
| **YEAR 2014** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 3.21 | 1.04 | 1.39 | 0.15 | 0.15 | 0.03 | 0.31 | 0.06 | | | | | 6.33 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 1.20 | 0.39 | 0.52 | 0.05 | 0.05 | 0.01 | 0.12 | 0.02 | | | | | 2.37 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 1.50 | | | | 0.07 | | | | | | 0.11 | 0.00 | 0.01 | 1.69 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 5.04 | | | | 0.23 | | | | | 2.10 | 0.36 | 0.01 | 0.02 | 7.76 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 7.14 | | | | 0.33 | | | | | | 0.50 | 0.01 | 0.03 | 8.01 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 4.86 | | | | 0.22 | | | | | 2.03 | 0.34 | 0.01 | 0.02 | 7.48 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1.56 | | | | 0.07 | | | | | 0.65 | 0.11 | 0.00 | 0.01 | 2.40 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.24 | | | | 0.01 | | | | | 0.27 | 0.52 | 0.01 | 0.03 | 1.09 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.22 | | | | 0.01 | | | | | 0.24 | 0.02 | 0.05 | 0.01 | 0.56 |
| | **YEAR 2014 TOTAL** | | **20.56** | **4.42** | **1.43** | **1.91** | **1.14** | **0.20** | **0.04** | **0.42** | **0.08** | **5.28** | **1.96** | **0.11** | **0.14** | **37.69** |

# PM (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2015** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 4.82 | 1.56 | 2.08 | 0.22 | 0.22 | 0.04 | 0.46 | 0.09 | | | | | 9.49 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 6.01 | | | | 0.27 | | | | | | 0.42 | 0.01 | 0.03 | 6.75 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 7.14 | | | | 0.33 | | | | | | 0.50 | 0.01 | 0.03 | 8.01 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 6.48 | | | | 0.30 | | | | | 2.70 | 0.46 | 0.01 | 0.03 | 9.98 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.24 | | | | 0.01 | | | | | 0.27 | 0.52 | 0.01 | 0.03 | 1.09 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2015 TOTAL** | | **19.87** | **4.82** | **1.56** | **2.08** | **1.13** | **0.22** | **0.04** | **0.46** | **0.09** | **2.97** | **1.91** | **0.05** | **0.13** | **35.32** |
| **YEAR 2016** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 1.20 | 0.39 | 0.52 | 0.05 | 0.05 | 0.01 | 0.12 | 0.02 | | | | | 2.37 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 2.41 | 0.78 | 1.04 | 0.11 | 0.11 | 0.02 | 0.23 | 0.05 | | | | | 4.74 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 6.01 | | | | 0.27 | | | | | | 0.42 | 0.01 | 0.03 | 6.75 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 5.08 | | | | 0.23 | | | | | | 0.36 | 0.01 | 0.02 | 5.70 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 2.97 | | | | 0.14 | | | | | | 0.21 | 0.01 | 0.01 | 3.34 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 6.48 | | | | 0.30 | | | | | 2.70 | 0.46 | 0.01 | 0.03 | 9.98 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.24 | | | | 0.01 | | | | | 0.27 | 0.52 | 0.01 | 0.03 | 1.09 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2016 TOTAL** | | **20.78** | **3.61** | **1.17** | **1.56** | **1.11** | **0.16** | **0.03** | **0.35** | **0.07** | **2.97** | **1.97** | **0.05** | **0.13** | **33.97** |
| **YEAR 2017** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 0.50 | | | | 0.02 | | | | | | 0.04 | 0.00 | 0.00 | 0.56 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 5.06 | | | | 0.23 | | | | | | 0.36 | 0.01 | 0.02 | 5.68 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 3.22 | | | | 0.15 | | | | | 1.34 | 0.23 | 0.01 | 0.02 | 4.96 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.10 | | | | 0.00 | | | | | 0.11 | 0.22 | 0.01 | 0.01 | 0.46 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2017 TOTAL** | | **8.88** | | | | **0.41** | | | | | **1.45** | **0.84** | **0.02** | **0.06** | **11.66** |

## TOTAL

100007609

| PM (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 6.42 | 2.08 | 2.77 | 0.29 | 0.29 | 0.06 | 0.62 | 0.12 | | | | | 12.65 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 7.22 | 2.34 | 3.12 | 0.33 | 0.33 | 0.07 | 0.69 | 0.14 | | | | | 14.23 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 4.42 | 1.43 | 1.91 | 0.20 | 0.20 | 0.04 | 0.42 | 0.08 | | | | | 8.70 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 7.22 | 2.34 | 3.12 | 0.33 | 0.33 | 0.07 | 0.69 | 0.14 | | | | | 14.23 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 2.41 | 0.78 | 1.04 | 0.11 | 0.11 | 0.02 | 0.23 | 0.05 | | | | | 4.74 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 14.03 | | | | 0.64 | | | | | | 0.99 | 0.03 | 0.07 | 15.75 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 29.62 | | | | 1.35 | | | | | 12.34 | 2.09 | 0.06 | 0.14 | 45.59 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 10.13 | | | | 0.46 | | | | | | 0.71 | 0.02 | 0.05 | 11.38 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 22.60 | | | | 1.03 | | | | | | 1.59 | 0.04 | 0.11 | 25.38 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 14.03 | | | | 0.64 | | | | | | 0.99 | 0.03 | 0.07 | 15.75 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 21.04 | | | | 0.96 | | | | | 8.77 | 1.48 | 0.04 | 0.10 | 32.40 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 21.82 | | | | 1.00 | | | | | 9.09 | 1.54 | 0.04 | 0.10 | 33.60 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.88 | | | | 0.04 | | | | | 0.97 | 1.92 | 0.05 | 0.13 | 4.00 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.88 | | | | 0.04 | | | | | 0.97 | 0.07 | 0.21 | 0.05 | 2.23 |
| | **PROJECT TOTAL** | | **135.04** | **27.70** | **8.96** | **11.95** | **7.43** | **1.26** | **0.25** | **2.65** | **0.53** | **32.15** | **11.38** | **0.52** | **0.81** | **241** |

100007609

| $PM_{2.5}$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2011** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 1.10 | 0.35 | 0.47 | 0.05 | 0.05 | 0.01 | 0.10 | 0.02 | | | | | 2.16 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 1.72 | | | | 0.08 | | | | | 0.72 | 0.12 | 0.00 | 0.01 | 2.65 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 1.28 | | | | 0.06 | | | | | | 0.09 | 0.00 | 0.01 | 1.43 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1.42 | | | | 0.06 | | | | | 0.59 | 0.10 | 0.00 | 0.01 | 2.18 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2011 TOTAL** | | **4.42** | **1.10** | **0.35** | **0.47** | **0.25** | **0.05** | **0.01** | **0.10** | **0.02** | **1.31** | **0.31** | **0.01** | **0.02** | **8.42** |
| **YEAR 2012** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 4.38 | 1.42 | 1.89 | 0.20 | 0.20 | 0.04 | 0.42 | 0.08 | | | | | 8.63 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 6.88 | | | | 0.31 | | | | | 2.87 | 0.49 | 0.01 | 0.03 | 10.59 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 5.11 | | | | 0.23 | | | | | | 0.36 | 0.01 | 0.02 | 5.73 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 5.67 | | | | 0.26 | | | | | 2.36 | 0.40 | 0.01 | 0.03 | 8.74 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2012 TOTAL** | | **17.66** | **4.38** | **1.42** | **1.89** | **1.01** | **0.20** | **0.04** | **0.42** | **0.08** | **5.23** | **1.24** | **0.03** | **0.08** | **33.70** |
| **YEAR 2013** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 0.37 | 0.12 | 0.16 | 0.02 | 0.02 | 0.00 | 0.03 | 0.01 | | | | | 0.72 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 4.02 | 1.30 | 1.73 | 0.18 | 0.18 | 0.04 | 0.38 | 0.08 | | | | | 7.91 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 6.88 | | | | 0.31 | | | | | 2.87 | 0.49 | 0.01 | 0.03 | 10.59 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 5.11 | | | | 0.23 | | | | | | 0.36 | 0.01 | 0.02 | 5.73 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 5.67 | | | | 0.26 | | | | | 2.36 | 0.40 | 0.01 | 0.03 | 8.74 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.12 | | | | 0.01 | | | | | 0.13 | 0.01 | 0.03 | 0.01 | 0.30 |
| | **YEAR 2013 TOTAL** | | **17.78** | **4.38** | **1.42** | **1.89** | **1.01** | **0.20** | **0.04** | **0.42** | **0.08** | **5.36** | **1.25** | **0.06** | **0.09** | **34.00** |

| $PM_{2.5}$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2014** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 2.56 | 0.83 | 1.10 | 0.12 | 0.12 | 0.02 | 0.24 | 0.05 | | | | | 5.04 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 1.10 | 0.35 | 0.47 | 0.05 | 0.05 | 0.01 | 0.10 | 0.02 | | | | | 2.16 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 6.88 | | | | 0.31 | | | | | 2.87 | 0.49 | 0.01 | 0.03 | 10.59 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 4.87 | | | | 0.22 | | | | | | 0.34 | 0.01 | 0.02 | 5.47 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 1.28 | | | | 0.06 | | | | | | 0.09 | 0.00 | 0.01 | 1.43 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 5.67 | | | | 0.26 | | | | | 2.36 | 0.40 | 0.01 | 0.03 | 8.74 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.05 | | | | 0.00 | | | | | 0.06 | 0.12 | 0.00 | 0.01 | 0.25 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.48 | | | | 0.02 | | | | | 0.53 | 0.04 | 0.12 | 0.03 | 1.22 |
| | **YEAR 2014 TOTAL** | | **19.24** | **3.65** | **1.18** | **1.58** | **1.05** | **0.17** | **0.03** | **0.35** | **0.07** | **5.82** | **1.48** | **0.16** | **0.12** | **34.89** |
| **YEAR 2015** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 2.92 | 0.95 | 1.26 | 0.13 | 0.13 | 0.03 | 0.28 | 0.06 | | | | | 5.76 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 1.10 | 0.35 | 0.47 | 0.05 | 0.05 | 0.01 | 0.10 | 0.02 | | | | | 2.16 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 1.37 | | | | 0.06 | | | | | | 0.10 | 0.00 | 0.01 | 1.54 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 4.59 | | | | 0.21 | | | | | 1.91 | 0.32 | 0.01 | 0.02 | 7.06 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 6.50 | | | | 0.30 | | | | | | 0.46 | 0.01 | 0.03 | 7.29 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 4.42 | | | | 0.20 | | | | | 1.84 | 0.31 | 0.01 | 0.02 | 6.81 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1.42 | | | | 0.06 | | | | | 0.59 | 0.10 | 0.00 | 0.01 | 2.18 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.22 | | | | 0.01 | | | | | 0.24 | 0.48 | 0.01 | 0.03 | 0.99 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.20 | | | | 0.01 | | | | | 0.22 | 0.02 | 0.05 | 0.01 | 0.51 |
| | **YEAR 2015 TOTAL** | | **18.71** | **4.02** | **1.30** | **1.73** | **1.04** | **0.18** | **0.04** | **0.38** | **0.08** | **4.81** | **1.78** | **0.10** | **0.13** | **34.30** |

# $PM_{2.5}$ (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2016** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 4.38 | 1.42 | 1.89 | 0.20 | 0.20 | 0.04 | 0.42 | 0.08 | | | | | 8.63 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 5.47 | | | | 0.25 | | | | | | 0.39 | 0.01 | 0.03 | 6.14 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 6.50 | | | | 0.30 | | | | | | 0.46 | 0.01 | 0.03 | 7.29 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 5.90 | | | | 0.27 | | | | | 2.46 | 0.42 | 0.01 | 0.03 | 9.08 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.22 | | | | 0.01 | | | | | 0.24 | 0.48 | 0.01 | 0.03 | 0.99 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2016 TOTAL** | | **18.08** | **4.38** | **1.42** | **1.89** | **1.03** | **0.20** | **0.04** | **0.42** | **0.08** | **2.70** | **1.74** | **0.05** | **0.12** | **32.14** |
| **YEAR 2017** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 1.10 | 0.35 | 0.47 | 0.05 | 0.05 | 0.01 | 0.10 | 0.02 | | | | | 2.16 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 2.19 | 0.71 | 0.95 | 0.10 | 0.10 | 0.02 | 0.21 | 0.04 | | | | | 4.32 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 5.47 | | | | 0.25 | | | | | | 0.39 | 0.01 | 0.03 | 6.14 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 4.62 | | | | 0.21 | | | | | | 0.33 | 0.01 | 0.02 | 5.19 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 2.71 | | | | 0.12 | | | | | | 0.19 | 0.01 | 0.01 | 3.04 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 5.90 | | | | 0.27 | | | | | 2.46 | 0.42 | 0.01 | 0.03 | 9.08 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.22 | | | | 0.01 | | | | | 0.24 | 0.48 | 0.01 | 0.03 | 0.99 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2017 TOTAL** | | **18.91** | **3.29** | **1.06** | **1.42** | **1.01** | **0.15** | **0.03** | **0.31** | **0.06** | **2.70** | **1.79** | **0.05** | **0.12** | **30.92** |
| **YEAR 2018** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 0.46 | | | | 0.02 | | | | | | 0.03 | 0.00 | 0.00 | 0.51 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 4.60 | | | | 0.21 | | | | | | 0.32 | 0.01 | 0.02 | 5.17 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 2.93 | | | | 0.13 | | | | | 1.22 | 0.21 | 0.01 | 0.01 | 4.51 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.09 | | | | 0.00 | | | | | 0.10 | 0.20 | 0.01 | 0.01 | 0.41 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2018 TOTAL** | | **8.08** | | | | **0.37** | | | | | **1.32** | **0.76** | **0.02** | **0.05** | **10.61** |

## TOTAL

100007609

| $PM_{2.5}$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 5.84 | 1.89 | 2.52 | 0.26 | 0.27 | 0.05 | 0.56 | 0.11 | | | | | 11.51 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 6.57 | 2.13 | 2.84 | 0.30 | 0.30 | 0.06 | 0.63 | 0.12 | | | | | 12.95 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 4.02 | 1.30 | 1.73 | 0.18 | 0.18 | 0.04 | 0.38 | 0.08 | | | | | 7.91 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 6.57 | 2.13 | 2.84 | 0.30 | 0.30 | 0.06 | 0.63 | 0.12 | | | | | 12.95 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 2.19 | 0.71 | 0.95 | 0.10 | 0.10 | 0.02 | 0.21 | 0.04 | | | | | 4.32 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 12.77 | | | | 0.58 | | | | | | 0.90 | 0.02 | 0.06 | 14.33 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 26.95 | | | | 1.23 | | | | | 11.23 | 1.90 | 0.05 | 0.13 | 41.49 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 9.22 | | | | 0.42 | | | | | | 0.65 | 0.02 | 0.04 | 10.35 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 20.57 | | | | 0.94 | | | | | | 1.45 | 0.04 | 0.10 | 23.09 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 12.77 | | | | 0.58 | | | | | | 0.90 | 0.02 | 0.06 | 14.33 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 19.15 | | | | 0.88 | | | | | 7.98 | 1.35 | 0.04 | 0.09 | 29.48 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 19.86 | | | | 0.91 | | | | | 8.27 | 1.40 | 0.04 | 0.09 | 30.57 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.80 | | | | 0.04 | | | | | 0.89 | 1.75 | 0.05 | 0.12 | 3.64 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.80 | | | | 0.04 | | | | | 0.89 | 0.06 | 0.19 | 0.05 | 2.03 |
| | **PROJECT TOTAL** | | **122.89** | **25.20** | **8.16** | **10.88** | **6.76** | **1.15** | **0.23** | **2.41** | **0.48** | **29.26** | **10.36** | **0.48** | **0.73** | **219** |

100007609

| $PM_{10}$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2011** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 1.16 | 0.37 | 0.50 | 0.05 | 0.05 | 0.01 | 0.11 | 0.02 | | | | | 2.28 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 1.81 | | | | 0.08 | | | | | 0.76 | 0.13 | 0.00 | 0.01 | 2.79 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 1.35 | | | | 0.06 | | | | | | 0.09 | 0.00 | 0.01 | 1.51 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1.50 | | | | 0.07 | | | | | 0.62 | 0.11 | 0.00 | 0.01 | 2.30 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2011 TOTAL** | | **4.66** | **1.16** | **0.37** | **0.50** | **0.27** | **0.05** | **0.01** | **0.11** | **0.02** | **1.38** | **0.33** | **0.01** | **0.02** | **8.89** |
| **YEAR 2012** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 4.62 | 1.50 | 2.00 | 0.21 | 0.21 | 0.04 | 0.44 | 0.09 | | | | | 9.11 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 7.26 | | | | 0.33 | | | | | 3.02 | 0.51 | 0.01 | 0.03 | 11.18 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 5.39 | | | | 0.25 | | | | | | 0.38 | 0.01 | 0.03 | 6.05 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 5.99 | | | | 0.27 | | | | | 2.49 | 0.42 | 0.01 | 0.03 | 9.21 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2012 TOTAL** | | **18.63** | **4.62** | **1.50** | **2.00** | **1.06** | **0.21** | **0.04** | **0.44** | **0.09** | **5.52** | **1.31** | **0.04** | **0.09** | **35.55** |
| **YEAR 2013** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 0.39 | 0.12 | 0.17 | 0.02 | 0.02 | 0.00 | 0.04 | 0.01 | | | | | 0.76 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 4.24 | 1.37 | 1.83 | 0.19 | 0.19 | 0.04 | 0.41 | 0.08 | | | | | 8.35 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 7.26 | | | | 0.33 | | | | | 3.02 | 0.51 | 0.01 | 0.03 | 11.18 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 5.39 | | | | 0.25 | | | | | | 0.38 | 0.01 | 0.03 | 6.05 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 5.99 | | | | 0.27 | | | | | 2.49 | 0.42 | 0.01 | 0.03 | 9.21 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.13 | | | | 0.01 | | | | | 0.14 | 0.01 | 0.03 | 0.01 | 0.32 |
| | **YEAR 2013 TOTAL** | | **18.76** | **4.62** | **1.50** | **2.00** | **1.07** | **0.21** | **0.04** | **0.44** | **0.09** | **5.66** | **1.32** | **0.07** | **0.09** | **35.87** |

| $PM_{10}$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2014** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 2.70 | 0.87 | 1.16 | 0.12 | 0.12 | 0.02 | 0.26 | 0.05 | | | | | 5.31 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 1.16 | 0.37 | 0.50 | 0.05 | 0.05 | 0.01 | 0.11 | 0.02 | | | | | 2.28 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 7.26 | | | | 0.33 | | | | | 3.02 | 0.51 | 0.01 | 0.03 | 11.18 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 5.14 | | | | 0.23 | | | | | | 0.36 | 0.01 | 0.02 | 5.77 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 1.35 | | | | 0.06 | | | | | | 0.09 | 0.00 | 0.01 | 1.51 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 5.99 | | | | 0.27 | | | | | 2.49 | 0.42 | 0.01 | 0.03 | 9.21 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.06 | | | | 0.00 | | | | | 0.06 | 0.13 | 0.00 | 0.01 | 0.26 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.51 | | | | 0.02 | | | | | 0.56 | 0.04 | 0.12 | 0.03 | 1.29 |
| | **YEAR 2014 TOTAL** | | **20.30** | **3.85** | **1.25** | **1.66** | **1.10** | **0.18** | **0.03** | **0.37** | **0.07** | **6.14** | **1.56** | **0.16** | **0.13** | **36.81** |
| **YEAR 2015** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 3.08 | 1.00 | 1.33 | 0.14 | 0.14 | 0.03 | 0.30 | 0.06 | | | | | 6.07 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 1.16 | 0.37 | 0.50 | 0.05 | 0.05 | 0.01 | 0.11 | 0.02 | | | | | 2.28 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 1.44 | | | | 0.07 | | | | | | 0.10 | 0.00 | 0.01 | 1.62 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 4.84 | | | | 0.22 | | | | | 2.02 | 0.34 | 0.01 | 0.02 | 7.45 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 6.85 | | | | 0.31 | | | | | | 0.48 | 0.01 | 0.03 | 7.69 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 4.67 | | | | 0.21 | | | | | 1.94 | 0.33 | 0.01 | 0.02 | 7.18 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 1.50 | | | | 0.07 | | | | | 0.62 | 0.11 | 0.00 | 0.01 | 2.30 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.23 | | | | 0.01 | | | | | 0.26 | 0.50 | 0.01 | 0.03 | 1.05 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.21 | | | | 0.01 | | | | | 0.23 | 0.02 | 0.05 | 0.01 | 0.54 |
| | **YEAR 2015 TOTAL** | | **19.74** | **4.24** | **1.37** | **1.83** | **1.10** | **0.19** | **0.04** | **0.41** | **0.08** | **5.07** | **1.88** | **0.10** | **0.14** | **36.18** |

| $PM_{10}$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2016** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 4.62 | 1.50 | 2.00 | 0.21 | 0.21 | 0.04 | 0.44 | 0.09 | | | | | 9.11 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 5.77 | | | | 0.26 | | | | | | 0.41 | 0.01 | 0.03 | 6.48 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 6.85 | | | | 0.31 | | | | | | 0.48 | 0.01 | 0.03 | 7.69 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 6.22 | | | | 0.28 | | | | | 2.59 | 0.44 | 0.01 | 0.03 | 9.58 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.23 | | | | 0.01 | | | | | 0.26 | 0.50 | 0.01 | 0.03 | 1.05 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2016 TOTAL** | | **19.08** | **4.62** | **1.50** | **2.00** | **1.08** | **0.21** | **0.04** | **0.44** | **0.09** | **2.85** | **1.83** | **0.05** | **0.12** | **33.91** |
| **YEAR 2017** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 1.16 | 0.37 | 0.50 | 0.05 | 0.05 | 0.01 | 0.11 | 0.02 | | | | | 2.28 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 2.31 | 0.75 | 1.00 | 0.10 | 0.11 | 0.02 | 0.22 | 0.04 | | | | | 4.55 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 5.77 | | | | 0.26 | | | | | | 0.41 | 0.01 | 0.03 | 6.48 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 4.87 | | | | 0.22 | | | | | | 0.34 | 0.01 | 0.02 | 5.47 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 2.86 | | | | 0.13 | | | | | | 0.20 | 0.01 | 0.01 | 3.21 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 6.22 | | | | 0.28 | | | | | 2.59 | 0.44 | 0.01 | 0.03 | 9.58 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.23 | | | | 0.01 | | | | | 0.26 | 0.50 | 0.01 | 0.03 | 1.05 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2017 TOTAL** | | **19.95** | **3.47** | **1.12** | **1.50** | **1.07** | **0.16** | **0.03** | **0.33** | **0.07** | **2.85** | **1.89** | **0.05** | **0.13** | **32.61** |
| **YEAR 2018** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 0.48 | | | | 0.02 | | | | | | 0.03 | 0.00 | 0.00 | 0.54 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 4.85 | | | | 0.22 | | | | | | 0.34 | 0.01 | 0.02 | 5.45 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 3.09 | | | | 0.14 | | | | | 1.29 | 0.22 | 0.01 | 0.01 | 4.76 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.10 | | | | 0.00 | | | | | 0.11 | 0.21 | 0.01 | 0.01 | 0.44 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2018 TOTAL** | | **8.53** | | | | **0.39** | | | | | **1.40** | **0.80** | **0.02** | **0.05** | **11.19** |

TOTAL

100007609

| $PM_{10}$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 6.17 | 2.00 | 2.66 | 0.28 | 0.28 | 0.06 | 0.59 | 0.12 | | | | | 12.14 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 6.94 | 2.24 | 2.99 | 0.31 | 0.32 | 0.06 | 0.66 | 0.13 | | | | | 13.66 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 4.24 | 1.37 | 1.83 | 0.19 | 0.19 | 0.04 | 0.41 | 0.08 | | | | | 8.35 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 6.94 | 2.24 | 2.99 | 0.31 | 0.32 | 0.06 | 0.66 | 0.13 | | | | | 13.66 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 2.31 | 0.75 | 1.00 | 0.10 | 0.11 | 0.02 | 0.22 | 0.04 | | | | | 4.55 |
| 6 | Sabine Pass 0-295+50 | 30" Cutter Suction | 13.47 | | | | 0.62 | | | | | | 0.95 | 0.03 | 0.06 | 15.12 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 28.43 | | | | 1.30 | | | | | 11.85 | 2.00 | 0.06 | 0.13 | 43.77 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 9.73 | | | | 0.44 | | | | | | 0.69 | 0.02 | 0.05 | 10.92 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 21.70 | | | | 0.99 | | | | | | 1.53 | 0.04 | 0.10 | 24.36 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 13.47 | | | | 0.62 | | | | | | 0.95 | 0.03 | 0.06 | 15.12 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 20.20 | | | | 0.92 | | | | | 8.42 | 1.42 | 0.04 | 0.09 | 31.10 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 20.95 | | | | 0.96 | | | | | 8.73 | 1.48 | 0.04 | 0.10 | 32.25 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.85 | | | | 0.04 | | | | | 0.94 | 1.85 | 0.05 | 0.12 | 3.84 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.85 | | | | 0.04 | | | | | 0.94 | 0.07 | 0.20 | 0.05 | 2.14 |
| | **PROJECT TOTAL** | | **129.64** | **26.59** | **8.60** | **11.47** | **7.13** | **1.21** | **0.24** | **2.55** | **0.51** | **30.86** | **10.93** | **0.50** | **0.77** | **231** |

100007609

| $SO_2$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2011** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 8.00 | 2.59 | 3.45 | 0.37 | 0.37 | 0.07 | 0.78 | 0.15 | | | | | 15.79 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 12.56 | | | | 0.58 | | | | | 5.23 | 0.90 | 0.02 | 0.06 | 19.36 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 9.32 | | | | 0.43 | | | | | | 0.67 | 0.02 | 0.04 | 10.49 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 10.36 | | | | 0.48 | | | | | 4.31 | 0.74 | 0.02 | 0.05 | 15.97 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2011 TOTAL** | | **32.23** | **8.00** | **2.59** | **3.45** | **1.86** | **0.37** | **0.07** | **0.78** | **0.15** | **9.55** | **2.32** | **0.06** | **0.15** | **61.61** |
| **YEAR 2012** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 32.00 | 10.36 | 13.81 | 1.47 | 1.49 | 0.29 | 3.13 | 0.62 | | | | | 63.16 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 50.24 | | | | 2.33 | | | | | 20.93 | 3.61 | 0.10 | 0.24 | 77.45 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 37.28 | | | | 1.73 | | | | | | 2.68 | 0.07 | 0.18 | 41.94 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 41.42 | | | | 1.92 | | | | | 17.26 | 2.98 | 0.08 | 0.20 | 63.86 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2012 TOTAL** | | **128.94** | **32.00** | **10.36** | **13.81** | **7.45** | **1.49** | **0.29** | **3.13** | **0.62** | **38.19** | **9.28** | **0.26** | **0.62** | **246.42** |
| **YEAR 2013** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 2.67 | 0.86 | 1.15 | 0.12 | 0.12 | 0.02 | 0.26 | 0.05 | | | | | 5.26 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 29.33 | 9.49 | 12.66 | 1.35 | 1.37 | 0.27 | 2.87 | 0.57 | | | | | 57.90 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 50.24 | | | | 2.33 | | | | | 20.93 | 3.61 | 0.10 | 0.24 | 77.45 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 37.28 | | | | 1.73 | | | | | | 2.68 | 0.07 | 0.18 | 41.94 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 41.42 | | | | 1.92 | | | | | 17.26 | 2.98 | 0.08 | 0.20 | 63.86 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.88 | | | | 0.04 | | | | | 0.97 | 0.07 | 0.22 | 0.05 | 2.23 |
| | **YEAR 2013 TOTAL** | | **129.82** | **32.00** | **10.36** | **13.81** | **7.49** | **1.49** | **0.29** | **3.13** | **0.62** | **39.16** | **9.35** | **0.47** | **0.67** | **248.65** |

| $SO_2$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2014** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 18.67 | 6.04 | 8.05 | 0.86 | 0.87 | 0.17 | 1.83 | 0.36 | | | | | 36.84 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 8.00 | 2.59 | 3.45 | 0.37 | 0.37 | 0.07 | 0.78 | 0.15 | | | | | 15.79 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 50.24 | | | | 2.33 | | | | | 20.93 | 3.61 | 0.10 | 0.24 | 77.45 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 35.56 | | | | 1.65 | | | | | | 2.56 | 0.07 | 0.17 | 40.01 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 9.32 | | | | 0.43 | | | | | | 0.67 | 0.02 | 0.04 | 10.49 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 41.42 | | | | 1.92 | | | | | 17.26 | 2.98 | 0.08 | 0.20 | 63.86 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.40 | | | | 0.02 | | | | | 0.44 | 0.89 | 0.02 | 0.06 | 1.83 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 3.52 | | | | 0.17 | | | | | 3.88 | 0.28 | 0.87 | 0.21 | 8.93 |
| | **YEAR 2014 TOTAL** | | **140.46** | **26.67** | **8.63** | **11.51** | **7.75** | **1.24** | **0.24** | **2.61** | **0.51** | **42.52** | **10.99** | **1.16** | **0.92** | **255.21** |
| **YEAR 2015** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 21.33 | 6.90 | 9.21 | 0.98 | 0.99 | 0.20 | 2.09 | 0.41 | | | | | 42.11 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 8.00 | 2.59 | 3.45 | 0.37 | 0.37 | 0.07 | 0.78 | 0.15 | | | | | 15.79 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 9.99 | | | | 0.46 | | | | | | 0.72 | 0.02 | 0.05 | 11.24 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 33.49 | | | | 1.55 | | | | | 13.95 | 2.41 | 0.07 | 0.16 | 51.63 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 47.42 | | | | 2.20 | | | | | | 3.41 | 0.09 | 0.23 | 53.35 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 32.29 | | | | 1.50 | | | | | 13.45 | 2.32 | 0.06 | 0.15 | 49.78 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 10.36 | | | | 0.48 | | | | | 4.31 | 0.74 | 0.02 | 0.05 | 15.97 |
| 13 | Sabine Lake | 24" Cutter Suction | 1.60 | | | | 0.08 | | | | | 1.77 | 3.56 | 0.10 | 0.24 | 7.33 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 1.47 | | | | 0.07 | | | | | 1.62 | 0.12 | 0.36 | 0.09 | 3.72 |
| | **YEAR 2015 TOTAL** | | **136.61** | **29.33** | **9.49** | **12.66** | **7.69** | **1.37** | **0.27** | **2.87** | **0.57** | **35.11** | **13.28** | **0.72** | **0.96** | **250.92** |

# $SO_2$ (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2016** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 32.00 | 10.36 | 13.81 | 1.47 | 1.49 | 0.29 | 3.13 | 0.62 | | | | | 63.16 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 39.94 | | | | 1.85 | | | | | | 2.87 | 0.08 | 0.19 | 44.94 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 47.42 | | | | 2.20 | | | | | | 3.41 | 0.09 | 0.23 | 53.35 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 43.05 | | | | 2.00 | | | | | 17.94 | 3.10 | 0.09 | 0.21 | 66.38 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 1.60 | | | | 0.08 | | | | | 1.77 | 3.56 | 0.10 | 0.24 | 7.33 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2016 TOTAL** | | **132.01** | **32.00** | **10.36** | **13.81** | **7.60** | **1.49** | **0.29** | **3.13** | **0.62** | **19.70** | **12.94** | **0.36** | **0.86** | **235.16** |
| **YEAR 2017** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 8.00 | 2.59 | 3.45 | 0.37 | 0.37 | 0.07 | 0.78 | 0.15 | | | | | 15.79 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 16.00 | 5.18 | 6.90 | 0.73 | 0.74 | 0.15 | 1.56 | 0.31 | | | | | 31.58 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 39.94 | | | | 1.85 | | | | | | 2.87 | 0.08 | 0.19 | 44.94 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 33.72 | | | | 1.56 | | | | | | 2.43 | 0.07 | 0.16 | 37.94 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 19.76 | | | | 0.92 | | | | | | 1.42 | 0.04 | 0.09 | 22.23 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 43.05 | | | | 2.00 | | | | | 17.94 | 3.10 | 0.09 | 0.21 | 66.38 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 1.60 | | | | 0.08 | | | | | 1.77 | 3.56 | 0.10 | 0.24 | 7.33 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2017 TOTAL** | | **138.07** | **24.00** | **7.77** | **10.36** | **7.51** | **1.12** | **0.22** | **2.35** | **0.46** | **19.70** | **13.37** | **0.37** | **0.89** | **226.19** |
| **YEAR 2018** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 3.33 | | | | 0.15 | | | | | | 0.24 | 0.01 | 0.02 | 3.75 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 33.59 | | | | 1.56 | | | | | | 2.42 | 0.07 | 0.16 | 37.80 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 21.41 | | | | 0.99 | | | | | 8.92 | 1.54 | 0.04 | 0.10 | 33.00 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.67 | | | | 0.03 | | | | | 0.74 | 1.48 | 0.04 | 0.10 | 3.06 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2018 TOTAL** | | **59.00** | | | | **2.74** | | | | | **9.65** | **5.68** | **0.16** | **0.38** | **77.60** |

## TOTAL

100007609

| $SO_2$ (tpy) | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 42.67 | 13.81 | 18.41 | 1.96 | 1.99 | 0.39 | 4.17 | 0.82 | | | | | 84.21 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 48.00 | 15.53 | 20.71 | 2.20 | 2.23 | 0.44 | 4.69 | 0.93 | | | | | 94.74 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 29.33 | 9.49 | 12.66 | 1.35 | 1.37 | 0.27 | 2.87 | 0.57 | | | | | 57.90 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 48.00 | 15.53 | 20.71 | 2.20 | 2.23 | 0.44 | 4.69 | 0.93 | | | | | 94.74 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 16.00 | 5.18 | 6.90 | 0.73 | 0.74 | 0.15 | 1.56 | 0.31 | | | | | 31.58 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 93.20 | | | | 4.32 | | | | | | 6.70 | 0.18 | 0.45 | 104.86 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 196.76 | | | | 9.13 | | | | | 81.98 | 14.15 | 0.39 | 0.94 | 303.35 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 67.31 | | | | 3.12 | | | | | | 4.84 | 0.13 | 0.32 | 75.73 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 150.16 | | | | 6.97 | | | | | | 10.80 | 0.30 | 0.72 | 168.94 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 93.20 | | | | 4.32 | | | | | | 6.70 | 0.18 | 0.45 | 104.86 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 139.80 | | | | 6.49 | | | | | 58.25 | 10.06 | 0.28 | 0.67 | 215.54 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 144.98 | | | | 6.73 | | | | | 60.41 | 10.43 | 0.29 | 0.70 | 223.52 |
| 13 | Sabine Lake | 24" Cutter Suction | 5.87 | | | | 0.29 | | | | | 6.47 | 13.04 | 0.36 | 0.87 | 26.89 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 5.87 | | | | 0.29 | | | | | 6.47 | 0.47 | 1.45 | 0.35 | 14.89 |
| | **PROJECT TOTAL** | | **897.15** | **183.99** | **59.55** | **79.39** | **50.10** | **8.57** | **1.69** | **17.99** | **3.55** | **213.59** | **77.19** | **3.56** | **5.46** | **1,602** |

100007609

# VOC (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2011** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 0.43 | 0.14 | 0.18 | 0.13 | 0.05 | 0.03 | 0.11 | 0.05 | | | | | 1.11 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 0.67 | | | | 0.20 | | | | | 0.28 | 0.13 | 0.00 | 0.01 | 1.29 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 0.50 | | | | 0.15 | | | | | | 0.09 | 0.00 | 0.01 | 0.75 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 0.55 | | | | 0.17 | | | | | 0.23 | 0.10 | 0.00 | 0.01 | 1.06 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2011 TOTAL** | | **1.72** | **0.43** | **0.14** | **0.18** | **0.64** | **0.05** | **0.03** | **0.11** | **0.05** | **0.51** | **0.32** | **0.01** | **0.02** | **4.21** |
| **YEAR 2012** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 1.70 | 0.55 | 0.74 | 0.51 | 0.21 | 0.10 | 0.44 | 0.21 | | | | | 4.46 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 2.68 | | | | 0.80 | | | | | 1.12 | 0.50 | 0.01 | 0.03 | 5.15 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 1.99 | | | | 0.60 | | | | | | 0.37 | 0.01 | 0.02 | 2.99 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 2.21 | | | | 0.66 | | | | | 0.92 | 0.42 | 0.01 | 0.03 | 4.24 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2012 TOTAL** | | **6.87** | **1.70** | **0.55** | **0.74** | **2.57** | **0.21** | **0.10** | **0.44** | **0.21** | **2.03** | **1.30** | **0.04** | **0.09** | **16.84** |
| **YEAR 2013** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | 0.14 | 0.05 | 0.06 | 0.04 | 0.02 | 0.01 | 0.04 | 0.02 | | | | | 0.37 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 1.56 | 0.51 | 0.67 | 0.46 | 0.19 | 0.09 | 0.40 | 0.19 | | | | | 4.09 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 2.68 | | | | 0.80 | | | | | 1.12 | 0.50 | 0.01 | 0.03 | 5.15 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 1.99 | | | | 0.60 | | | | | | 0.37 | 0.01 | 0.02 | 2.99 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 2.21 | | | | 0.66 | | | | | 0.92 | 0.42 | 0.01 | 0.03 | 4.24 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.05 | | | | 0.01 | | | | | 0.05 | 0.01 | 0.03 | 0.01 | 0.16 |
| | **YEAR 2013 TOTAL** | | **6.92** | **1.70** | **0.55** | **0.74** | **2.58** | **0.21** | **0.10** | **0.44** | **0.21** | **2.09** | **1.31** | **0.07** | **0.09** | **17.00** |

# VOC (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2014** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 0.99 | 0.32 | 0.43 | 0.30 | 0.12 | 0.06 | 0.25 | 0.12 | | | | | 2.60 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 0.43 | 0.14 | 0.18 | 0.13 | 0.05 | 0.03 | 0.11 | 0.05 | | | | | 1.11 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 2.68 | | | | 0.80 | | | | | 1.12 | 0.50 | 0.01 | 0.03 | 5.15 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 1.89 | | | | 0.57 | | | | | | 0.36 | 0.01 | 0.02 | 2.85 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 0.50 | | | | 0.15 | | | | | | 0.09 | 0.00 | 0.01 | 0.75 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 2.21 | | | | 0.66 | | | | | 0.92 | 0.42 | 0.01 | 0.03 | 4.24 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.02 | | | | 0.01 | | | | | 0.02 | 0.12 | 0.00 | 0.01 | 0.19 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.19 | | | | 0.06 | | | | | 0.21 | 0.04 | 0.12 | 0.03 | 0.64 |
| | **YEAR 2014 TOTAL** | | **7.48** | **1.42** | **0.46** | **0.61** | **2.67** | **0.17** | **0.08** | **0.36** | **0.18** | **2.27** | **1.53** | **0.16** | **0.13** | **17.54** |
| **YEAR 2015** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 1.14 | 0.37 | 0.49 | 0.34 | 0.14 | 0.07 | 0.29 | 0.14 | | | | | 2.97 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 0.43 | 0.14 | 0.18 | 0.13 | 0.05 | 0.03 | 0.11 | 0.05 | | | | | 1.11 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 0.53 | | | | 0.16 | | | | | | 0.10 | 0.00 | 0.01 | 0.80 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 1.78 | | | | 0.54 | | | | | 0.74 | 0.34 | 0.01 | 0.02 | 3.43 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 2.53 | | | | 0.76 | | | | | | 0.48 | 0.01 | 0.03 | 3.81 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 1.72 | | | | 0.52 | | | | | 0.72 | 0.32 | 0.01 | 0.02 | 3.31 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 0.55 | | | | 0.17 | | | | | 0.23 | 0.10 | 0.00 | 0.01 | 1.06 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.09 | | | | 0.03 | | | | | 0.09 | 0.50 | 0.01 | 0.03 | 0.75 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.08 | | | | 0.02 | | | | | 0.09 | 0.02 | 0.05 | 0.01 | 0.27 |
| | **YEAR 2015 TOTAL** | | **7.28** | **1.56** | **0.51** | **0.67** | **2.65** | **0.19** | **0.09** | **0.40** | **0.19** | **1.87** | **1.85** | **0.10** | **0.13** | **17.51** |

# VOC (tpy)

| | | | Dredge | | | | | Survey Boat | | Trawler | | Floating | Tug | Spill Barge | Crew Boat | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dredging | Propelling | Pumping | Generating | Idling | Propelling | Idling | Propelling | Idling | Pumping | Propelling | Main Engine | Propelling | |
| **YEAR 2016** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 1.70 | 0.55 | 0.74 | 0.51 | 0.21 | 0.10 | 0.44 | 0.21 | | | | | 4.46 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 2.13 | | | | 0.64 | | | | | | 0.40 | 0.01 | 0.03 | 3.21 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 2.53 | | | | 0.76 | | | | | | 0.48 | 0.01 | 0.03 | 3.81 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 2.29 | | | | 0.69 | | | | | 0.96 | 0.43 | 0.01 | 0.03 | 4.41 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.09 | | | | 0.03 | | | | | 0.09 | 0.50 | 0.01 | 0.03 | 0.75 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2016 TOTAL** | | **7.03** | **1.70** | **0.55** | **0.74** | **2.62** | **0.21** | **0.10** | **0.44** | **0.21** | **1.05** | **1.81** | **0.05** | **0.12** | **16.63** |
| **YEAR 2017** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 0.43 | 0.14 | 0.18 | 0.13 | 0.05 | 0.03 | 0.11 | 0.05 | | | | | 1.11 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 0.85 | 0.28 | 0.37 | 0.25 | 0.10 | 0.05 | 0.22 | 0.11 | | | | | 2.23 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 2.13 | | | | 0.64 | | | | | | 0.40 | 0.01 | 0.03 | 3.21 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 1.80 | | | | 0.54 | | | | | | 0.34 | 0.01 | 0.02 | 2.71 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 1.05 | | | | 0.32 | | | | | | 0.20 | 0.01 | 0.01 | 1.59 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 2.29 | | | | 0.69 | | | | | 0.96 | 0.43 | 0.01 | 0.03 | 4.41 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.09 | | | | 0.03 | | | | | 0.09 | 0.50 | 0.01 | 0.03 | 0.75 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2017 TOTAL** | | **7.36** | **1.28** | **0.41** | **0.55** | **2.59** | **0.16** | **0.08** | **0.33** | **0.16** | **1.05** | **1.87** | **0.05** | **0.12** | **16.00** |
| **YEAR 2018** | | | | | | | | | | | | | | | | |
| **Contract No.** | **Location/Disposal Site** | **Dredge** | | | | | | | | | | | | | | |
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 0.18 | | | | 0.05 | | | | | | 0.03 | 0.00 | 0.00 | 0.27 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 1.79 | | | | 0.54 | | | | | | 0.34 | 0.01 | 0.02 | 2.70 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 1.14 | | | | 0.34 | | | | | 0.48 | 0.22 | 0.01 | 0.01 | 2.19 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 0.04 | | | | 0.01 | | | | | 0.04 | 0.21 | 0.01 | 0.01 | 0.31 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | | | | | | | | |
| | **YEAR 2018 TOTAL** | | **3.14** | | | | **0.94** | | | | | **0.51** | **0.79** | **0.02** | **0.05** | **5.47** |

TOTAL

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# VOC (tpy)

| Contract No. | Location/Disposal Site | Dredge | Dredge: Dredging | Dredge: Propelling | Dredge: Pumping | Dredge: Generating | Dredge: Idling | Survey Boat: Propelling | Survey Boat: Idling | Trawler: Propelling | Trawler: Idling | Floating: Pumping | Tug: Propelling | Spill Barge: Main Engine | Crew Boat: Propelling | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | 2.27 | 0.74 | 0.98 | 0.67 | 0.28 | 0.13 | 0.58 | 0.28 | | | | | 5.94 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | 2.56 | 0.83 | 1.10 | 0.76 | 0.31 | 0.15 | 0.66 | 0.32 | | | | | 6.69 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | 1.56 | 0.51 | 0.67 | 0.46 | 0.19 | 0.09 | 0.40 | 0.19 | | | | | 4.09 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | 2.56 | 0.83 | 1.10 | 0.76 | 0.31 | 0.15 | 0.66 | 0.32 | | | | | 6.69 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | 0.85 | 0.28 | 0.37 | 0.25 | 0.10 | 0.05 | 0.22 | 0.11 | | | | | 2.23 |
| 6 | Sabine Pass 0-295+50 | 30" Cutter Suction | 4.97 | | | | 1.49 | | | | | | 0.94 | 0.03 | 0.06 | 7.48 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 10.48 | | | | 3.15 | | | | | 4.37 | 1.98 | 0.05 | 0.13 | 20.16 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 3.59 | | | | 1.08 | | | | | | 0.68 | 0.02 | 0.05 | 5.40 |
| 9 | Sabine-Neches Canal 170-592+9 | 30" Cutter Suction | 8.00 | | | | 2.40 | | | | | | 1.51 | 0.04 | 0.10 | 12.05 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 4.97 | | | | 1.49 | | | | | | 0.94 | 0.03 | 0.06 | 7.48 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 7.45 | | | | 2.23 | | | | | 3.10 | 1.40 | 0.04 | 0.09 | 14.32 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 7.72 | | | | 2.32 | | | | | 3.22 | 1.46 | 0.04 | 0.10 | 14.85 |
| 13 | Sabine Lake | 24" Cutter Suction | 0.31 | | | | 0.10 | | | | | 0.34 | 1.82 | 0.05 | 0.12 | 2.75 |
| 14 | Channel to Orange | none | | | | | | | | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 0.31 | | | | 0.10 | | | | | 0.34 | 0.07 | 0.20 | 0.05 | 1.07 |
| | **PROJECT TOTAL** | | **47.80** | **9.80** | **3.17** | **4.23** | **17.26** | **1.20** | **0.58** | **2.51** | **1.22** | **11.38** | **10.78** | **0.50** | **0.76** | **111** |

100007609

## Summary of Dredge Emissions (tons per year)

### YEAR 2011

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | 10.8 | 95.2 | 2.4 | 2.2 | 2.3 | 15.8 | 1.1 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 12.9 | 117.0 | 2.9 | 2.6 | 2.8 | 19.4 | 1.3 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 7.2 | 63.2 | 1.6 | 1.4 | 1.5 | 10.5 | 0.7 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 10.6 | 96.5 | 2.4 | 2.2 | 2.3 | 16.0 | 1.1 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | |
| | **YEAR 2011 TOTAL** | | **41.6** | **371.9** | **9.3** | **8.4** | **8.9** | **61.6** | **4.2** |

### YEAR 2012

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | 43.3 | 380.9 | 9.5 | 8.6 | 9.1 | 63.2 | 4.5 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 51.5 | 467.9 | 11.6 | 10.6 | 11.2 | 77.5 | 5.1 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 28.9 | 252.9 | 6.3 | 5.7 | 6.0 | 41.9 | 3.0 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 42.5 | 385.8 | 9.6 | 8.7 | 9.2 | 63.9 | 4.2 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | |
| | **YEAR 2012 TOTAL** | | **166.2** | **1,487.5** | **37.0** | **33.7** | **35.5** | **246.4** | **16.8** |

## Summary of Dredge Emissions (tons per year)

### YEAR 2013

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | 3.6 | 31.7 | 0.8 | 0.7 | 0.8 | 5.3 | 0.4 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | 39.7 | 349.1 | 8.7 | 7.9 | 8.3 | 57.9 | 4.1 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 51.5 | 467.9 | 11.6 | 10.6 | 11.2 | 77.5 | 5.1 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 28.9 | 252.9 | 6.3 | 5.7 | 6.0 | 41.9 | 3.0 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 42.5 | 385.8 | 9.6 | 8.7 | 9.2 | 63.9 | 4.2 |
| 13 | Sabine Lake | 24" Cutter Suction | | | | | | | |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 1.6 | 13.4 | 0.3 | 0.3 | 0.3 | 2.2 | 0.2 |
| | **YEAR 2013 TOTAL** | | **167.8** | **1,500.9** | **37.4** | **34.0** | **35.9** | **248.7** | **17.0** |

### YEAR 2014

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | 25.3 | 222.2 | 5.5 | 5.0 | 5.3 | 36.8 | 2.6 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | 10.8 | 95.2 | 2.4 | 2.2 | 2.3 | 15.8 | 1.1 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | | | | | | | |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 51.5 | 467.9 | 11.6 | 10.6 | 11.2 | 77.5 | 5.1 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | 27.6 | 241.2 | 6.0 | 5.5 | 5.8 | 40.0 | 2.9 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 7.2 | 63.2 | 1.6 | 1.4 | 1.5 | 10.5 | 0.7 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | | | | | | | |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 42.5 | 385.8 | 9.6 | 8.7 | 9.2 | 63.9 | 4.2 |
| 13 | Sabine Lake | 24" Cutter Suction | 1.6 | 10.9 | 0.3 | 0.2 | 0.3 | 1.8 | 0.2 |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 6.3 | 53.8 | 1.3 | 1.2 | 1.3 | 8.9 | 0.6 |
| | **YEAR 2014 TOTAL** | | **172.8** | **1,540.2** | **38.3** | **34.9** | **36.8** | **255.2** | **17.5** |

## Summary of Dredge Emissions (tons per year)

### YEAR 2015

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | 28.9 | 253.9 | 6.3 | 5.8 | 6.1 | 42.1 | 3.0 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | 10.8 | 95.2 | 2.4 | 2.2 | 2.3 | 15.8 | 1.1 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 7.7 | 67.7 | 1.7 | 1.5 | 1.6 | 11.2 | 0.8 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 34.3 | 311.9 | 7.8 | 7.1 | 7.5 | 51.6 | 3.4 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | 36.8 | 321.7 | 8.0 | 7.3 | 7.7 | 53.3 | 3.8 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 33.1 | 300.7 | 7.5 | 6.8 | 7.2 | 49.8 | 3.3 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 10.6 | 96.5 | 2.4 | 2.2 | 2.3 | 16.0 | 1.1 |
| 13 | Sabine Lake | 24" Cutter Suction | 6.5 | 43.4 | 1.1 | 1.0 | 1.0 | 7.3 | 0.7 |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 2.6 | 22.4 | 0.6 | 0.5 | 0.5 | 3.7 | 0.3 |
| | **YEAR 2015 TOTAL** | | **171.4** | **1,513.5** | **37.7** | **34.3** | **36.2** | **250.9** | **17.5** |

### YEAR 2016

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | 43.3 | 380.9 | 9.5 | 8.6 | 9.1 | 63.2 | 4.5 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 31.0 | 271.0 | 6.8 | 6.1 | 6.5 | 44.9 | 3.2 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | | | | | | | |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | 36.8 | 321.7 | 8.0 | 7.3 | 7.7 | 53.3 | 3.8 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 44.1 | 401.0 | 10.0 | 9.1 | 9.6 | 66.4 | 4.4 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 6.5 | 43.4 | 1.1 | 1.0 | 1.0 | 7.3 | 0.7 |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | |
| | **YEAR 2016 TOTAL** | | **161.7** | **1,417.9** | **35.3** | **32.1** | **33.9** | **235.2** | **16.6** |

## Summary of Dredge Emissions (tons per year)

### YEAR 2017

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | 10.8 | 95.2 | 2.4 | 2.2 | 2.3 | 15.8 | 1.1 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | 21.7 | 190.4 | 4.7 | 4.3 | 4.6 | 31.6 | 2.2 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 31.0 | 271.0 | 6.8 | 6.1 | 6.5 | 44.9 | 3.2 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 26.2 | 228.7 | 5.7 | 5.2 | 5.5 | 37.9 | 2.7 |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | 15.3 | 134.0 | 3.3 | 3.0 | 3.2 | 22.2 | 1.6 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 44.1 | 401.0 | 10.0 | 9.1 | 9.6 | 66.4 | 4.4 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 6.5 | 43.4 | 1.1 | 1.0 | 1.0 | 7.3 | 0.7 |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | |
| | | **YEAR 2017 TOTAL** | **155.6** | **1,363.8** | **34.0** | **30.9** | **32.6** | **226.2** | **16.0** |

### YEAR 2018

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | | | | | | | |
| 2 | Sabine Bank 132-95+734 | Large Hopper | | | | | | | |
| 3 | Sabine Bank 95+734-53 | Large Hopper | | | | | | | |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | | | | | | | |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | | | | | | | |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 2.6 | 22.6 | 0.6 | 0.5 | 0.5 | 3.7 | 0.3 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | | | | | | | |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 26.1 | 227.9 | 5.7 | 5.2 | 5.5 | 37.8 | 2.7 |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | | | | | | | |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | | | | | | | |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 21.9 | 199.4 | 5.0 | 4.5 | 4.8 | 33.0 | 2.2 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | | | | | | | |
| 13 | Sabine Lake | 24" Cutter Suction | 2.7 | 18.1 | 0.5 | 0.4 | 0.4 | 3.1 | 0.3 |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | | | | | | | |
| | | **YEAR 2018 TOTAL** | **53.3** | **467.9** | **11.7** | **10.6** | **11.2** | **77.6** | **5.5** |

## Summary of Dredge Emissions (tons per year)

TOTAL

| Contract No. | Location/Disposal Site | Dredge | CO | $NO_x$ | PM | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Sabine Bank 165-132 | Large Hopper | 57.8 | 507.8 | 12.7 | 11.5 | 12.1 | 84.2 | 5.9 |
| 2 | Sabine Bank 132-95+734 | Large Hopper | 65.0 | 571.3 | 14.2 | 13.0 | 13.7 | 94.7 | 6.7 |
| 3 | Sabine Bank 95+734-53 | Large Hopper | 39.7 | 349.1 | 8.7 | 7.9 | 8.3 | 57.9 | 4.1 |
| 4 | Sabine Pass Outer Bar 53-00 | Large Hopper | 65.0 | 571.3 | 14.2 | 13.0 | 13.7 | 94.7 | 6.7 |
| 5 | Sabine Pass Jetty Ch - 215+29-00 | Large Hopper | 21.7 | 190.4 | 4.7 | 4.3 | 4.6 | 31.6 | 2.2 |
| 6 | Sabine Pass 0-295+60 | 30" Cutter Suction | 72.3 | 632.2 | 15.8 | 14.3 | 15.1 | 104.9 | 7.5 |
| 7 | Port Arthur Canal 0-240 | 30" Cutter Suction | 201.7 | 1,832.6 | 45.6 | 41.5 | 43.8 | 303.4 | 20.2 |
| 8 | Sabine-Neches Canal 0-170 | 30" Cutter Suction | 52.2 | 456.6 | 11.4 | 10.4 | 10.9 | 75.7 | 5.4 |
| 9 | Sabine-Neches Canal 170-592+91 | 30" Cutter Suction | 116.5 | 1,018.6 | 25.4 | 23.1 | 24.4 | 168.9 | 12.1 |
| 10 | Neches River Channel 0-292 | 30" Cutter Suction | 72.3 | 632.2 | 15.8 | 14.3 | 15.1 | 104.9 | 7.5 |
| 11 | Neches River Channel 292-716 | 30" Cutter Suction | 143.3 | 1,302.1 | 32.4 | 29.5 | 31.1 | 215.5 | 14.3 |
| 12 | Neches River Channel 716-980 | 30" Cutter Suction | 148.6 | 1,350.3 | 33.6 | 30.6 | 32.3 | 223.5 | 14.9 |
| 13 | Sabine Lake | 24" Cutter Suction | 23.8 | 159.2 | 4.0 | 3.6 | 3.8 | 26.9 | 2.7 |
| 14 | Channel to Orange | none | | | | | | | |
| 15 | GIWW E. Of Orange | 24" Cutter Suction | 10.5 | 89.6 | 2.2 | 2.0 | 2.1 | 14.9 | 1.1 |
| | | **TOTAL** | **1,090.4** | **9,663.6** | **240.6** | **219.0** | **231.0** | **1,601.8** | **111.2** |

**Annual Dredge Emission (tpy)**
**Sabine Neches Waterway**

| | CO | $NO_X$ | PM | PM2.5 | PM10 | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|
| **Year 2011** | 41.56 | 371.87 | 9.26 | 8.42 | 8.89 | 61.61 | 4.21 |
| **Year 2012** | 166.23 | 1,487.47 | 37.03 | 33.70 | 35.55 | 246.42 | 16.84 |
| **Year 2013** | 167.80 | 1,500.92 | 37.36 | 34.00 | 35.87 | 248.65 | 17.00 |
| **Year 2014** | 172.79 | 1,540.20 | 38.35 | 34.89 | 36.81 | 255.21 | 17.54 |
| **Year 2015** | 171.41 | 1,513.49 | 37.69 | 34.30 | 36.18 | 250.92 | 17.51 |
| **Year 2016** | 161.73 | 1,417.91 | 35.32 | 32.14 | 33.91 | 235.16 | 16.63 |
| **Year 2017** | 155.59 | 1,363.78 | 33.97 | 30.92 | 32.61 | 226.19 | 16.00 |
| **Year 2018** | 53.29 | 467.93 | 11.66 | 10.61 | 11.19 | 77.60 | 5.47 |

# Appendix B

## Public Notices and Publisher's Affidavits

# Affidavit of Publication

**STATE OF LOUISIANA**
**Parish of Calcasieu**

Before me the undersigned authority, personally came and appeared

Marlana Bergeron

who being duly sworn, deposes and says:

He/She is a duly authorized agent of
**LAKE CHARLES AMERICAN PRESS**
a newspaper published daily at 4900 Highway 90 East,
Lake Charles, Louisiana, 70615. (Mail address: P.O. Box 2893
Lake Charles, LA 70602)

The attached Notice was published in said newspaper in its issue(s) dated:

00585027 - $688.50
January 21, 2010
January 22, 2010
January 23, 2010

Marlana Bergeron
Duly Authorized Agent

Subscribed and sworn to before me on this 25th day of January, 2010 at Lake Charles, LA

Gwendolyn R. Dugas
Notary Public

00080648
CROUCH ENVIRONMENTAL

Gwendolyn R. Dugas
#056523

## 14TH JUDICIAL DISTRICT COURT: DWIS

Sentences were imposed on 13 people who pleaded either guilty or no contest recently in 14th Judicial District Court to drunken driving charges and on one other who was found guilty following nonjury trial.

Most of the sentences were recommended by state and defense attorneys and were accepted by the court. Amendments and dismissals were made by the prosecutors.

Judge David Ritchie imposed a suspended four-month jail term on **Tyra A. Duke II**, 23, 1315 Joseph St. in Sulphur, for first-offense DWI. Banks was placed on one year of probation with special conditions the defendant perform 10 eight-hour days of court-approved community service, attend 12 weekly meetings of a support group for either alcohol or drug abusers, attend one victim's-impact session sponsored by Mothers Against Drunk Driving and pay a fine of $400 and court costs or serve 30 days in jail.

Ritchie imposed suspended 90-day jail terms plus fines of $400 and court costs on the following all for first-offense DWI:

**Clint Thibodeaux**, 26, 4788 Nick Clair Lane, Iowa.

**Summer Statum**, 32, 129 Lewis Statum Road, Starks.

**Derek Milburn**, 45, 4127 Long Pine Lane.

**Marty Droddy Sr.**, 53, 2010 Patton St., Lot 39, Sulphur.

**Stephen Saucier**, 28, 42 Raintree Cove.

Each of those defendants was placed on one year of probation with the condition they each attend one victim's-impact session.

Saucier was ordered to perform eight days of community service, while each of the other defendants was ordered to perform four days.

On a charge of aggravated assault, Saucier was sentenced to a suspended five-month jail term and was placed on probation for two years.

On a charge of illegal carrying of a weapon, he was sentenced to a suspended six-month jail term and was placed on two years of probation with conditions he pay a fine of $750 and court costs, submit to testing and/or treatment for drug abuse, obtain anger-management counseling, forfeit the pistol involved and neither possess nor consume any alcohol.

Defendants and their charges and the sentences imposed by Judge Robert Wyatt:

**Russell S. Campbell**, 37, 4314 S. La. 27, Sulphur; one count of second-offense DWI and one count of first-offense — jail terms totaling 90 days to be served after prison terms totaling five years imposed when Campbell's probation on prior convictions for issuing worthless checks, theft in excess of $500 and possession of stolen goods valued at $300-$500 was revoked; charges of simple burglary, theft in excess of $500 and distribution of a false controlled drug were dismissed.

**Alice Hinton**, 48, 910 Broussard St., Iowa; second-offense DWI — 60 days in jail with all except 48 hours of home incarceration suspended, one year of probation, $750 and court costs or 60 days in jail, 30 days of community service, one victim's-impact session; charges of reckless driving and hit-and-run were dismissed.

**Jesse J. Combs**, 29, 2562 Montfort Drive; same charge and sentence as Hinton with the addition of $200 to the Public Defenders Office as partial payment for legal services.

**Clayton Trahan**, 25, Jennings; second-offense DWI — 60 days in jail with all except 48 hours suspended, two years probation, $750 and court costs or 90 days in jail, 30 days of community service, one victim's-impact session.

**Brandon Bottley**, 29, 2549 13th St.; first-offense DWI — suspended 60-day jail term, one year of probation, $400 and court costs or 60 days in jail, four days of community service, one victim's-impact session.

**George Hartfield**, 64, Orange, Texas; first-offense DWI — suspended 30-day jail term, one year of probation, $350 and court costs or 30 days in jail, four days of community service, one victim's-impact session.

**Stephanie Miller**, also known as **Stephanie O'Quain**, 30, 4314 La. 27 South; two counts of first-offense DWI — suspended imposition of any jail term, one year of probation, fines totaling $600 and court costs, eight days of community service, one victim's-impact session, restitution for a dismissed worthless check charge.

If Miller successfully completes probation, she may have her criminal record changed to reflect acquittals.

Most of the defendants were also ordered to complete the Safety Council of Southwest Louisiana's defensive driving and substance abuse education programs.

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## 14TH JUDICIAL

Probation was revol and previously suspend prison or jail terms impo on 25 people following he ings conducted recently 14th Judicial District Cour

Judge Robert Wy revoked the probation of following people — lis here with their convicti and the sentences they m now serve:

**Charley Leday Jr.**, 47, 19 Winterhalter St., Apt. C; o count each of second- an third-offense possession marijuana; prison terms totaling five years.

**Christopher O. Hasty**, 2 2208 Belden St.; indecent behavior with a juvenile; seven years in prison.

**Aaron Young**, 21, 2425 Conoco St.; possession of cocaine; three years in prison.

**James P. Spangler**, 28, 6 Jones St.; burglary and the prison terms totaling two years.

**Miracle L. Chatman**, 23, 1739 O'Brien St.; two cou of distribution of controlle drugs; prison terms totali three years.

Judge Kent Savoie revok the probation of the followi people — listed here wi their convictions and the s tences they must now serve

**Keith W. Robertson**, 29, 709 10th St.; carnal knowledge of a juvenile a unauthorized entry of an inhabited dwelling; prison terms totaling five years.

**Michael R. Sigler**, 20, 160 W. Fourth St.; simple burglary; three years in prison.

**Byron L. Jackson**, 19, 424

## POLICE BLOTTE

The following arrests ha been reported by area l enforcement agencies.

### Drugs

**Kardayle Shepard Brown**

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reportedly found a gallon-size bag containing marijuana, a smaller bag of marijuana and $3,012 in cash.

■

**Rashad Johnson**, 24; and **Michael Pepp**, 22, both of Leesville — possession of controlled dangerous substance (CDS) schedule I (marijuana) with intent to distribute and illegal carrying of weapons.

**Joseph Lopez**, 18, of New Llano — possession of drugs that included five crack cocaine "cookies" with an estimated street value of $15,000 and a handgun.

■

**Keith Washington**, 28, **Brandon Leone**, 20, both of Leesville, **Ebony Miles**, 25, of Reserve — possession of marijuana, possession of drug paraphernalia, illegal use of CDS in presence of minors, illegal carrying of weapons.

The three were arrested by [illegible] without an occupational license.

## Forgery

**Allen P. Conner**, 25, of Singer; two counts of forgery and one court of simple burglary of an inhabited dwelling.

Beauregard sheriff's officials said Conner was arrested in connection with a complaint received of checks missing from a Singer residence.

BRIEFLY

BY THE ASSOCIATED PRESS

## Former teacher-coach admits to sex charges

BATON ROUGE — A former Redemptorist High School teacher and coach has pleaded guilty to charges that accuse him of having sex with a 15-year-old female student and rubbing and kissing the neck of a 14-year-old female student in 2006.

After his arrest in January 2007, The Advocate reports 26-year-old Ray Samuel Clement III resigned from his job at the school where he taught earth sciences and algebra and also coached track and field.

## Two suspects held in slaying of teen

PLAQUEMINE — A state judge has ordered two construction workers suspected in the slaying of a Plaquemine teenager held without bail pending trial.

Judge Alvin Batiste Jr. denied bail on Tuesday to 25-year-old Channing Paul Touchet and 19-year-old Nicholas Lee Gorring in the Dec. 19 drive-by shooting death of 17-year-old Jamarius Riley.

Police tell The Advocate that Touchet and Gorringe were in the Plaquemine area looking to buy illegal drugs at the time of the slaying.

00582371

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.85-.90 PER LB.
.82-.87 PER LB.
.75-.80 PER LB.
.75-.82 PER LB.
.70-.72 PER LB.

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.44-.46 PER LB.
.45-.51 PER LB.
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.54-.62 PER LB.
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16% Cen-La 2:1 Range Meal ..... $288.00
41 %Cottonseed Meal ..... $354.00
38% Cottonseed Meal Cubes ..... $372.40
20% Sabine Breeder Cubes ..... $318.00

NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

Interested parties are hereby notified of and invited to attend an open house and public meeting to be conducted by the U.S. Army Corps of Engineers and the Sabine-Neches Navigation District on:

WEDNESDAY, JANUARY 27, 2010
OPEN HOUSE 5:30-7:00 PM PUBLIC MEETING 7:00-9:00 PM
(REGISTRATION BEGINS AT 5:30 PM)

LAKE CHARLES CIVIC CENTER JEAN LAFITTE ROOM
700 LAKESHORE DR. LAKE CHARLES, LA 70601

The meeting will provide an opportunity for all persons to comment on the proposed project, the ocean dredged material disposal sites (ODMDS) designation, and draft determination. Those unable to attend may find the draft project EIS, ODMDS EIS, and draft conformity determination at www.swg.usace.army.mil. Written comments with regard to the EIS and the ODMDS EIS must be postmarked by February 10, 2010. Note that written comments with regard to the draft general conformity determination must be postmarked by 30 days from the date this notice is published.

Comments may be mailed or emailed to:
GALVESTON DISTRICT, CORPS OF ENGINEERS ATTN:
MS. JANELLE STOKES P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

00585027

**Jermaine O'Brien**, 27, 409 N. Simmons St.; first-offense DWI — suspended 90-day jail term, six months of unsupervised probation, $400 and court costs, eight days of community service.

**Donna Lankford**, 52, 1111 Henning Drive, Apt. B, Sulphur; first-offense DWI — 30 days in jail.

**Shawn McCorvey**, 38,

Sasovetz, Hebert, Levier and Murry successfully complete probation, they may have their records changed to reflect acquittals.

Most of the defendants were also ordered to complete the Safety Council of Southwest Louisiana's defensive driving and substance abuse education programs.

VINCENT LUPO

**Check out the Jambalaya pages on weekdays, Saturdays for your crossword and horoscope.**

NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

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(REGISTRATION BEGINS AT 5:30 PM)

LAKE CHARLES CIVIC CENTER JEAN LAFITTE ROOM
700 LAKESHORE DR. LAKE CHARLES, LA 70601

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Comments may be mailed or emailed to:
GALVESTON DISTRICT, CORPS OF ENGINEERS ATTN:
MS. JANELLE STOKES P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

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flavinrealty.com

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**TRAVEL**
Econo Travel Agency
econo-travel.com

**WEATHER**
Five Day Forecast
accuweather.com

**To list your business or group, call 337.494.4002 or e-mail kcole@americanpress.com.**

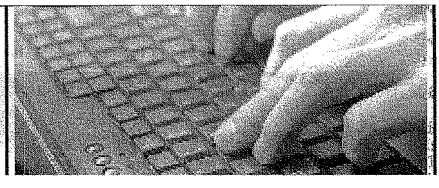

over their cash. Cox reached for his wallet, saying he didn't have 50 cents. That's when he was shot, Rudell said.

Cox dropped face first into sewage pumped from the man-

Medical personnel reluctantly let her see her husband before the surgery.

"The pillow was just soaked in his blood. I grabbed his hand and told him, 'Don't

DWIS



RESS

June 23, 2006, and insisted on searching it without a warrant or permission from anyone.

They said they were looking 50,000-volt stun gun.

That left him unable to walk; police dragged him to a squad car and took him to jail, according to the ACLU.

## The Cowboy Way

offer other services are being held at several area Walgreens. The screenings are through Friday, Jan. 29.

p.m., Walgreens, 2636 Ryan St., Lake Charles; Sunday, Jan. 24, 11 a.m. – 5p.m.

# Help with energy bills available for eligible residents

The U.S. Department of Health and Human Services on Wednesday announced the release of $6.3 million in Low-Income Home Energy Assistance Program funds for eligible homeowners and renters in Louisiana.

The program offers assistance for heating, cooling and other energy costs, as well as helping to weatherize families' homes.

The funds are in addition to basic LIHEAP funding states receive automatically.

To apply for energy assistance, contact the local or state LIHEAP agency. In Calcasieu, call the parish Office of Community Services at 437-3567.

For more information, vis www.acf.hhs.gov/program ocs/liheap or ww acf.hhs.gov/programs/oc liheap/brochure/brochu html.

NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

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WEDNESDAY, JANUARY 27, 2010
OPEN HOUSE 5:30-7:00 PM PUBLIC MEETING 7:00-9:00 PM
(REGISTRATION BEGINS AT 5:30 PM)

LAKE CHARLES CIVIC CENTER JEAN LAFITTE ROOM
700 LAKESHORE DR. LAKE CHARLES, LA 70601

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Comments may be mailed or emailed to:
GALVESTON DISTRICT, CORPS OF ENGINEERS ATTN:
MS. JANELLE STOKES P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

00585027

WHAT'S AHEAD

### Sowela e-commerce course scheduled

Beginning Thursday, Jan. 28, Sowela Technical Community College will offer a 10-week e-commerce course to teach students how to better navigate the Internet and start a Web-based business.

The course is 5:30-8:30 p.m. Thursdays and costs $150, plus fees.

www.americanpress.com

# Board to exp

BY DORIS MARI
AMERICAN P

JENNINGS — Jeff Da Parish students who exce the LEAP and iLEAP te will have the opportunit continue their fun and le ing even when school lets for the summer.

The Jeff Davis Pa School Board began cussing plans Thursda expand its summer camp gram to include a high sc

GoRun
Training Programs
5k 10k 13.1 26.2
2010
Train Hard Train Smart
REGISTRATION Sat., Jan. 23 & 30 • 6:30
Lake Charles Civic Center
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KAREN WINK / AMERICAN PRESS

ler way

BY MIKE JONES
AMERICAN PRESS

A historic warehouse that

## Paperwork has been submitted

# PUBLISHER'S AFFIDAVIT

Tear Sheet Attached
Crouch Environmental Svc

STATE OF TEXAS
COUNTY OF JEFFERSON

BEFORE ME, THE UNDERSIGNED AUTHORITY, ON THIS DAY, PERSONALLY APPEARED Nettie Dumes WHO BEING BY ME DULY SWORN, DEPOSES AND SAYS THAT HE/SHE IS THE Classified Sales Exec. OF THE BEAUMONT ENTERPRISE; THAT SAID NEWSPAPER IS REGULARLY PUBLISHED IN JEFFERSON, HARDIN, TYLER, NEWTON, CHAMBERS, ORANGE , JASPER, LIBERTY, SABINE, SAN AUGUSTINE, ANGELINA AND GALVESTON COUNTY (COUNTIES), TEXAS; THAT THE ATTACHED NOTICE WAS PUBLISHED IN THE BEAUMONT ENTERPRISE ON THE FOLLOWING DATE(S), TO WIT January 21, 2010.

NEWSPAPER REPRESENTATIVE SIGNATURE

SWORN AND SUBSCRIBED TO BEFORE ME ON THIS THE 25th DAY OF January 2010, TO CERTIFY WHICH WITNESS MY HAND AND SEAL OF OFFICE.

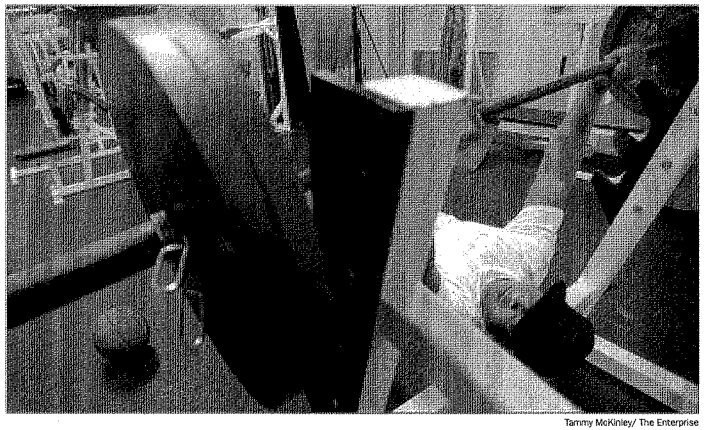
Robin Hillin

NOTARY PUBLIC IN AND FOR THE STATE OF TEXAS

ROBIN R. HILLIN
MY COMMISSION EXPIRES
04-29-2010

PRINT OR TYPE NAME OF NOTARY PUBLIC
MY COMMISSION EXPIRES

ROBIN R HILLIN
Notary Public, State Of Texas
My Commission Expires
04-29-2010



Tammy McKinley/ The Enterprise

Nelson Brown works out at the YMCA in Beaumont on Wednesday.

# YMCA needs 1,000 new members

BEAUMONT

By Mike D. Smith
MDSmith@BeaumontEnterprise.com
(409) 880-0753

The Beaumont Metropolitan YMCA is considering an aggressive community effort to grab the up to 1,000 additional memberships needed to save the L.L. Melton Branch.

The "commitment campaign" is another effort by the YMCA to save the facility at 3455 Sarah St., which operates on a budget that hemorrhages up to $25,000 a month, Beaumont YMCA CEO Jeff Moore said.

Operating losses have forced YMCA officials to reduce hours.

The YMCA only plans to open the building on Saturday, but they chose not to do it," Moore said.

Beaumont Ward 4 Councilman Jamie Smith, whose district includes the Melton, said the city would have had to pay $200,000 under the deal, no matter how many of the city's 1,300 employees used the center.

"It was a little unfair saying 'this is what we're paying for,'" Smith said. "Then you're pushing something on the employees they may not be happy with."

Smith said he thinks solutions are still possible, including possibly relocating the YMCA's Parkdale Mall operations into the Melton Branch.

Smith said the branch could also be operated similar to the city-run Sterling Pruitt Recreation Center, will continue at off-site locations throughout the community, Moore said.

The YMCA has been seeking an entity to take over the Melton Branch the past year. Antioch Missionary Baptist Church expressed interest, but backed out of talks last autumn. The YMCA also has approached the Beaumont City Council to consider a city takeover.

However, a quick resolution to the Melton Branch's dilemma might be nowhere in sight.

The center is tied up in a contractual agreement between the city and the YMCA.

The city used $1 million from the U.S. Department of Housing and Urban Development to build a new gym at the Melton facility in 2001, payment schedule on that $1 million amount using block grant funds.

The city will continue to make those payments, Hayes said.

If the Melton facility ceases being a YMCA facility, ownership of the building goes to the city, and the city could seek at least a partial repayment from the YMCA, Hayes said.

Meanwhile, talks slowly continue.

Moore said the group's last proposal to the city in December included starting a health initiative under which city employees would have discounted memberships.

Memberships would have generated enough money to patch the facility's deficits and keep the center afloat while the YMCA developed a

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**OPEN HOUSE 5:30-7:00 PM**
**PUBLIC MEETING 7:00-9:00 PM**
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**BEAUMONT CIVIC CENTER**
**701 MAIN STREET**
**BEAUMONT, TX 77701**

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**P.O. BOX 1229**
**GALVESTON, TEXAS 77553**
**Or Janelle.S.Stokes@usace.army.mil**

2332

**The Port Arthur News**
**A Division of Newspaper Holdings, Inc.**
**Port Arthur, Texas**

## AFFIDAVIT OF PUBLICATION

**The State of Texas**
**County of Jefferson,**
**City of Port Arthur**

***Tara Ford*, being duly sworn deposes and says:**

That she is a resident citizen of Jefferson County, Texas and that she is of lawful age; that she is the Classified Representative of the PORT ARTHUR NEWS, a division of Newspaper Holdings, Inc., same being a newspaper published and having a general circulation in the City of Port Arthur, Jefferson County, Texas; that said newspaper has been continuously and regularly published for a period of more than one year in Jefferson County, Texas, and that the advertising of Crouch Environmental, Ad # 16223P was published in said newspaper in the issue of January 20th, 21st + 22nd, 2010 which were the regular publication days of said issues; and that said issues were actually published, circulated and distributed.

Tara Ford

**SUBSCRIBED AND sworn to before me,**
**this the 3rd day of February, A.D. 2010**

Notary Public in and for Jefferson County, Texas

Jeree Powell
Notary Public, State of Texas
My Commission Expires:
April 25, 2010

WEDNESDAY, JANUARY 20, 2010

PORT ARTHUR The News

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Could Stroud take 2010 to the next level

## Mr. Seat 41

Scott lands crucial win for GOP

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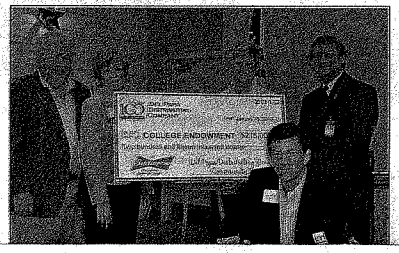
# Del Papa Distributing creates scholarships for local colleges



As part of Del Papa Distributing Company's 100th anniversary celebration, the company announced that it will endow scholarships to 13 community and four-year colleges located in the 17 counties Del Papa services.

Lamar State College-Port Arthur, Lamar Institute of Technology, Lamar State College–Orange and Lamar University are among

# Fuel gas leak isolated at Total in Port Arthur

By Mary Meaux
The News staff writer

A fuel gas leak at the Total Port Arthur Refinery has been isolated and plans are made to make necessary repairs, Pat Avery, administrative manager, said.

The gaseous leak occurred between 2 and 3 a.m. Wednesday. An unknown number of contract workers within the facility were sent home as per company policy, Avery said. When an incident such as this occurs, extra persons are kept out of the facility.

Air monitoring at the fence line has been ongoi

"We are conducting monitoring at the fence l and no unsafe levels vapors have been detect she said.

The Texas Commiss on Environmental Qua has been notified of the i dent, as is required.

*mmeaux@panews.com*

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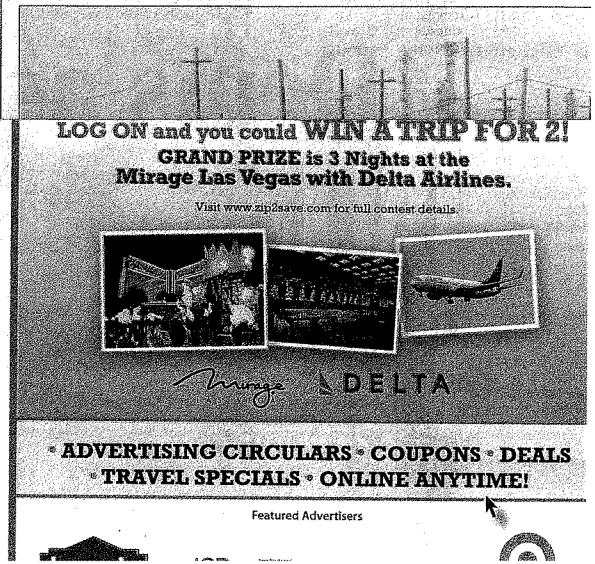


2335

# Exhibit explores legacy of women in Pop

PHILADELPHIA (AP) — As radical social changes rocked 1960s America, the contemporary art world remained largely a boys club that largely ignored female Pop artists as their male counterparts strive to become older are invited to stop in

retrospective of dancer and experimental filmmaker Yvonne Rainer. Why, he wondered, were she and other female artists of the 1960s not included in the art canon alongside Andy Warhol, Robert Indiana, Claes Oldenburg and Roy

Saturday. Ages 21 and older

tinues to create groundbreaking art with her trademark hallucinatory polka-dot motifs.

Soft sculptures popularized by Oldenburg's huge deflated fans, and use of repetition like Warhol's multicolor Marilyns were

wave didn't carry female contemporary artists to the levels of recognition and respect reached by their male counterparts, said University of the Arts professor and art historian Nancy Heller.

She said women have

to be Honky Tonk Texas in

# Global warming opens up Arctic for undersea cable

ANCHORAGE, Alaska (AP) — Global warming has melted so much Arctic ice that a telecommunication group is moving forward with a project that was unthinkable just a few years ago: laying cables

beneath the

The project, while still facing many significant obstacles, also serves as an example of how warming has altered the Arctic landscape in profound ways.

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# State of Louisiana

## Parish of Calcasieu

Before me, the undersigned authority, personally came and appeared JOEANN BENOIT who, being duly sworn, deposes and says: That he is the manager of the

**SOUTHWEST DAILY NEWS**

A newspaper published daily (Sunday, Tuesday, Wednesday, Thursday, Friday and Saturday) in Sulphur, Louisiana.

That the hereto attached notice was published in said newspaper in its issues dated the 01/19/10
01/20/10
01/21/10
01/22/10

NOTICE OF PUBLIC MEETING

GALVESTON DISTRICT, CORPS OF ENGINEERS

Manager, Joe Ann Benoit

Sworn and subscribed to at my office in Sulphur, Louisiana, on this 15 day of JANUARY A.D., 2010 Before me.

Linda Duggan
Notary Public
LINDA DUGGAN ID#1848

to come in a little later, but the damage is not as bad as the industry first believed, LSU AgCenter experts said.

Regina Bracy, LSU AgCenter horticulturist at the LSU AgCenter's Hammond Research Station, said the crop could be set back for nearly a month.

"It takes 21 days from flower to berry. So if the growers lose all of their flowers and berries at this time, then they will not have another crop for 21 days," she said.

"We've lost about 95 percent of the bloom crop that's out there right now and a good bit of our green berries due to cold-weather damage and the freeze," said Eric Morrow, a Ponchatoula grower with 13 acres.

William Fletcher, another Ponchatoula grower, said he lost about 80 percent of what was on the plants.

"I expect a market drop in production for about a month. If we don't see any more cold weather, production should come back," Fletcher said.

The peak season for Louisiana strawberries is usually in March and ers is November, December and January.

Bracy said Louisiana produces about 300 acres of strawberries, which is down from 1,000 acres 10 years ago.

"We're seeing the decrease in acres, but we're also seeing some young farmers coming in, and that gives us some hope that the industry is going to continue in this area," she said.

Bracy said the cold weather doesn't affect the quality of the berries if they are protected and not damaged.

"The berries that come out after this weather will be as good as any we've had," she said. "In fact, cold weather does less damage than applying too much water or having too much rain."

---

Information from: The Advocate, http://www.2theadvocate.com

of $524.04 each for deer, and $30 a lock and $2.21 a pound for alligators.

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**700 LAKESHORE DR.**
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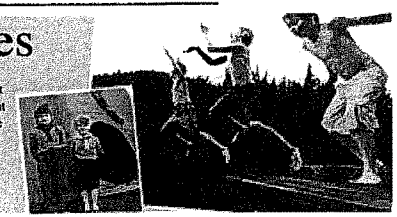
We're Here


# Share your Scouting memories

This year marks the 100th anniversary of the Boy Scouts of America, and we would like you to submit your memories and photos of your Scouting days. Scouting offers adventure and a sense of service that often become the fabric of our lives. Send us your photos and stories from your Scouting days to share with the community.

SUBMIT PHOTOS & STORIES Submit your photos and Scouting memories to Southwest Daily News at 716 E. Napoleon as soon as possible, and we'll run them in our print edition and online at sdneditorial@yahoo.com



2338

Cyan Magenta

# Affidavit of Publication

**STATE OF LOUISIANA**
**Parish of Calcasieu**

Before me the undersigned authority, personally came and appeared

Marlana Bergeron

who being duly sworn, deposes and says:

He/She is a duly authorized agent of
**LAKE CHARLES AMERICAN PRESS**
a newspaper published daily at 4900 Highway 90 East,
Lake Charles, Louisiana, 70615. (Mail address: P.O. Box 2893
Lake Charles, LA 70602)

The attached Notice was published in said newspaper in its issue(s) dated:

00585027 - $688.50
January 21, 2010
January 22, 2010
January 23, 2010

Marlana Bergeron
Duly Authorized Agent

Subscribed and sworn to before me on this 25th day of January, 2010 at Lake Charles, LA

Gwendolyn R. Dugas
Notary Public

00080648
CROUCH ENVIRONMENTAL

Gwendolyn R. Dugas
#056523

## 14TH JUDICIAL DISTRICT COURT: DWIS

Sentences were imposed on 13 people who pleaded either guilty or no contest recently in 14th Judicial District Court to drunken driving charges and on one other who was found guilty following nonjury trial.

Most of the sentences were recommended by state and defense attorneys and were accepted by the court. Amendments and dismissals were made by the prosecutors.

Judge David Ritchie imposed a suspended four-month jail term on **Tyra A. Duke II,** 23, 1815 Joseph St. in Sulphur, for first-offense DWI. Banks was placed on one year of probation with special conditions the defendant perform 10 eight-hour days of court-approved community service, attend 12 weekly meetings of a support group for either alcohol or drug abusers, attend one victim's-impact session sponsored by Mothers Against Drunk Driving and pay a fine of $400 and court costs or serve 30 days in jail.

Ritchie imposed suspended 90-day jail terms plus fines of $400 and court costs on the following all for first-offense DWI:

**Clint Thibodeaux**, 26, 4788 Nick Clair Lane, Iowa.

**Summer Statum**, 32, 129 Lewis Statum Road, Starks.

**Derek Milburn**, 45, 4127 Long Pine Lane.

**Marty Droddy Sr.**, 53, 2010 Patton St., Lot 39, Sulphur.

**Stephen Saucier**, 28, 42 Raintree Cove.

Each of those defendants was placed on one year of probation with the condition they each attend one victim's-impact session.

Saucier was ordered to perform eight days of community service, while each of the other defendants was ordered to perform four days.

On a charge of aggravated assault, Saucier was sentenced to a suspended five-month jail term and was placed on probation for two years.

On a charge of illegal carrying of a weapon, he was sentenced to a suspended six-month jail term and was placed on two years of probation with conditions he pay a fine of $750 and court costs, submit to testing and/or treatment for drug abuse, obtain anger-management counseling, forfeit the pistol involved and neither possess nor consume any alcohol.

Defendants and their charges and the sentences imposed by Judge Robert Wyatt:

**Russell S. Campbell**, 37, 4314 S. La. 27, Sulphur; one count of second-offense DWI and one count of first-offense — jail terms totaling 90 days to be served after prison terms totaling five years imposed when Campbell's probation on prior convictions for issuing worthless checks, theft in excess of $500 and possession of stolen goods valued at $300-$500 was revoked; charges of simple burglary, theft in excess of $500 and distribution of a false controlled drug were dismissed.

**Alice Hinton**, 48, 910 Broussard St., Iowa; second-offense DWI — 60 days in jail with all except 48 hours of home incarceration suspended, one year of probation, $750 and court costs or 60 days in jail, 30 days of community service, one victim's-impact session; charges of reckless driving and hit-and-run were dismissed.

**Jesse J. Combs**, 29, 2562 Montfort Drive; same charge and sentence as Hinton with the addition of $200 to the Public Defenders Office as partial payment for legal services.

**Clayton Trahan**, 25, Jennings; second-offense DWI — 60 days in jail with all except 48 hours suspended, two years probation, $750 and court costs or 90 days in jail, 30 days of community service, one victim's-impact session.

**Brandon Bottley**, 29, 2549 13th St.; first-offense DWI — suspended 60-day jail term, one year of probation, $400 and court costs or 60 days in jail, four days of community service, one victim's-impact session.

**George Hartfield**, 64, Orange, Texas; first-offense DWI — suspended 30-day jail term, one year of probation, $350 and court costs or 30 days in jail, four days of community service, one victim's-impact session.

**Stephanie Miller**, also known as **Stephanie O'Quain**, 30, 4314 La. 27 South; two counts of first-offense DWI — suspended imposition of any jail term, one year of probation, fines totaling $600 and court costs, eight days of community service, one victim's-impact session, restitution for a dismissed worthless check charge.

If Miller successfully completes probation, she may have her criminal record changed to reflect acquittals.

Most of the defendants were also ordered to complete the Safety Council of Southwest Louisiana's defensive driving and substance abuse education programs.

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## 14TH JUDICIAL

Probation was revo
and previously suspen
prison or jail terms impo
on 25 people following he
ings conducted recently
14th Judicial District Cour

Judge Robert Wy
revoked the probation of
following people — lis
here with their convicti
and the sentences they m
now serve:

**Charley Leday Jr.**, 47, 19
Winterhalter St., Apt. C; o
count each of second- an
third-offense possession
marijuana; prison terms
totaling five years.

**Christopher O. Hasty**, 2
2208 Belden St.; indecent
behavior with a juvenile;
seven years in prison.

**Aaron Young**, 21, 2425
Conoco St.; possession of
cocaine; three years in
prison.

**James P. Spangler**, 28, 6
Jones St.; burglary and th
prison terms totaling two
years.

**Miracle L. Chatman**, 23,
1739 O'Brien St.; two cou
of distribution of controlle
drugs; prison terms totali
three years.

Judge Kent Savoie revok
the probation of the followi
people — listed here wi
their convictions and the s
tences they must now serve

**Keith W. Robertson**, 29,
709 10th St.; carnal
knowledge of a juvenile a
unauthorized entry of an
inhabited dwelling; prison
terms totaling five years.

**Michael R. Sigler**, 20, 160
W. Fourth St.; simple
burglary; three years in
prison.

**Byron L. Jackson**, 19, 424

## POLICE BLOTTE

The following arrests ha
been reported by area l
enforcement agencies.

### Drugs

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reportedly found a gallon-size bag containing marijuana, a smaller bag of marijuana and $3,012 in cash.

■

**Rashad Johnson**, 24; and **Michael Pepp**, 22, both of Leesville — possession of controlled dangerous substance (CDS) schedule I (marijuana) with intent to distribute and illegal carrying of weapons.

**Joseph Lopez**, 18, of New Llano — possession of drugs that included five crack cocaine "cookies" with an estimated street value of $15,000 and a handgun.

■

**Keith Washington**, 28, **Brandon Leone**, 20, both of Leesville, **Ebony Miles**, 25, of Reserve — possession of marijuana, possession of drug paraphernalia, illegal use of CDS in presence of minors, illegal carrying of weapons.

The three were arrested by [illegible] without an occupational license.

## Forgery

**Allen P. Conner**, 25, of Singer; two counts of forgery and one court of simple burglary of an inhabited dwelling.

Beauregard sheriff's officials said Conner was arrested in connection with a complaint received of checks missing from a Singer residence.

## BRIEFLY

BY THE ASSOCIATED PRESS

### Former teacher-coach admits to sex charges

BATON ROUGE — A former Redemptorist High School teacher and coach has pleaded guilty to charges that accuse him of having sex with a 15-year-old female student and rubbing and kissing the neck of a 14-year-old female student in 2006.

After his arrest in January 2007, The Advocate reports 26-year-old Ray Samuel Clement III resigned from his job at the school where he taught earth sciences and algebra and also coached track and field.

### Two suspects held in slaying of teen

PLAQUEMINE — A state judge has ordered two construction workers suspected in the slaying of a Plaquemine teenager held without bail pending trial.

Judge Alvin Batiste Jr. denied bail on Tuesday to 25-year-old Channing Paul Touchet and 19-year-old Nicholas Lee Gorring in the Dec. 19 drive-by shooting death of 17-year-old Jamarius Riley.

Police tell The Advocate that Touchet and Gorringe were in the Plaquemine area looking to buy illegal drugs at the time of the slaying.

00582371

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41 %Cottonseed Meal ..... $354.00
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NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

Interested parties are hereby notified of and invited to attend an open house and public meeting to be conducted by the U.S. Army Corps of Engineers and the Sabine-Neches Navigation District on:

WEDNESDAY, JANUARY 27, 2010
OPEN HOUSE 5:30-7:00 PM PUBLIC MEETING 7:00-9:00 PM
(REGISTRATION BEGINS AT 5:30 PM)

LAKE CHARLES CIVIC CENTER JEAN LAFITTE ROOM
700 LAKESHORE DR. LAKE CHARLES, LA 70601

The meeting will provide an opportunity for all persons to comment on the proposed project, the ocean dredged material disposal sites (ODMDS) designation, and draft determination. Those unable to attend may find the draft project EIS, ODMDS EIS, and draft conformity determination at www.swg.usace.army.mil. Written comments with regard to the EIS and the ODMDS EIS must be postmarked by February 10, 2010. Note that written comments with regard to the draft general conformity determination must be postmarked by 30 days from the date this notice is published.

Comments may be mailed or emailed to:
GALVESTON DISTRICT, CORPS OF ENGINEERS ATTN:
MS. JANELLE STOKES P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

00585027

**Jermaine O'Brien**, 27, 409 N. Simmons St.; first-offense DWI — suspended 90-day jail term, six months of unsupervised probation, $400 and court costs, eight days of community service.

**Donna Lankford**, 52, 1111 Henning Drive, Apt. B, Sulphur; first-offense DWI — 30 days in jail.

**Shawn McCorvey**, 38,

Sasovetz, Hebert, Levier and Murry successfully complete probation, they may have their records changed to reflect acquittals.

Most of the defendants were also ordered to complete the Safety Council of Southwest Louisiana's defensive driving and substance abuse education programs.

VINCENT LUPO

**Check out the Jambalaya pages on weekdays, Saturdays for your crossword and horoscope.**

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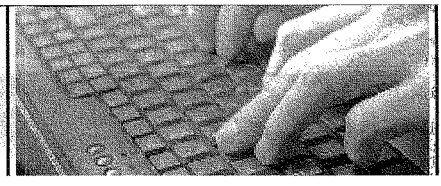
over their cash. Cox reached for his wallet, saying he didn't have 50 cents. That's when he was shot, Rudell said.

Cox dropped face first into sewage pumped from the man-

Medical personnel reluctantly let her see her husband before the surgery.

"The pillow was just soaked in his blood. I grabbed his hand and told him, 'Don't



DWIS

RESS

June 23, 2006, and insisted on searching it without a warrant or permission from anyone.

They said they were looking for a 50,000-volt stun gun.

That left him unable to walk; police dragged him to a squad car and took him to jail, according to the ACLU.

## The Cowboy Way

offer other services are being held at several area Walgreens. The screenings are through Friday, Jan. 29.

p.m., Walgreens, 2636 Ryan St., Lake Charles; Sunday, Jan. 24, 11 a.m. – 5p.m.

# Help with energy bills available for eligible residents

The U.S. Department of Health and Human Services on Wednesday announced the release of $6.3 million in Low-Income Home Energy Assistance Program funds for eligible homeowners and renters in Louisiana.

The program offers assistance for heating, cooling and other energy costs, as well as helping to weatherize families' homes.

The funds are in addition to basic LIHEAP funding states receive automatically.

To apply for energy assistance, contact the local or state LIHEAP agency. In Calcasieu, call the parish Office of Community Services at 437-3567.

For more information, vis www.acf.hhs.gov/program ocs/liheap or ww acf.hhs.gov/programs/oc liheap/brochure/brochu html.

NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

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MS. JANELLE STOKES P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

00585027

WHAT'S AHEAD

### Sowela e-commerce course scheduled

Beginning Thursday, Jan. 28, Sowela Technical Community College will offer a 10-week e-commerce course to teach students how to better navigate the Internet and start a Web-based business.

The course is 5:30-8:30 p.m. Thursdays and costs $150, plus fees.

www.americanpress.com

# Board to exp

BY DORIS MARI
AMERICAN P

JENNINGS — Jeff Da Parish students who exce the LEAP and iLEAP te will have the opportunit continue their fun and le ing even when school lets for the summer.

The Jeff Davis Pa School Board began cussing plans Thursda expand its summer camp gram to include a high sc

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BY MIKE JONES
AMERICAN PRESS

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# PUBLISHER'S AFFIDAVIT

Tear Sheet Attached
Crouch Environmental Svc

STATE OF TEXAS
COUNTY OF JEFFERSON

BEFORE ME, THE UNDERSIGNED AUTHORITY, ON THIS DAY, PERSONALLY APPEARED Nattie Dumes WHO BEING BY ME DULY SWORN, DEPOSES AND SAYS THAT HE/SHE IS THE Classified Sales Exec. OF THE BEAUMONT ENTERPRISE; THAT SAID NEWSPAPER IS REGULARLY PUBLISHED IN JEFFERSON, HARDIN, TYLER, NEWTON, CHAMBERS, ORANGE , JASPER, LIBERTY, SABINE, SAN AUGUSTINE, ANGELINA AND GALVESTON COUNTY (COUNTIES), TEXAS; THAT THE ATTACHED NOTICE WAS PUBLISHED IN THE BEAUMONT ENTERPRISE ON THE FOLLOWING DATE(S), TO WIT January 21, 2010.

NEWSPAPER REPRESENTATIVE SIGNATURE

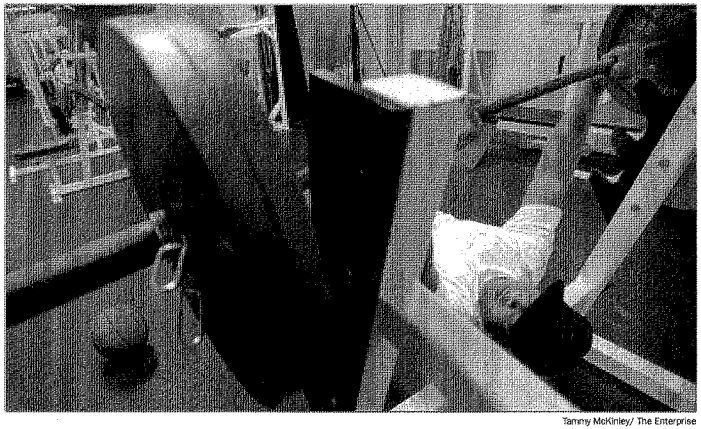
SWORN AND SUBSCRIBED TO BEFORE ME ON THIS THE 25th DAY OF January 2010, TO CERTIFY WHICH WITNESS MY HAND AND SEAL OF OFFICE.

Robin R Hillin
NOTARY PUBLIC IN AND FOR THE STATE OF TEXAS

ROBIN R. HILLIN
MY COMMISSION EXPIRES
04-29-2010

PRINT OR TYPE NAME OF NOTARY PUBLIC
MY COMMISSION EXPIRES

ROBIN R HILLIN
Notary Public, State Of Texas
My Commission Expires
04-29-2010



Tammy McKinley/ The Enterprise

Nelson Brown works out at the YMCA in Beaumont on Wednesday.

# YMCA needs 1,000 new members

BEAUMONT

By Mike D. Smith
MDSmith@BeaumontEnterprise.com
(409) 880-0753

The Beaumont Metropolitan YMCA is considering an aggressive community effort to grab the up to 1,000 additional memberships needed to save the L.L. Melton Branch.

The "commitment campaign" is another effort by the YMCA to save the facility at 3455 Sarah St., which operates on a budget that hemorrhages up to $25,000 a month, Beaumont YMCA CEO Jeff Moore said.

Operating losses have forced YMCA officials to reduce hours.

The YMCA only plans to open the building on Saturday, will continue at off-site locations throughout the community, Moore said.

The YMCA has been seeking an entity to take over the Melton Branch the past year. Antioch Missionary Baptist Church expressed interest, but backed out of talks last autumn. The YMCA also has approached the Beaumont City Council to consider a city takeover.

However, a quick resolution to the Melton Branch's dilemma might be nowhere in sight.

The center is tied up in a contractual agreement between the city and the YMCA.

The city used $1 million from the U.S. Department of Housing and Urban Development to build a new gym at the Melton facility in 2001, payment schedule on that $1 million amount using block grant funds.

The city will continue to make those payments, Hayes said.

If the Melton facility ceases being a YMCA facility, ownership of the building goes to the city, and the city could seek at least a partial repayment from the YMCA, Hayes said.

Meanwhile, talks slowly continue.

Moore said the group's last proposal to the city in December included starting a health initiative under which city employees would have discounted memberships.

Memberships would have generated enough money to patch the facility's deficits and keep the center afloat while the YMCA developed a but they chose not to do it," Moore said.

Beaumont Ward 4 Councilman Jamie Smith, whose district includes the Melton, said the city would have had to pay $200,000 under the deal, no matter how many of the city's 1,300 employees used the center.

"It was a little unfair saying 'this is what we're paying for,'" Smith said. "Then you're pushing something on the employees they may not be happy with."

Smith said he thinks solutions are still possible, including possibly relocating the YMCA's Parkdale Mall operations into the Melton Branch.

Smith said the branch could also be operated similar to the city-run Sterling Pruitt Recreation Center,

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**TUESDAY, JANUARY 26, 2010**
**OPEN HOUSE 5:30-7:00 PM**
**PUBLIC MEETING 7:00-9:00 PM**
**(REGISTRATION BEGINS AT 5:30 PM)**

**BEAUMONT CIVIC CENTER**
**701 MAIN STREET**
**BEAUMONT, TX 77701**

**The meeting will provide an opportunity for all persons to comment on the proposed project, the ocean dredged material disposal sites (ODMDS) designation, and draft determination. Those unable to attend may find the draft project EIS, ODMDS EIS, and draft conformity determination at www.swg.usace.army.mil. Written comments with regard to the EIS and the ODMDS EIS must be postmarked by February 10, 2010. Note that written comments with regard to the draft general conformity determination must be postmarked by 30 days from the date this notice is published.**

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**P.O. BOX 1229**
**GALVESTON, TEXAS 77553**
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2345

**The Port Arthur News**
**A Division of Newspaper Holdings, Inc.**
**Port Arthur, Texas**

## AFFIDAVIT OF PUBLICATION

**The State of Texas**
**County of Jefferson,**
**City of Port Arthur**

***Tara Ford*, being duly sworn deposes and says:**

That she is a resident citizen of Jefferson County, Texas and that she is of lawful age; that she is the Classified Representative of the PORT ARTHUR NEWS, a division of Newspaper Holdings, Inc., same being a newspaper published and having a general circulation in the City of Port Arthur, Jefferson County, Texas; that said newspaper has been continuously and regularly published for a period of more than one year in Jefferson County, Texas, and that the advertising of Crouch Environmental, Ad # 16223P was published in said newspaper in the issue of January 20th, 21st + 22nd, 2010 which were the regular publication days of said issues; and that said issues were actually published, circulated and distributed.

Tara Ford

**SUBSCRIBED AND sworn to before me,**
**this the 3rd day of February, A.D. 2010**

Notary Public in and for Jefferson County, Texas

Jeree Powell
Notary Public, State of Texas
My Commission Expires:
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WEDNESDAY, JANUARY 20, 2010

PORT ARTHUR The News

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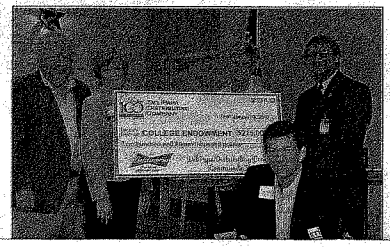
# Del Papa Distributing creates scholarships for local colleges




As part of Del Papa Distributing Company's 100th anniversary celebration, the company announced that it will endow scholarships to 13 community and four-year colleges located in the 17 counties Del Papa services.

Lamar State College-Port Arthur, Lamar Institute of Technology, Lamar State College–Orange and Lamar University are among

# Fuel gas leak isolated at Total in Port Arthur

**By Mary Meaux**
The News staff writer

A fuel gas leak at the Total Port Arthur Refinery has been isolated and plans are made to make necessary repairs, Pat Avery, administrative manager, said.

The gaseous leak occurred between 2 and 3 a.m. Wednesday. An unknown number of contract workers within the facility were sent home as per company policy, Avery said. When an incident such as this occurs, extra persons are kept out of the facility.

Air monitoring at the fence line has been ongoi

"We are conducting monitoring at the fence l and no unsafe levels vapors have been detect she said.

The Texas Commiss on Environmental Qua has been notified of the i dent, as is required.

*mmeaux@panews.com*

**NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE - NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION**

**Interested parties are hereby notified of and invited to attend an open house and public meeting to be conducted by the U.S. Army Corps of Engineers and the Sabine Neches Navigation District on:**

**TUESDAY, JANUARY 26, 2010**
**OPEN HOUSE 5:30-7:00 PM**
**PUBLIC MEETING 7:00-9:00 PM**
**(REGISTRATION BEGINS AT 5:30 PM)**

**BEAUMONT CIVIC CENTER**
**701 MAIN STREET**
**BEAUMONT, TX 77701**

**The meeting will provide an opportunity for all persons to comment on the proposed project, the ocean dredged material disposal sites (ODMDS) designation, and draft determination. Those unable to attend may find the draft project EIS, ODMDS EIS, and draft conformity determination at www.swg.usace.army.mil. Written comments must be**

2348

# Exhibit explores legacy of women in Pop

PHILADELPHIA (AP) — As radical social changes rocked 1960s America, the contemporary art world remained largely a boys' club that largely ignored female Pop artists as their male counterparts grew to become

retrospective of dancer and experimental filmmaker Yvonne Rainer. Why, he wondered, were she and other female artists of the 1960s not included in the art canon alongside Andy Warhol, Robert Indiana, Claes Oldenburg and Roy

Saturday. Ages 21 and older

issues to create ground-breaking art with her trademark hallucinatory polka-dot motifs.

Soft sculptures popularized by Oldenburg's huge deflated fans and use of repetition like Warhol's multicolor Marilyns were

wave didn't carry female contemporary artists to the levels of recognition and respect reached by their male counterparts, said University of the Arts professor and art historian Nancy Heller.

She and others have

# Global warming opens up Arctic for undersea cable

ANCHORAGE, Alaska (AP) — "Global warming has melted so much Arctic ice that a telecommunication group is moving forward with a project that was unthinkable just a few years ago: laying cables under

hascanda."

The project, while still facing many significant obstacles, also serves as an example of how warming has altered the Arctic landscape in profound ways.

NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE - NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

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GALVESTON DISTRICT, CORPS OF ENGINEERS
ATTN: MS. JANELLE STOKES
P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

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# State of Louisiana

## Parish of Calcasieu

Before me, the undersigned authority, personally came and appeared JOEANN BENOIT who, being duly sworn, deposes and says: That he is the manager of the

**SOUTHWEST DAILY NEWS**

A newspaper published daily (Sunday, Tuesday, Wednesday, Thursday, Friday and Saturday) in Sulphur, Louisiana.

That the hereto attached notice was published in said newspaper in its issues dated the 01/19/10
01/20/10
01/21/10
01/22/10

NOTICE OF PUBLIC MEETING

GALVESTON DISTRICT, CORPS OF ENGINEERS

Manager, Joe Ann Benoit

Sworn and subscribed to at my office in Sulphur, Louisiana, on this 15 day of JANUARY A.D., 2010 Before me.

Linda Duggan
Notary Public
LINDA DUGGAN ID#1848

to come in a little later, but the damage is not as bad as the industry first believed, LSU AgCenter experts said.

Regina Bracy, LSU AgCenter horticulturist at the LSU AgCenter's Hammond Research Station, said the crop could be set back for nearly a month.

"It takes 21 days from flower to berry. So if the growers lose all of their flowers and berries at this time, then they will not have another crop for 21 days," she said.

"We've lost about 95 percent of the bloom crop that's out there right now and a good bit of our green berries due to cold-weather damage and the freeze," said Eric Morrow, a Ponchatoula grower with 13 acres.

William Fletcher, another Ponchatoula grower, said he lost about 80 percent of what was on the plants.

"I expect a market drop in production for about a month. If we don't see any more cold weather, production should come back," Fletcher said.

The peak season for Louisiana strawberries is usually in March and ers is November, December and January.

Bracy said Louisiana produces about 300 acres of strawberries, which is down from 1,000 acres 10 years ago.

"We're seeing the decrease in acres, but we're also seeing some young farmers coming in, and that gives us some hope that the industry is going to continue in this area," she said.

Bracy said the cold weather doesn't affect the quality of the berries if they are protected and not damaged.

"The berries that come out after this weather will be as good as any we've had," she said. "In fact, cold weather does less damage than applying too much water or having too much rain."

---

Information from: The Advocate, http://www.2theadvocate.com

of $524.04 each for deer, and $30 a lock and $2.21 a pound for alligators.

**NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION**

**Interested parties are hereby notified of and invited to attend an open house and public meeting to be conducted by the U.S. Army Corps of Engineers and the Sabine Neches Navigation District on:**

**WEDNESDAY, JANUARY 27, 2010**
**OPEN HOUSE 5:30-7:00 PM**
**PUBLIC MEETING 7:00-9:00 PM**
**(REGISTRATION BEGINS AT 5:30 PM)**

**LAKE CHARLES CIVIC CENTER**
**JEAN LAFITTE ROOM**
**700 LAKESHORE DR.**
**LAKE CHARLES, LA 70601**

**The meeting will provide an opportunity for all persons to comment on the proposed project, the ocean dredged material disposal sites (ODMDS) designation, and draft determination. Those unable to attend may find the draft project EIS, ODMDS EIS, and draft conformity determination at www.swg.usace.army.mil. Written comments with regard to the EIS and the ODMDS EIS must be postmarked by February 10, 2010. Note that written comments with regard to the draft general conformity determination must be postmarked by 30 days from the date this notice is published.**

**Comments may be mailed or emailed to:**
**GALVESTON DISTRICT, CORPS OF ENGINEERS**
**ATTN: MS. JANELLE STOKES**
**P.O. BOX 1229**
**GALVESTON, TEXAS 77553**

**Or Janelle.S.Stokes@usace.army.mil**


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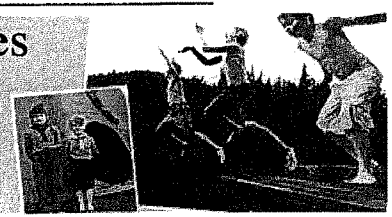
# Share your Scouting memories

This year marks the 100th anniversary of the Boy Scouts of America, and we would like you to submit your memories and photos of your Scouting days. Scouting offers adventure and a sense of service that often become the fabric of our lives. Send us your photos and stories from your Scouting days to share with the community.

SUBMIT PHOTOS & STORIES Submit your photos and Scouting memories to Southwest Daily News at 716 E. Napoleon as soon as possible, and we'll run them in our print edition and online at sdneditorial@yahoo.com



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Cyan Magenta

# Appendix C

## TCEQ General Conformity Concurrence Letter

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

April 15, 2010

Ms. Janelle Stokes
Regional Environmental Specialist
United States Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Re: General conformity concurrence for the Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

This letter provides general conformity concurrence for the proposed Sabine-Neches Waterway Channel Improvement project. The Texas Commission on Environmental Quality (TCEQ) reviewed the project in accordance with Title 40 Code of Federal Regulations Part 93, and Title 30 Texas Administrative Code (TAC) § 101.30 of the TCEQ general rules. The proposed project is located in the Beaumont-Port Arthur (BPA) area and is classified as moderate nonattainment for the 1997 ozone standard, and emissions are expected to be above the 100 tons per year *de minimis* threshold. Therefore, a general conformity analysis is required.

The TCEQ has determined, pursuant to 30 TAC §101.30(h)(1)(E)(i)(I), that emissions from the proposed project will not exceed the emissions from the applicable state implementation plan, the BPA Rate-of-Progress adopted by the TCEQ Commission on October 27, 2004, and approved by the United States Environmental Protection Agency on February 22, 2006. This general conformity determination is based upon information provided in a September 2009 Draft General Conformity Determination prepared for the U.S. Army Corps of Engineers (USACE).

In support of the ozone National Ambient Air Quality Standard, the TCEQ suggests the USACE adopt pollution prevention and/or reduction measures in conjunction with this and future projects, such as the following:

- encourage construction contractors to apply for Texas Emission Reduction Plan grants;
- establish bidding conditions that give preference to clean contractors;
- direct construction contractors to exercise air quality best management practices;
- direct contractors that will use tugboats during construction to use clean fuels;
- direct operators of the assist tugboats used in maneuvering dredge vessels to use clean fuels;
- select assist tugs based on lowest nitrogen oxides ($NO_X$) emissions instead of lowest price; or
- purchase and permanently retire surplus $NO_X$ offsets prior to commencement of operations.

Thank you for providing the necessary information and staff assistance for our review. We would also appreciate update(s), as appropriate, as this project moves forward. I look forward to working with you in the future on any upcoming projects you may have that affect air quality in your district. If you require further assistance on this matter, please contact Mr. Koy Howard at (512) 239-2306 or kohoward@tceq.state.tx.us.

Sincerely,

David Brymer, Director
Air Quality Division

DB/KH/kb

cc: Ruben Velasquez, P.E., PBS&J

# Appendix G

# Biological Assessment and Biological Opinion

# Appendix G1

# Biological Assessment

Document No. 060201
PBS&J Job No. 100007609/441206

# BIOLOGICAL ASSESSMENT FOR IMPACTS TO ENDANGERED AND THREATENED SPECIES RELATIVE TO THE SABINE-NECHES WATERWAY CHANNEL IMPROVEMENTS PROJECT TEXAS AND LOUISIANA

Prepared for:

U.S. Army Corps of Engineers
Galveston District
2000 Fort Point Road
Galveston, Texas 77550

Prepared by:

PBS&J
6504 Bridge Point Parkway
Suite 200
Austin, Texas 78730

June 2010

*Printed on recycled paper*

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**Attachments:**

A Agency Correspondence
B PBS&J 2006 Piping Plover Habitat Survey at Texas and Louisiana Points

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## Acronyms and Abbreviations

| | |
|---|---|
| °F | degrees Fahrenheit |
| AOU | American Ornithologist's Union |
| BA | Biological Assessment |
| BOOTS | Bulk Oil Offshore Transfer System |
| CFR | Code of Federal Regulations |
| DMMP | Dredged Material Management Plan |
| ESA | Endangered Species Act |
| FEIS | Final Environmental Impact Statement |
| FR | Federal Register |
| GIWW | Gulf Intracoastal Waterway |
| GSMFC | Gulf States Marine Fisheries Commission |
| Gulf | Gulf of Mexico |
| HU | Hydrologic Unit |
| HWG | Habitat Workgroup |
| ICT | Interagency Coordination Team |
| LCWCR/WCRA | Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority |
| LNHP | Louisiana Natural Heritage Program |
| LOOP | Louisiana Offshore Oil Port |
| mcy | million cubic yards |
| MLLW | mean low low water |
| NDD | Natural Diversity Database |
| NED | National Economic Development |
| NFWL | National Fish and Wildlife Laboratories |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NPS | National Park Service |
| NRC | National Research Council |
| NWI | National Wetlands Inventory |
| NWR | National Wildlife Refuge |
| ODMDS | Ocean Dredged Material Disposal Sites |
| PCE | primary constituent element |
| Plan | Recommended Plan |
| ppt | parts per thousand |
| SNWW | Sabine-Neches Waterway |
| STSSN | Sea Turtle Stranding and Salvage Network |
| TED | turtle excluder devices |
| TPWD | Texas Parks and Wildlife Department |
| USACE | U.S. Army Corps of Engineer |
| USFWS | U.S. Fish and Wildlife Service |
| VTS | vessel traffic service |
| WMA | Wildlife Management Area |

# 1.0 INTRODUCTION

## 1.1 PURPOSE OF THE BIOLOGICAL ASSESSMENT

This revised Biological Assessment (BA) has been prepared in fulfillment of the U.S. Army Corps of Engineers' (USACE) responsibilities under Section (7)(c) of the Endangered Species Act (ESA) of 1973, as amended. Originally, a proposed 48-foot deepening and widening project was coordinated with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) by letters dated February 21, 2007. The 2007 BA concluded that the 48-foot deepening and widening project was not likely to adversely affect federally listed terrestrial species or designated terrestrial critical habitat. However, since it was determined that the project could affect federally listed marine species, USACE requested initiation of formal consultation pursuant to 50 Code of Federal Regulations (CFR) 402.14 to evaluate the effects of that project on threatened and endangered sea turtles. This consultation concluded with the NMFS's issuance of a Biological Opinion, dated August 13, 2007 (Appendix G2).

For the purposes of the BA, we define the "project area" as those areas that would be directly affected by construction of the Recommended Plan (Plan). This includes the proposed dredging footprint, existing and proposed placement areas identified in the Dredged Material Management Plan (DMMP), DMMP restoration and nourishment areas, and compensatory mitigation areas (Figure 1).

The "study area" includes a larger area for which environmental effects of the Plan have been analyzed (see Figure 1). The study area encompasses a 2,000-square-mile area, which contains the smaller project area, and includes the following waterbodies and adjacent coastal wetlands: Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River channel up to the new Neches River Saltwater Barrier, the Sabine River channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf of Mexico.

The "Project" refers to the Recommended Plan of navigation improvements for a 48-foot channel. Details of the Plan are provided in Section 1.4.

The proposed Federal action (Project) requiring the assessment is the deepening of the Sabine-Neches Waterway (SNWW) in Texas and Louisiana. This BA evaluates the potential impacts the Project may have on federally listed endangered and listed species. The "Project" refers to the Recommended Plan of navigation improvements for a 48-foot channel. Details of the Plan are provided in Section 1.4 of the Final Environmental Impact Statement (FEIS).

This update is being provided because the proposed plan of navigation improvements has been modified. The proposed depth and length of the navigation improvements remain the same, but proposed widening of the Sabine Pass Jetty Channel, Sabine Pass Channel, and Port Arthur Canal has been dropped from

proposed improvements. Potential effects to federally listed species remain essentially unchanged. Modifications to the formerly proposed plan are as follows:

1. Widening the Sabine Pass Jetty Channel, the Sabine Pass Channel, and the Port Arthur Canal to 700 feet have been dropped from the plan. The current 500-foot-width and centerline of these channels would be maintained with proposed deepening.

2. Turning/Anchorage Basins 2, 3, 5, 6, and 7 have been dropped from the recommended plan. However, the project sponsor may choose to construct them at a later date, so their impacts are still being addressed by this BA and Final Environmental Impact Statement (FEIS).

3. Some components of the proposed Neches River Beneficial Use feature have been dropped or modified: Rose City West has been dropped, the size of Rose City East has been reduced, and Bessie Heights West has been dropped. There are no changes to the remaining components of the Neches River Beneficial Use Feature (Bessie Heights East and Old River Cove) or the Gulf Shore Beneficial Use Feature.

4. There are no changes to proposed marsh mitigation measures in Louisiana. However, oyster reef mitigation is no longer proposed since there would be no widening impacts.

5. There are no changes to offshore channels or Ocean Dredged Material Disposal Sites (ODMDS) disposal plans for these channels. However, the quantity of material from the Sabine Pass Jetty Channel has been reduced because widening has been dropped.

An FEIS, to which this BA is attached as an appendix, has been prepared to address the impacts of the Project.

## 1.2 PROJECT SETTING

The existing project is a 65-mile-long deep-draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont. The Channel to Orange segment of the SNWW was not included in the feasibility study, and no improvements to this waterway segment are included in the Plan. The east jetty is 4.8 miles long, while the west jetty is 4.15 miles long.

The study area (not to be confused with the project area) includes the SNWW and a much broader geographical range covering approximately 2,000 square miles inland. Due to potential additional saltwater intrusion into the Sabine Lake estuary resulting from the Project, hydrologic features associated with the SNWW and Sabine Lake are an important consideration for overall project impacts.

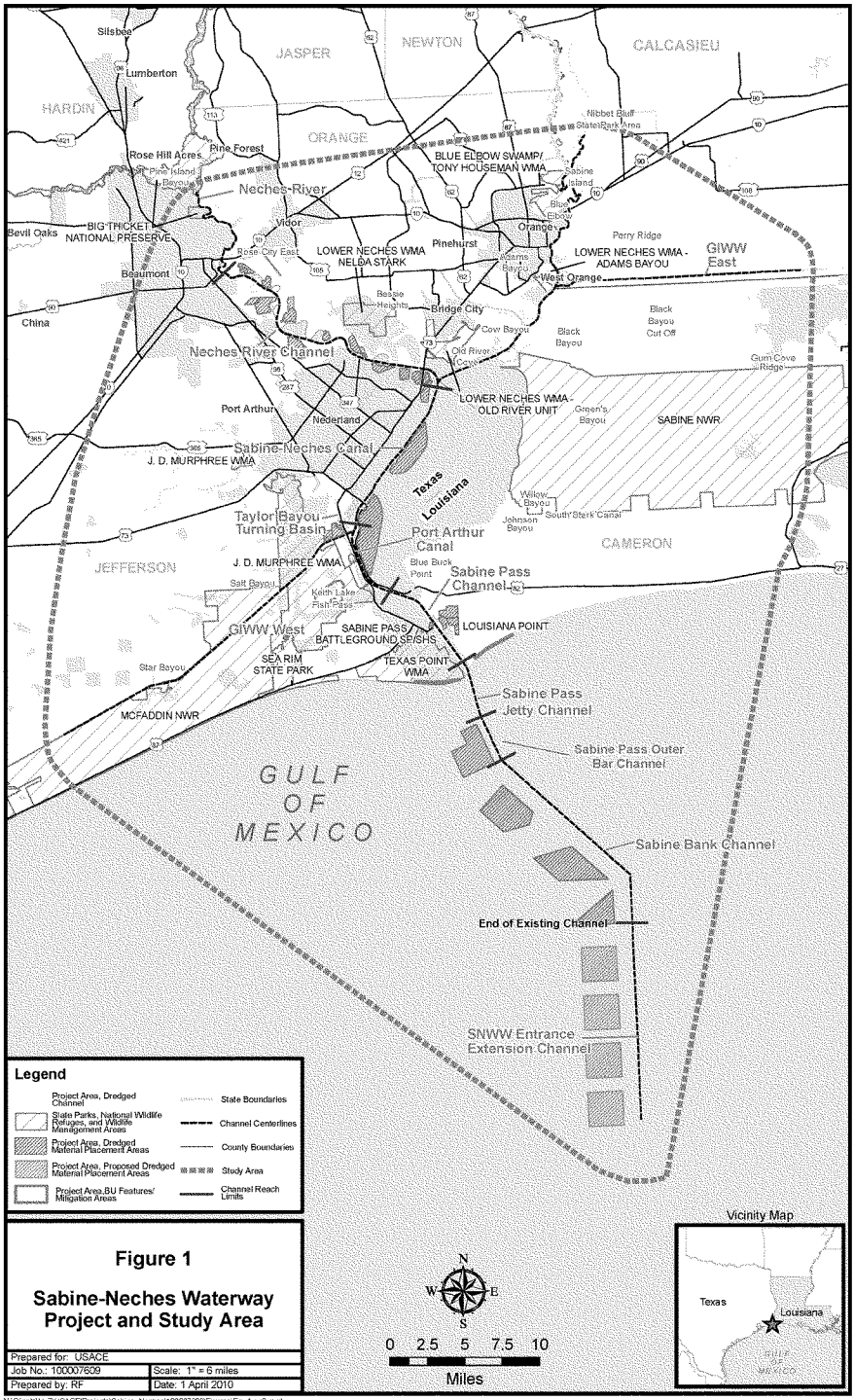


**Figure 1**

**Sabine-Neches Waterway Project and Study Area**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100007609 | Scale: 1" = 6 miles |
| Prepared by: RF | Date: 1 April 2010 |

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### 1.2.1 Study Area Habitat Description

The study area is located in the Austroriparian biotic province (Blair, 1950), which extends from east Texas, along the Gulf coastal plain, to the Atlantic coast. The study area is characterized by a diversity of features that are a result of the natural transition between marine and freshwater environments and anthropogenic impacts. The study area is located within the Gulf Coast Prairies and Marshes and Pineywoods vegetation areas (Hatch et al., 1990). The vegetation communities include marshes, swamps, bottomland hardwood forests, upland forests, and upland grassland and rangeland. The study area includes an important ecosystem called the Chenier Plain, which is composed of paleo-beach ridges that parallel the shoreline (USFWS, 1998; White et al., 1987) fanning out where they are cut by river mouths. The upland habitat of the cheniers supports the Coastal Live Oak-Sugarberry Series (*Quercus virginiana-Celtis laevigata*), a maritime woodland or forest of the Upper Gulf Coast that is unique to the Chenier Plain (USFWS, 1998). The Chenier Plain is separated from the Pleistocene Prairie Complex to the north by a broad low area, which is dominated by brackish marshes (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority [LCWCR/WCRA], 1998). Wildlife native to the study area include those that inhabit the Austroriparian Biotic Province (Blair, 1950). Diversity in the study area is high with large numbers of vertebrate and invertebrate species. The Austroriparian Biotic Province is situated in the eastern portion of Texas and extends southward to the Gulf coast and east through Louisiana to the Atlantic Ocean. The vertebrate fauna of the Austroriparian Biotic Province in Texas and Louisiana, with few exceptions, is the typical vertebrate fauna of the Austroriparian Biotic Province eastward to the Atlantic seaboard. According to Blair (1950), at least 47 species of mammals, 29 species of snakes, 10 lizards, 2 land turtles, 17 anurans, and 18 urodeles occur or have occurred there. Additional detail on project and study area habitats can be found in Section 3 of the FEIS to which this BA is appended.

## 1.3 ALTERNATIVES CONSIDERED

A lengthy array of alternatives was considered during plan formulation. The alternatives were developed from ideas provided by the public, resource agencies, USACE, and the non-Federal sponsor. Alternatives considered were the "no-action" plan, a nonstructural plan, an alternative commodity transport plan, and over 120 variations of channel depths and widths.

All of the alternatives were evaluated in terms of whether they met planning objectives and produced a positive preliminary benefit to cost ratio. Planning objectives consisted of improving the navigational efficiency and safety of the waterway, and maintaining or restoring existing coastal and estuarine resources.

### 1.3.1 No-Action Alternative

The No-Action Alternative forms the basis against which all other alternative plans are measured. Under the No-Action Alternative, the Federal Government and the non-Federal sponsor would not implement

the Project and the objectives of improving the navigational efficiency and safety of the waterway, and restoring existing coastal and estuarine resources would not be met.

The No-Action Alternative would retain the 40-x-500-foot SNWW navigation channel with no improvements. The current channel dimensions do not allow the existing fleet to use the channel efficiently. Ships are limited either by the current channel depth of 40 feet or by the narrow channel width and safety limitations, which cause the waterway to be operated with one-way and daylight-only sailing restrictions. The need to lighter products and/or light-load vessels increases overall vessel trips and shipping costs, and decreases the efficiency of the vessels using the waterway. Safety would continue to be good because of stringent pilot rules. Pilot rules would continue to limit the possibility of vessels meeting in the Sabine-Neches channel reach. Vessel and shallow-draft tow movements would be scheduled through both vessel traffic service (VTS) and communication between vessel pilots.

### 1.3.2 Nonstructural Alternative

Three Nonstructural Alternatives were evaluated: an alternative mode of commodity transport, a VTS, and modification of existing pilot rules. Offshore oil terminals were evaluated as an alternative mode of commodity transport. Economic analyses were conducted to determine if it would be more economical for the primary users of the waterway (crude oil tankers) to utilize existing or proposed deepwater ports like the Louisiana Offshore Oil Port (LOOP). The estimated cost of offshore ports has usually been so high that they are not typically considered beyond the initial planning stage. Their efficiency is diminished by their ability to serve only one commodity (i.e., crude oil) and high cost and complexity required to deal with various grades and blends of crude oil and multi-party usage. The offshore terminal alternative does not meet the efficiency objective for all waterway users and was eliminated from further consideration.

The existing Port Arthur VTS was also evaluated as a nonstructural alternative. The VTS is designed to expedite vessel movements, increase efficiency of the transportation system, improve all-weather operating capability, and enhance vessel safety. It is a voluntary system operated in accordance with U.S. Coast Guard regulations. While the VTS would relieve congestion and improve safety to some degree, its role is limited to specific circumstances when the waterway is congested or experiencing hazardous conditions. The VTS assists vessel operators in making independent decisions regarding the safe navigation of their vessels, for which they retain complete responsibility. In this sense, VTS should be considered primarily a navigational aid, a tool for mariners to use along with other tools to facilitate safe navigation, and thus would not change deep-draft navigation inefficiencies created by the need for lightering and associated vessel delays. It was also eliminated from further consideration.

Relaxation of the existing pilot rules for the waterway was considered as a nonstructural alternative. However, because of concerns about vessel handling and associated safety issues, and the fact that vessels utilizing the waterway are wider than those using the channel even 5 to 10 years ago, the Sabine Pilots Association would not consider relaxing the rules. The expectation for the with- and without-project

future is that pilot rules would continue to limit the possibility of vessel meetings in the Sabine-Neches Canal reach and that both vessel and shallow-draft tow movements would be scheduled through both VTS and communication between vessel pilots.

## 1.4 RECOMMENDED PLAN

Evaluation of various structural alternatives resulted in the selection of the 48-x-500-foot alternative as the Plan. The 48-x-500-foot alternative was recommended as the locally preferred plan as it was preferred by the project sponsor over the National Economic Development (NED) Plan (49-x-500-foot alternative). Structural modifications of the 48-x-500-foot alternative meet the planning objective for increased navigational efficiency, and DMMP restoration/nourishment features and compensatory mitigation measures have been developed, which effectively avoid and mitigate all environmental impacts. Details of the plan include (additional detail can be found in the Final Feasibility Report bound with the FEIS to which this BA is appended):

- Deepening the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont from 40 to 48 feet, plus advance maintenance and allowable overdraft. Dredging in the Sabine Pass Jetty Channel would be conducted by hopper dredge, while the remaining inshore channels would be constructed with hydraulic pipeline dredges.

- Deepening the existing SNWW Entrance Channel in the Gulf from 42 to 50 feet, plus advance maintenance and allowable overdepth, and constructing an extension of the offshore entrance channel (50 x 700 feet x 13.1 miles). Dredging would be conducted by hopper dredge. Additional details of this construction are provided below because of its potential to affected endangered sea turtles.

- Bend easings in three areas on the Sabine-Neches Canal and three areas on the Neches River Channel.

- Deepening the Taylor Bayou Navigation Channel and turning basins to 48 feet, and widening the entrance and connecting channels to improve vessel maneuverability.

- Dredging a new anchorage basin (AB 8) and two turning and anchorage basins (TAB 1 and 4) on the Neches River Channel, and reducing the existing Sabine Pass anchorage basin in size by approximately 50 percent.

- Beneficially using dredged material, as part of the DMMP, to restore three degraded marsh areas on the Neches River (Rose City East, Bessie Heights East, and Old River Cove) and nourish Gulf shorelines at Texas and Louisiana Points. Gulf shore nourishment, which affects piping plover Critical Habitat at Louisiana Point, is described in detail below. Construction of the Project would yield a total of approximately 98 million cubic yards (mcy) of new work material.

- Restoring six degraded marsh areas near Willow and Black bayous, Louisiana, as mitigation for unavoidable salinity impacts from the Project. Dedicated dredging using a hydraulic pipeline

dredge of a 2.1 miles long by 1,100-foot-wide borrow trench in Sabine Lake would provide material for the marsh restoration near Willow Bayou. Material from hydraulic pipeline maintenance dredging of the Channel to Orange would be used to restore one marsh area north of Black Bayou. Material accumulated in the GIWW/Lake Charles Deepwater Channel would be hydraulically dredged and used to restore degraded marsh areas near the Black Bayou Cut-off Canal.

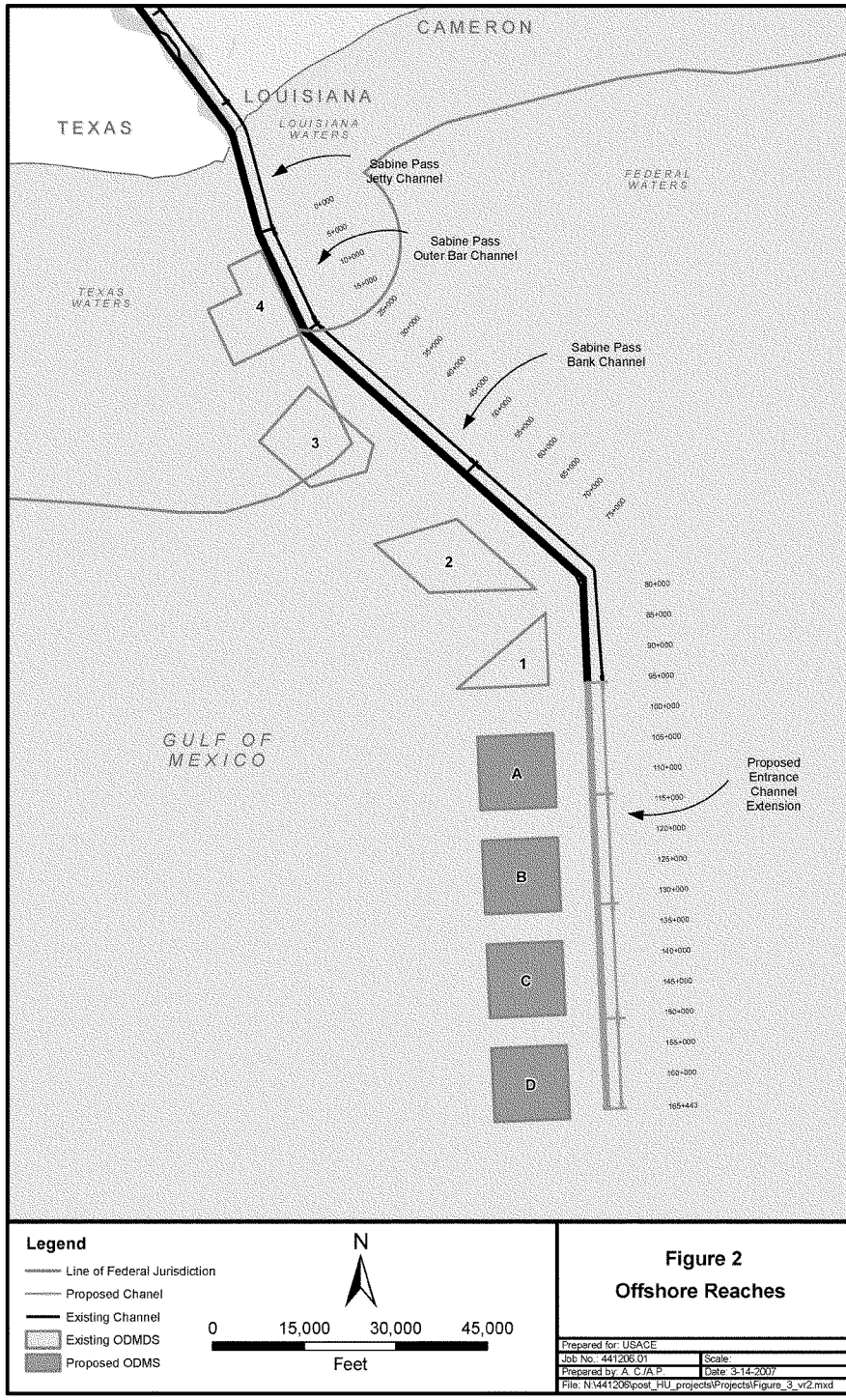
- Adding four new ODMDS sites in the Gulf along the 13-mile channel extension.
- Using 16 existing upland placement areas and 2 new expansions of existing placement areas for construction and maintenance of the Project. The quantity of maintenance material to be removed over the 50-year project life is estimated to total approximately 650 mcy.

### 1.4.1 Hopper Dredging

New work dredging in the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel would be accomplished using a hopper dredge (Figure 2). The total length of the four channel reaches is approximately 35 miles. The new Sabine Pass Jetty Channel would begin and end at approximately the same location as the existing channel. The new Sabine Pass Outer Bar Channel and the Sabine Bank Channel would begin and end at the same location as the existing channel, but the bottom width of the latter would be reduced from 800 to 700 feet. The new Extension Channel would begin at the end of the Sabine Bank Channel with a bottom width of 700 feet. The alignment would remain the same as the existing and extend at the same bearing.

With advance maintenance and allowable overdepth dredging, it is projected that construction of the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel would require approximately 6 years to complete, with no contracts running simultaneously. Because of the length of the offshore channels, the contracts would average 15 months in length.

Dredged material management for construction and maintenance material from the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel would incorporate the use of four existing and four proposed ODMDSs. Existing ODMDSs 1 through 4 average approximately 3,535 acres in size and would accommodate 24.3 mcy of new work material over the approximately 14,000 acres. They are located between 4.8 and 18.4 miles from shore in water depths ranging from 16 to 43 feet. Maintenance dredging cycles for these sites would range from 1 to 5 years, with an average of 2.6 mcy deposited per cycle. Proposed ODMDSs A through D average approximately 3,392 acres in size and would accommodate 18.7 mcy of new work material over the approximately 13,500 acres. They would be located between 21 and 30 miles from shore in water depths ranging from 44 to 46 feet. The maintenance dredging frequency for these sites is estimated to be 4 years, with an average of 0.75 mcy deposited per cycle. The existing and proposed ODMDSs are located in a dispersive


CAMERON
LOUISIANA
TEXAS
LOUISIANA WATERS
FEDERAL WATERS
TEXAS WATERS
Sabine Pass Jetty Channel
Sabine Pass Outer Bar Channel
Sabine Pass Bank Channel
Proposed Entrance Channel Extension
GULF OF MEXICO
1
2
3
4
A
B
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0+000
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Figure 2
Offshore Reaches
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environment, and therefore no long-term accumulation of dredged material would be expected. No beneficial use sites are proposed for the offshore portion of the Project.

### 1.4.2 Gulf Shoreline Nourishment

The DMMP would include Gulf shoreline nourishment at Louisiana Point and Texas Point. Over the 50-year period of analysis, beach nourishment activities using maintenance material from the adjacent Sabine Pass channel would result in the creation of new saline marsh along a 3-mile stretch of shore (mile 0.5 to 3.5) at Louisiana Point and the same at Texas Point. The placement of material from each 3-year Sabine Pass dredging cycle would alternate between Texas and Louisiana Points, so that placement of materials at each shoreline would occur every 6 years.

Historic dredging records indicate that the material from Sabine Pass would average 51 percent silt, 31 percent clay, and 18 percent sand. The material would be hydraulically pumped into the nearshore zone, and some material is expected to flow over existing marsh while the remainder flows into the nearshore waters. Marsh plantings would occur as soon as possible on the inland half of the emergent berm, to assist in stabilization. Recent experience with a similar project constructed at Texas Point indicates that the dredged material would dissipate quickly during a placement event, with 60 percent remaining and forming a shelf on the shallow nearshore slope in front of the existing marsh edge. Since the material would be unconsolidated and prone to erosion, it is estimated that 50 percent of the material that remains after each placement episode would erode away by the end of each 6-year cycle. New material added every 6 years would add to the remaining sediment, eventually accumulating to form new saline marsh by the end of the period of analysis at each Point.

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# 2.0 STATUS OF THE LISTED SPECIES

To assess the potential impacts of the proposed Project on endangered and threatened species, PBS&J personnel (1) conducted a literature review and searched for other scientific data to determine species distributions, habitat needs, and other biological requirements; (2) interviewed recognized experts on the listed species, including local and regional authorities and Federal (USFWS [Clear Lake and Lafayette Ecological Field Offices] and NMFS) and State (Texas Parks and Wildlife Department [TPWD] and Louisiana Natural Heritage Program [LNHP]) wildlife personnel; (3) conducted an on-site inspection of the biological resources of the project area; and (4) compiled lists of threatened and endangered species that were requested from USFWS and NMFS (Table 1).

Significant literature sources consulted for this report include the USFWS series on endangered species of the seacoast of the U.S. (National Fish and Wildlife Laboratories [NFWL], 1980), Federal status reports and recovery plans, job reports of the TPWD, peer-reviewed journals, and other standard references, including USFWS and NMFS websites for listed species by county or parish. Habitat assessments were initially based on aerial photography and National Wetlands Inventory (NWI) mapping and then field-verified. Field visits were conducted on various occasions by PBS&J ecologists and members of the Habitat Workgroup (HWG) of the Interagency Coordination Team (ICT). Input was also solicited from State and Federal resource agency personnel and from personnel from Federal National Wildlife Refuge (NWR) and State WMAs in the area.

## 2.1 LOGGERHEAD SEA TURTLE

### 2.1.1 Reasons for Status

USFWS listed the loggerhead sea turtle (*Caretta caretta*) as threatened throughout its range on July 28, 1978 (43 Federal Register [FR] 32808). The decline of the loggerhead, like that of most sea turtles, is the result of overexploitation by man, inadvertent mortality associated with fishing and trawling activities, and natural predation. The most significant threats to its population are coastal development, commercial fisheries, and pollution (NMFS, 2006a).

### 2.1.2 Habitat

The loggerhead occurs in the open seas as far as 500 miles from shore, but mainly over the continental shelf, and in bays, estuaries, lagoons, creeks, and mouths of rivers. It favors warm temperate and subtropical regions not far from shorelines. The adults occupy various habitats, from turbid bays to clear waters of reefs. Subadults occur mainly in nearshore and estuarine waters. Hatchlings move directly to sea after hatching, and often float in masses of sargassum. They may remain associated with sargassum for perhaps 3 to 5 years (NMFS and USFWS, 1991a).

TABLE 1

FEDERALLY LISTED ENDANGERED AND THREATENED
FISH AND WILDLIFE SPECIES OF POSSIBLE OCCURRENCE IN
JEFFERSON AND ORANGE COUNTIES, TEXAS
AND
CALCASIEU AND CAMERON PARISHES, LOUISIANA[1]

| Common Name[2] | Scientific Name[2] | Status[3] | Jurisdiction |
|---|---|---|---|
| **REPTILES** | | | |
| Leatherback sea turtle | *Dermochelys coriacea* | E | NMFS |
| Atlantic hawksbill sea turtle | *Eretmochelys imbricata imbricata* | E | NMFS |
| Kemp's ridley sea turtle | *Lepidochelys kempii* | E | NMFS |
| Loggerhead sea turtle | *Caretta caretta* | T | NMFS |
| Green sea turtle | *Chelonia mydas* | T | NMFS |
| **BIRDS** | | | |
| Piping plover | *Charadrius melodus* | T w/CH | FWS |
| Red-cockaded woodpecker | *Picoides borealis* | E | FWS |
| **MAMMALS** | | | |
| Red wolf (Extirpated) | *Canis rufus* | E | FWS |
| Sei whale | *Balaenoptera borealis* | E | FWS |
| Blue whale | *Balaenoptera musculus* | E | FWS |
| Finback whale | *Balaenoptera physalus* | E | FWS |
| Humpback whale | *Megaptera novaeangliae* | E | FWS |
| Sperm whale | *Physeter macrocephalus* | E | FWS |
| West Indian manatee | *Trichechus manatus* | E | FWS |
| Louisiana black bear | *Ursus americanus luteolus* | E | FWS |
| Black bear | *Ursus americanus* | T/SA; NL | FWS |
| **FISHES** | | | |
| Gulf sturgeon | *Acipenser oxyrinchus desotoi* | T | NMFS |
| Dusky shark | *Carcharhinus obscurus* | SOC | NMFS |
| Sand tiger shark | *Carcharias taurus* | SOC | NMFS |
| Night shark | *Carcharhinus signatus* | SOC | NMFS |
| Saltmarsh topminnow | *Fundulus jenkinsi* | SOC | NMFS |
| Warsaw grouper | *Epinephelus nigritus* | SOC | NMFS |
| Speckled hind | *Epinephelus drummondhayi* | SOC | NMFS |
| Smalltooth sawfish | *Pristis pectinata* | E | NMFS |
| **INVERTEBRATES** | | | |
| Elkhorn coral | *Acropora palmata* | T | NMFS |
| Staghorn coral | *Acropora cervicornis* | T | NMFS |
| Ivory tree coral | *Oculina varicosa* | SOC | NMFS |

[1] According to Natural Diversity Database (NDD, 2005a, 2005b), NMFS (2009), USFWS (2009).

[2] Nomenclature follows American Ornithologist's Union (AOU, 1998, 2000, 2002, 2003, 2004, 2005, 2006), Crother et al. (2000, 2001, 2003), NDD (2005a, 2005b), and USFWS (2005, 2006).

[3] FWS – U.S. Fish and Wildlife Service; NMFS – National Marine Fisheries Service.

E – Endangered; E w/CH – Endangered, with Critical Habitat; T – Threatened; DL – Federally delisted; NL – Not listed; T/SA – Threatened because of similarity of appearance to another threatened/endangered species; T w/CH - Threatened, with Critical Habitat; SOC – Species of Concern.

Commensurate with their use of varied habitats, loggerheads consume a wide variety of both benthic and pelagic food items, which they crush before swallowing. Conches, shellfish, horseshoe crabs, prawns and other crustacea, squid, sponges, jellyfish, basket stars, fish (carrion or slow-moving species), and even hatchling loggerheads have all been recorded as loggerhead prey (Hughes, 1974; Rebel, 1974; Mortimer, 1982). Adults forage primarily on the bottom, but also take jellyfish from the surface. The young feed on prey concentrated at the surface, such as gastropods, fragments of crustaceans, and sargassum.

Nesting occurs usually on open sandy beaches above the high-tide mark and seaward of well-developed dunes. They nest primarily on high-energy beaches on barrier islands adjacent to continental land masses in warm-temperate and subtropical regions. Steeply sloped beaches with gradually sloped offshore approaches are favored. In Florida, nesting on urban beaches was strongly correlated with the presence of tall objects (trees or buildings), which apparently shield the beach from city lights (Salmon et al., 1995).

### 2.1.3 Range

The loggerhead is widely distributed in tropical and subtropical seas, being found in the Atlantic Ocean from Nova Scotia to Argentina, Gulf of Mexico, Indian and Pacific oceans (although it is rare in the eastern and central Pacific), and the Mediterranean Sea (Rebel, 1974; Ross, 1982; Iverson, 1986). In the continental U.S., loggerheads nest along the Atlantic coast from Florida to as far north as New Jersey (Musick, 1979) and sporadically along the Gulf Coast. In recent years, a few have nested on barrier islands along the Texas coast. The loggerhead is the most abundant sea turtle species in U.S. coastal waters (NMFS, 2006a).

### 2.1.4 Distribution in Texas and Louisiana

The loggerhead is the most abundant turtle in Texas marine waters, preferring shallow inner continental shelf waters, and occurring only very infrequently in the bays. It often occurs near offshore oil rig platforms, reefs, and jetties. Loggerheads are probably present year-round but are most noticeable in the spring when a favored food item, the Portuguese man-of-war (*Physalia physalis*), is abundant. Loggerheads constitute a major portion of the dead or moribund turtles washed ashore (stranded) on the Texas coast each year. This species has also been stranded on the Louisiana coast (Sea Turtle Stranding and Salvage Network [STSSN], 2006). A large proportion of these deaths are the result of accidental capture by shrimp trawlers, where caught turtles drown and their bodies are dumped overboard. Before 1977, no positive documentation of loggerhead nests in Texas existed (Hildebrand, 1982). Since that time, several nests have been recorded along the Texas coast. In 1999, two loggerhead nests were confirmed in Texas, while in 2000, five loggerhead nests were confirmed (Shaver, 2000). For the last 5 years, up to five nests per year have been recorded from the Texas coast (Shaver, 2006). Like the worldwide population, the population of loggerheads in Texas has declined. Prior to World War I, the species was taken in Texas for local consumption and a few were marketed (Hildebrand, 1982). Today, even with protection, insufficient loggerheads exist to support a fishery. The loggerhead is the second most abundant sea turtle in Louisiana (Fuller et al., 1987).

### 2.1.5 Presence in the Study Area

There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of loggerheads exist from Jefferson County, Texas (Dixon, 2000). It is of potential occurrence in the project area.

## 2.2 KEMP'S RIDLEY SEA TURTLE

### 2.2.1 Reasons for Status

Kemp's ridley sea turtle (*Lepidochelys kempii*) was listed as endangered throughout its range on December 2, 1970 (35 FR 18320). Populations of this species have declined since 1947, when an estimated 42,000 females nested in one day (Hildebrand, 1963), to a total nesting population of approximately 1,000 in the mid-1980s. The decline of this species was primarily due to human activities including collection of eggs, fishing for juveniles and adults, killing adults for meat and other products, and direct take for indigenous use. In addition to these sources of mortality, Kemp's ridleys have been subject to high levels of incidental take by shrimp trawlers (USFWS and NMFS, 1992; NMFS, 2006a). The National Research Council's (NRC) Committee on Sea Turtle Conservation estimated in 1990 that 86 percent of the human-caused deaths of juvenile and adult loggerheads and Kemp's ridleys resulted from shrimp trawling (Campbell, 1995). It is estimated that before the implementation of turtle excluder devices (TED) the commercial shrimp fleet killed between 500 and 5,000 Kemp's ridleys each year (NMFS, 2006a). Kemp's ridleys have also been taken by pound nets, gill nets, hook and line, crab traps, and longlines.

Another problem shared by adult and juvenile sea turtles is the ingestion of man-made debris and garbage. Postmortem examinations of sea turtles found stranded on the south Texas coast from 1986 through 1988 revealed 54 percent (60 of the 111 examined) of the sea turtles had eaten some type of marine debris. Plastic materials were most frequently ingested and included pieces of plastic bags, Styrofoam, plastic pellets, balloons, rope, and fishing line. Nonplastic debris such as glass, tar, and aluminum foil were also ingested by the sea turtles examined. Much of this debris comes from offshore oil rigs, cargo ships, commercial and recreational fishing boats, research vessels, naval ships, and other vessels operating in the Gulf. Laws enacted during the late 1980s to regulate this dumping are difficult to enforce over vast expanses of water. In addition to trash, pollution from heavy spills of oil or waste products pose additional threats (Campbell, 1995).

Further threats to this species include collisions with boats, explosives used to remove oil rigs, and entrapment in coastal power plant intake pipes (Campbell, 1995). Dredging operations affect Kemp's ridley turtles through incidental take and by degrading the habitat. Incidental take of ridleys has been documented with hopper dredges. In addition to direct take, channelization of the inshore and nearshore areas can degrade foraging and migratory habitat through dredged material placement, degraded water quality/clarity, and altered current flow (USFWS and NMFS, 1992).

Sea turtles are especially subject to human impacts during the time the females come ashore for nesting. Modifications to nesting areas can have a devastating effect on sea turtle populations. In many cases, prime sea turtle nesting sites are also prime real estate. If a nesting site has been disturbed or destroyed, female turtles may nest in inferior locations where the hatchlings are less likely to survive, or they may not lay any eggs at all. Artificial lighting from developed beachfront areas often disorients nesting females and hatchling sea turtles, causing them to head inland by mistake, often with fatal results. Adult females also may avoid brightly lit areas that would otherwise provide suitable nesting sites.

Kemp's ridley appears to be in the earliest stages of recovery. Approximately 6,000 Kemp's ridley nests were recorded on Mexican beaches during the 2000 nesting season (Shaver, 2000); just over 10,000 nests were recorded there during the 2005 nesting season (Shaver, 2006). Similarly, increased nesting activity has been recorded on the Texas beaches in the last decade or so from four nests in 1995 to 51 nests in 2005 (National Park Service [NPS], 2006; Shaver, 2006). Some of these nests were from headstarted ridleys. Of 46 Kemp's ridley nests encountered in the continental U.S. during 2004, 42 were on Texas beaches (NPS, 2006). The increase likely can be attributed to two primary factors: full protection of nesting females and their nests in Mexico, and the requirement to use TEDs in shrimp trawls both in the U.S. and in Mexico (NMFS, 2006a).

### 2.2.2 Habitat

Kemp's ridleys inhabit shallow coastal and estuarine waters, usually over sand or mud bottoms. Adults are primarily shallow-water benthic feeders that specialize on crabs, especially portunid crabs, while juveniles feed on sargassum (*Sargassum* sp.) and associated infauna, and other epipelagic species of the Gulf (USFWS and NMFS, 1992). In some regions the blue crab (*Callinectes sapidus*) is the most common food item of adults and juveniles. Other food items include shrimp, snails, bivalves, sea urchins, jellyfish, sea stars, fish, and occasional marine plants (Pritchard and Marquez, 1973; Shaver, 1991; Campbell, 1995).

### 2.2.3 Range

Adults are primarily restricted to the Gulf, although juveniles may range throughout the Atlantic Ocean since they have been observed as far north as Nova Scotia (Musick, 1979) and in coastal waters of Europe (Brongersma, 1972). Important foraging areas include Campeche Bay, Mexico, and Louisiana coastal waters.

Almost the entire population of Kemp's ridleys nests on an 11-mile stretch of coastline near Rancho Nuevo, Tamaulipas, Mexico, approximately 190 miles south of the Rio Grande. A secondary nesting area occurs at Tuxpan, Veracruz, and sporadic nesting has been reported from Mustang Island, Texas, southward to Isla Aquada, Campeche. Several scattered isolated nesting attempts have occurred from North Carolina to Colombia.

Because of the dangerous population decline at the time, a head-starting program was carried out from 1978 to 1988. Eggs were collected from Rancho Nuevo and placed into polystyrene foam boxes containing Padre Island sand so that the eggs never touched the Ranch Nuevo sand. The eggs were flown to the U.S. and placed in a hatchery on Padre Island and incubated. The resulting hatchlings were allowed to crawl over the Padre Island beaches into the surf for imprinting purposes before being recovered from the surf and taken to Galveston for rearing. They were fed a diet of high-protein commercial floating pellets for 7 to 15 months before being released into Texas (mainly) or Florida waters (Caillouet et al., 1995). This program has shown some results. The first nesting from one of these headstarted individuals occurred at Padre Island in 1996, and more nesting has occurred since (Shaver, 2000).

### 2.2.4 Distribution in Texas and Louisiana

Kemp's ridley occurs in Texas in small numbers and in many cases may well be in transit between crustacean-rich feeding areas in the northern Gulf and breeding grounds in Mexico. It has nested sporadically in Texas in the last 50 years. Nests were found near Yarborough Pass in 1948 and 1950, and in 1960 a single nest was located at Port Aransas. The number of nestings, however, has increased in recent years: 1995 (4 nests); 1996 (6 nests); 1997 (9 nests); 1998 (13 nests); 1999 (16 nests); 2000 (12 nests); 2001 (8 nests); 2002 (38 nests); 2003 (19 nests); 2004 (42 nests); and 2005 (51 nests) (Shaver, 2000, 2006; NPS, 2006). As noted above, some of these nests were from headstarted ridleys. Of the 51 Kemp's ridley nests recorded for Texas in 2005, 28 were at the Padre Island National Seashore (Shaver, 2006). Such nestings, together with the proximity of the Rancho Nuevo rookery, probably account for the occurrence of hatchlings and subadults in Texas. According to Hildebrand (1982, 1986, 1987), sporadic ridley nesting in Texas has always been the case. This is in direct contradiction, however, to Lund (1974), who believed that Padre Island historically supported large numbers of nesting Kemp's ridleys, but that the population became extirpated because of excessive egg collection. Kemp's ridley also occurs in small numbers in Louisiana; however, it is the most frequently reported sea turtle species (Fuller et al., 1987).

### 2.2.5 Presence in the Study Area

There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of Kemp's ridleys exist from Jefferson County, Texas (Dixon, 2000). Thus, it is of potential occurrence in the project area.

## 2.3 HAWKSBILL SEA TURTLE

### 2.3.1 Reasons for Status

The hawksbill sea turtle (*Eretmochelys imbricata*) was federally listed as endangered on June 2, 1970 (35 FR 8495) with Critical Habitat designated in Puerto Rico on May 24, 1978 (43 FR 22224). The greatest threat to this species is harvest to supply the market for tortoiseshell and stuffed turtle curios (Meylan and Donnelly, 1999). Hawksbill shell (bekko) commands high prices. Japanese imports of raw bekko between

1970 and 1989 totaled 713,850 kilograms, representing more than 670,000 turtles. The hawksbill is also used in the manufacture of leather, oil, perfume, and cosmetics (NMFS, 2006a).

Other threats include destruction of breeding locations by beach development, incidental take in lobster and Caribbean reef fish fisheries, pollution by petroleum products (especially oil tanker discharges), entanglement in persistent marine debris (Meylan, 1992), and predation on eggs and hatchlings. See USFWS (1998) for detailed information on certain threats, including beach erosion, beach armoring, beach nourishment, sand mining, artificial lighting, beach cleaning, increased human presence, recreational beach equipment, predation, and poaching.

In 1998, NMFS designated Critical Habitat near Isla Mona and Isla Monito, Puerto Rico, seaward to 3.9 miles (63 FR 46693–46701). There is no Critical Habitat within the study area.

### 2.3.2 Habitat

Hawksbills generally inhabit coastal reefs, bays, rocky areas, passes, estuaries, and lagoons, where they occur at depths of less than 70 feet. Like some other sea turtle species, hatchlings are sometimes found floating in masses of marine plants (e.g., sargassum rafts) in the open ocean (NFWL, 1980). Hawksbills reenter coastal waters when they reach a carapace length of approximately 7.9 to 9.8 inches. Coral reefs are widely recognized as the resident foraging habitat of juveniles, subadults, and adults. This habitat association is undoubtedly related to their diet of sponges, which need solid substrate for attachment. Hawksbills also occur around rocky outcrops and high-energy shoals, which are also optimum sites for sponge growth. In Texas, juvenile hawksbills are associated with stone jetties (NMFS, 2006a).

While this species is omnivorous, it prefers invertebrates, especially encrusting organisms, such as sponges, tunicates, bryozoans, mollusks, corals, barnacles, and sea urchins. Pelagic species consumed include jellyfish and fish, and plant material such as algae, sea grasses, and mangroves, have been reported as food items for this turtle (Carr, 1952; Rebel, 1974; Pritchard, 1977; Musick, 1979; Mortimer, 1982). The young are reported to be somewhat more herbivorous than adults (Ernst and Barbour, 1972).

Terrestrial habitat is typically limited to nesting activities. The hawksbill, which is typically a solitary nester, nests on undisturbed, deep-sand beaches, from high-energy ocean beaches to tiny pocket beaches about 10 feet wide bounded by crevices of cliff walls. Typically, the sand beaches are low energy, with woody vegetation, such as sea grape (*Coccoloba uvifera*), near the waterline (NRC, 1990).

### 2.3.3 Range

The hawksbill is circumtropical, occurring in tropical and subtropical seas of the Atlantic, Pacific, and Indian oceans (Witzell, 1983). This species is probably the most tropical of all marine turtles, although it does occur in many temperate regions. The hawksbill sea turtle is widely distributed in the Caribbean Sea and western Atlantic Ocean, with representatives of at least some life history stages regularly occurring in southern Florida and the northern Gulf (especially Texas), south to Brazil (NMFS, 2006a). In the

continental U.S., the hawksbill largely nests in Florida where it is sporadic at best (NFWL, 1980). However, a major nesting beach exists on Mona Island, Puerto Rico. Elsewhere in the western Atlantic, hawksbills nest in small numbers along the Gulf Coast of Mexico, the West Indies, and along the Caribbean coasts of Central and South America (Musick, 1979).

### 2.3.4 Distribution in Texas and Louisiana

Texas is the only state outside of Florida where hawksbills are sighted with any regularity. Most of these sightings involve posthatchlings and juveniles, and are primarily associated with stone jetties. These small turtles are believed to originate from nesting beaches in Mexico (NMFS, 2006a). On June 13, 1998, the first hawksbill nest recorded on the Texas coast was found at Padre Island National Seashore. This nest remains the only documented hawksbill nest on the Texas coast (NPS, 2006; Shaver, 2006). The hawksbill has been reported from Louisiana, but it is rare (Fuller et al., 1987).

### 2.3.5 Presence in the Study Area

There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), and no documented records of hawksbills exist from Jefferson or Orange counties, Texas (Dixon, 2000), and they are not expected to be present in the project area.

## 2.4 GREEN SEA TURTLE

### 2.4.1 Reasons for Status

The green sea turtle (*Chelonia mydas*) was listed on July 28, 1978, as threatened except for Florida and the Pacific Coast of Mexico (including the Gulf of California) where it was listed as endangered (43 FR 32808). The greatest cause of decline in green sea turtle populations is commercial harvest for eggs and food. Other turtle parts are used for leather and jewelry, and small turtles are sometimes stuffed for curios. Incidental catch during commercial shrimp trawling is a continued source of mortality that adversely affects recovery. It is estimated that before the implementation of TED requirements, the offshore commercial shrimp fleet captured about 925 green sea turtles a year, of which approximately 225 would die. Most turtles killed are juveniles and subadults. Various other fishing operations also negatively affect this species (NMFS, 2006a). Epidemic outbreaks of fibropapilloma or "tumor" infections recently have occurred on green sea turtles, especially in Hawaii and Florida, posing a severe threat. The cause of these outbreaks is largely unknown, but it could be caused by a viral infection (Barrett, 1996). This species is also subject to various negative impacts shared by sea turtles in general.

### 2.4.2 Habitat

The green sea turtle primarily utilizes shallow habitats such as lagoons, bays, inlets, shoals, estuaries, and other areas with an abundance of marine algae and seagrasses. Individuals observed in the open ocean are believed to be migrants en route to feeding grounds or nesting beaches (Meylan, 1982). Hatchlings often

float in masses of sea plants (e.g., rafts of sargassum) in convergence zones. Coral reefs and rocky outcrops near feeding pastures often are used as resting areas. The adults are primarily herbivorous, while the juveniles consume more invertebrates. Foods consumed include seagrasses, macroalgae, and other marine plants, mollusks, sponges, crustaceans, and jellyfish (Mortimer, 1982; Derek Green, unpubl. data).

Terrestrial habitat is typically limited to nesting activities, although in some areas, such as Hawaii and the Galápagos Islands, they will bask on beaches (Balazs, 1980; Green, unpubl. data). They prefer high-energy beaches with deep sand, which may be coarse to fine, with little organic content. At least in some regions, they generally nest consistently at the same beach, which is apparently their natal beach (Meylan et al., 1990; Allard et al., 1994), although an individual might switch to a different nesting beach within a single nesting season (Derek Green, unpubl. data).

### 2.4.3 Range

The green sea turtle is a circumglobal species in tropical and subtropical waters. In U.S. Atlantic waters, it occurs around the U.S. Virgin Islands, Puerto Rico, and continental U.S. from Massachusetts to Texas. Major nesting activity occurs on Ascension Island, Aves Island (Venezuela), Costa Rica, and in Surinam. Relatively small numbers nest in Florida, with even smaller numbers in Georgia, North Carolina, and Texas (NMFS and USFWS, 1991b; Hirth, 1997).

### 2.4.4 Distribution in Texas and Louisiana

The green sea turtle in Texas inhabits shallow bays and estuaries where its principal foods, the various marine grasses, grow (Bartlett and Bartlett, 1999). Its population in Texas has suffered a decline similar to that of its world population. In the mid to late nineteenth century, Texas waters supported a green sea turtle fishery. Most of the turtles were caught in Matagorda Bay, Aransas Bay, and the lower Laguna Madre, although a few also came from Galveston Bay. Many live turtles were shipped to places such as New Orleans or New York and from there to other areas. Others were processed into canned products such as meat or soup prior to shipment. By 1900, however, the fishery had virtually ceased to exist. Turtles continued to be hunted sporadically for a while, the last Texas turtler hanging up his nets in 1935. Incidental catches by anglers and shrimpers were sometimes marketed prior to 1963, when it became illegal to do so (Hildebrand, 1982).

Green sea turtles still occur in these same bays today but in much-reduced numbers (Hildebrand, 1982). While green sea turtles prefer to inhabit bays with seagrass meadows, they may also be found in bays that are devoid of seagrasses. The green sea turtles in these Texas bays are mainly small juveniles. Adults, juveniles, and even hatchlings are occasionally caught on trotlines or by offshore shrimpers or are washed ashore in a moribund condition.

Green sea turtle nests are rare in Texas. Five nests were recorded at the Padre Island National Seashore in 1998, none in 1999, and one in 2000 (Shaver, 2000; NPS, 2006). For the last 5 years, up to five nests per year have been recorded from the Texas coast (Shaver, 2006). Green sea turtles, however, nest more in

Florida and in Mexico. Since long migrations of green sea turtles from their nesting beaches to distant feeding grounds are well documented (Meylan, 1982; Green, 1984), the adult green sea turtles occurring in Texas may be either at their feeding grounds or in the process of migrating to or from their nesting beaches. The juveniles frequenting the seagrass meadows of the bay areas may remain there until they move to other feeding grounds or, perhaps, once having attained sexual maturity, return to their natal beaches outside of Texas to nest. Green sea turtles are uncommon in Louisiana. Most of the reported sightings are of juveniles (Fuller et al., 1987).

### 2.4.5 Presence in the Study Area

There are no records of green sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of green sea turtles exist from Jefferson County, Texas (Dixon, 2000). It is of potential occurrence in the project area.

## 2.5 LEATHERBACK SEA TURTLE

### 2.5.1 Reasons for Status

The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered throughout its range on June 2, 1970 (35 FR 8495), with Critical Habitat designated in the U.S. Virgin Islands on September 26, 1978 and March 23, 1979 (43 FR 43688–43689 and 44 FR 17710–17712, respectively). Its decline is attributable to overexploitation by man and incidental mortality associated with commercial shrimping and fishing activities. Use of turtle meat for fish bait and the consumption of litter by turtles are also causes of mortality, the latter phenomenon apparently occurring when plastic is mistaken for jellyfish (Rebel, 1974). Nesting populations of leatherback sea turtles are especially difficult to estimate because the females frequently change nesting beaches; however, Spotila et al. (1996) estimated the 1995 worldwide population of nesting female leatherbacks at 26,000 to 42,000. The major threat is egg collecting, although they are jeopardized to some extent by destruction or degradation of nesting habitat (NatureServe, 2006). This species is probably more susceptible than other turtles to drowning in shrimp trawlers equipped with TEDs because adult leatherbacks are too large to pass through the TED exit opening. Because leatherbacks nest in the tropics during hurricane season, a potential exists for storm-generated waves and wind to erode nesting beaches, resulting in nest loss (NMFS and USFWS, 1992).

Critical Habitat for the leatherback sea turtle includes St. Croix, Virgin Islands; Santa Rosa NP., Costa Rica; and sites in Mexico. NMFS (FR, May 12, 1995) established a leatherback conservation zone extending from Cape Canaveral to the Virginia-North Carolina border and including all inshore and offshore waters; this zone is subject to shrimping closures when high abundance of leatherbacks is documented. Mortality associated with the swordfish gillnet fisheries in Peru and Chile represents the single largest source of mortality for East Pacific leatherbacks (Eckert and Sarti, 1997).

### 2.5.2 Habitat

The leatherback sea turtle is mainly pelagic, inhabiting the open ocean, and seldom approaches land except for nesting (Eckert, 1992). It is most often found in coastal waters only when nesting or when following concentrations of jellyfish (TPWD, 2006), when it can be found in inshore waters, bays, and estuaries. It dives almost continuously, often to great depths.

Despite their large size, the diet of leatherbacks consists largely of jellyfish and sea squirts. They also consume sea urchins, squid, crustaceans, fish, blue-green algae, and floating seaweed (NFWL, 1980). The leatherback typically nests on beaches with a deepwater approach (Pritchard, 1971).

### 2.5.3 Range

The leatherback is probably the most wide-ranging of all sea turtle species. It occurs in the Atlantic, Pacific, and Indian oceans; as far north as British Columbia, Newfoundland, Great Britain, and Norway; as far south as Australia, Cape of Good Hope, and Argentina; and in other water bodies such as the Mediterranean Sea (NFWL, 1980). Leatherbacks nest primarily in tropical regions; major nesting beaches include Malaysia, Mexico, French Guiana, Surinam, Costa Rica, and Trinidad (Ross, 1982). Leatherbacks nest only sporadically in some of the Atlantic and Gulf states of the continental U.S., with one nesting reported as far north as North Carolina (Schwartz, 1976). In the Atlantic and Caribbean, the largest nesting assemblages occur in the U.S. Virgin Islands, Puerto Rico, and Florida (NMFS, 2006a).

The leatherback migrates farther and ventures into colder water than any other marine reptile. Adults appear to engage in routine migrations between boreal, temperate, and tropical waters, presumably to optimize both foraging and nesting opportunities. The longest-known movement is that of an adult female that traveled 3,666 miles to Ghana, West Africa, after nesting in Surinam (NMFS and USFWS, 1992). During the summer, leatherbacks tend to occur along the East Coast of the U.S. from the Gulf of Maine south to the middle of Florida.

### 2.5.4 Distribution in Texas and Louisiana

Apart from occasional feeding aggregations such as the large one of 100 animals reported by Leary (1957) off Port Aransas in December 1956, or possible concentrations in the Brownsville Eddy in winter (Hildebrand, 1983), leatherbacks are rare along the Texas coast, tending to keep to deeper offshore waters where their primary food source, jellyfish, occurs. In the Gulf, the leatherback is often associated with two species of jellyfish: the cabbagehead (*Stomolophus* sp.) and the moon jellyfish (*Aurelia* sp.) (NMFS and USFWS, 1992). According to USFWS (1981), leatherbacks never have been common in Texas waters. No nests of this species have been recorded in Texas for at least 70 years (NPS, 2006). The last two, one from the late 1920s and one from the mid-1930s, were both from Padre Island (Hildebrand, 1982, 1986). Leatherbacks in Louisiana are rare and restricted to offshore waters (Fuller et al., 1987).

### 2.5.5 Presence in the Study Area

There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of leatherbacks exist from Jefferson County, Texas (Dixon, 2000); however, the species is unlikely to occur in the project area since only one has been captured by a relocation trawler (1.5 miles offshore of Aransas Pass), and there is no record of a take by a hopper dredge (NMFS, 2003).

## 2.6 RED-COCKADED WOODPECKER

### 2.6.1 Reason for Status

USFWS listed the red-cockaded woodpecker (*Picoides borealis*) as endangered on October 13, 1970 (35 FR 16047–16048). Reasons for listing included its perceived rarity, documented declines in local populations, and reductions in available nesting habitat (USFWS, 1985). The primary impacts of human activity include cavity tree and foraging habitat loss resulting from short-rotation, even-aged forest management, conversion of forest (i.e., conversion from forest to nonforest and conversion from longleaf pine to slash pine), and suppression of fires (Jackson, 1994).

Logging is the primary reason for the initial decline in suitable habitat. Subsequently, fire suppression and silvicultural practices resulted in further declines of remnant habitat. These have led to hardwood encroachment and increases in suboptimal pine species within the species range. The overall lack of suitable habitat has now resulted in insufficient numbers of cavities and cavity trees; habitat fragmentation and a subsequent reduction in genetic variation, dispersal, and demography; lack of foraging habitat; and increased vulnerability to random demographic, environmental, genetic, and catastrophic events (USFWS, 2003).

### 2.6.2 Habitat

Red-cockaded woodpeckers require mature open pine forest naturally maintained by periodic wildfire, a habitat that has declined over much of the species' range. Common species occurring in suitable habitat include longleaf pine (*Pinus palustris*), loblolly pine (*Pinus taeda*), slash pine (*Pinus elliottii*), shortleaf pine (*Pinus echinata*), Virginia pine (*Pinus virginiana*), pond pine (*Pinus serotina*), and pitch pine (*Pinus rigida*). Cavity trees must be within open stands containing little to no hardwood midstory or overstory. The species depends on live mature pines for excavating cavities. Mature pines have the sufficient heartwood necessary to house a cavity at the preferred heights and are more likely to have red heart fungus, an infection that helps facilitate cavity excavation (USFWS, 2003). Live trees are critical to the species, as they produce large amounts of resin, which exudes following excavation and acts as a barrier to predators, particularly snakes (USFWS, 2003). Suitable foraging habitat consists of mature pines with an open canopy and little to no hardwood or pines in the midstory, little to no overstory hardwoods, and an abundance of native bunchgrass and/or forb groundcover (USFWS, 2003).

### 2.6.3 Range

Red-cockaded woodpeckers historically ranged throughout the southeastern U.S., from New Jersey and Pennsylvania, south and west to Missouri and southeastern Oklahoma (USFWS, 1985; Jackson, 1994). Today the species is still rather widespread, although populations are highly fragmented. The species' current range includes all southern and southeastern coastal states from eastern Texas to southern Virginia, with small interior populations in southeastern Oklahoma and southern Arkansas (USFWS, 2003). The largest populations are within Federal and State lands in the Carolinas, Florida, Georgia, Alabama, Mississippi, Louisiana, and eastern Texas (USFWS, 2003).

In east Texas, known populations occur on State and Federal lands including the Sabine, Angelina, Davy Crockett, and Sam Houston national forests, the L.D. Fairchild and W.G. Jones state forests, the Huntsville State Fish Hatchery, the Alabama-Coushatta Indian Reservation, and on two private properties, Brushy Creek (International Paper) and Scrappin' Valley (Temple Inland Corporation) (USFWS, 2003). In Louisiana, the species occurs on State and Federal lands including the Kisatchie National Forest, the Upper Ouachita, D'Arbonne, and Black Bayou Lake NWRs, the Peason Ridge and Fort Polk military installations, and Crossett Forest (Plum Creek Timber Company) (USFWS, 2003). Other populations may occur elsewhere on private lands in east Texas and Louisiana, where suitable habitat is present.

### 2.6.4 Presence in the Study Area

No known current populations occur in any of the study area counties or parishes, and suitable habitat is absent in the study area. Thus, the species is unlikely to occur in the study area.

## 2.7 PIPING PLOVER

### 2.7.1 Reasons for Status

USFWS listed the piping plover (*Charadrius melodus*) as threatened and endangered on December 11, 1985 (50 FR 50726–50734). The piping plover is a federally listed endangered species in the Great Lakes watershed, while the birds breeding on the Atlantic Coast and northern Great Plains are federally listed as threatened. Piping plovers wintering in Texas and Louisiana are part of the northern Great Plains and Great Lakes populations and, therefore, are listed as threatened.

Shorebird hunting during the early 1900s caused the first known major decline of piping plovers (Bent, 1929). Since then, loss or modification of habitat resulting from commercial, residential, and recreational developments, dune stabilization, damming and channelization of rivers (eliminating sandbars, encroachment of vegetation, and altering water flows), and wetland drainage have further contributed to the decline of the species (USFWS, 1995a). Additional threats include human disturbances through recreational use of habitat, and predation of eggs by feral pets (USFWS, 1995a).

### 2.7.2 Habitat

Piping plovers typically inhabit shorelines of oceans, rivers, and inland lakes. Nest sites include sandy beaches, especially where scattered tufts of grass are present; sandbars; causeways; bare areas on dredge-created and natural alluvial islands in rivers; gravel pits along rivers; silty flats; and salt-encrusted bare areas of sand, gravel, or pebbly mud on interior alkali lakes and ponds (Haig and Elliott-Smith, 2004). On the wintering grounds, these birds use beaches, mudflats, sandflats, dunes, and offshore emergent placement areas (USFWS, 1995a; AOU, 1998).

### 2.7.3 Range

The piping plover breeds on the northern Great Plains (Iowa, northwestern Minnesota, Montana, Nebraska, North and South Dakota, Alberta, Manitoba, and Saskatchewan), in the Great Lakes (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario), and along the Atlantic Coast from Newfoundland to Virginia and (formerly) North Carolina. It winters on the Atlantic and Gulf coasts from North Carolina to Mexico, including coastal Texas, and, less commonly, in the Bahamas and West Indies (AOU, 1998; 50 FR 50726, December 11, 1985). Migration occurs both through the interior of North America east of the Rocky Mountains (especially in the Mississippi Valley) and along the Atlantic Coast (AOU, 1998). Few data exist on the migration routes of this species.

### 2.7.4 Presence in the Study Area

Approximately 35 percent of the known global population of piping plovers winters along the Texas Gulf Coast, where they spend 60 to 70 percent of the year (Campbell, 1995; Haig and Elliott-Smith, 2004). The species is a common migrant and rare to uncommon winter resident on the upper Texas coast (Richardson et al., 1998; Lockwood and Freeman, 2004). Piping plover concentrations in Texas occur in the following counties: Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kleberg, Matagorda, Nueces, San Patricio, and Willacy (USFWS, 1988). In Louisiana, the piping plover is a rare migrant statewide and uncommon winter resident along the Gulf Coast in Cameron and Jefferson parishes (USFWS, 1994). Piping plovers may occur in the study area, but suitable habitat is of limited extent.

Critical Habitat: USFWS has designated Critical Habitat for the species in its nesting and wintering range (65 FR 41781–41812, July 6, 2000). Designation of Critical Habitat became final on July 10, 2001 (66 FR 36038–36143). Within Louisiana, USFWS has designated critical wintering habitat for the piping plover along the entire shoreline from the east side of Sabine Pass (Texas-Louisiana border) east approximately 16 miles to the west end of Constance Beach (Hydrologic Unit [HU] LA-1, in part). Critical habitat includes the land from the seaward boundary of mean low low water (MLLW) to where densely vegetated habitat, not used by the species, begins and where the constituent elements no longer occur. Primary constituent elements (PCEs) are defined in 66 FR 36065 as "Important components (primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. In some cases, these flats may be covered or partially covered by a mat of bluegreen algae. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially

for roosting piping plovers. Such sites may have debris, detritus (decaying organic matter), or microtopographic relief (less than 20 inches above substrate surface) offering refuge from high winds and cold weather. Important components of the beach/dune ecosystem include surf-cast algae for feeding of prey, sparsely vegetated backbeach (beach area above mean high tide seaward of the dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road) for roosting and refuge during storms, spits (a small point of land, especially sand, running into water) for feeding and roosting. . . ." No USFWS-designated Critical Habitat for the piping plover is present within the Texas portions of the project area.

## 2.8 RED WOLF

### 2.8.1 Reason for Status

USFWS listed the red wolf (*Canis rufus*) as endangered on March 11, 1967 (32 FR 4001). Later it received protection under the ESA of 1973. The primary reasons for the species' decline include human persecution (i.e., hunting and trapping) and land-clearing activities (i.e., drainage projects, logging, farming, and mineral exploration) (USFWS, 1990). Land-clearing activities in the mid-twentieth century resulted in the loss of vast areas of forest and woodland habitat, which allowed the coyote (*Canis latrans*) to expand its range eastward and subsequently, resulted in hybridization of the two species and suppression of the genetic identity of the red wolf (USFWS, 1990; Schmidly, 2004).

### 2.8.2 Habitat

Red wolves formerly inhabited a variety of wooded habitats including pine forests, bottomland hardwood forests, swamps, marshes, and coastal prairies (Schmidly, 1983). USFWS (1990) indicates that the species requires large areas of habitat (greater than 170,000 acres).

### 2.8.3 Range

Red wolves originally occurred in woodlands and forests throughout the southeastern U.S.; however, the species was apparently extinct in the wild by 1980. Captive breeding colonies of red wolves now exist at several locations throughout the country. Beginning in 1987, USFWS began the reintroduction of red wolves to the Alligator River NWR, North Carolina. Between 1987 and 1992, USFWS released 42 wolves in Alligator River NWR, and at least 23 wolves were born in the wild. As of August 1992, the Alligator River NWR population numbered at least 24 wolves. Additionally, USFWS has released red wolf pairs on Bull's Island, South Carolina, St. Vincent Island, Florida, and Horn Island, Mississippi, but breeding and survival on these islands have been limited. Most recently, USFWS has reintroduced red wolves to the Great Smoky Mountains National Park.

### 2.8.4 Presence in the Study Area

Red wolves historically ranged throughout the eastern half of Texas and Louisiana, but the species is extirpated in these areas and is not present in the study area.

## 2.9 WEST INDIAN MANATEE

### 2.9.1 Reason for Status

USFWS listed the West Indian manatee (*Trichechus manatus*) as endangered on March 11, 1967 (32 FR 4001). Later it received protection under the ESA of 1973. The largest known human-related cause of manatee mortality is collisions with hulls and/or propellers of boats and ships. The second-largest human-related cause of mortality is entrapment in floodgates and navigation locks. Other known causes of human-related manatee mortality include poaching and vandalism, entrapment in shrimp nets and other fishing gear, entrapment in water pipes, and ingestion of marine debris (USFWS, 2001). Hunting and fishing pressures were responsible for much of its original decline because of the demand for meat, hides, and bones, which resulted in near extirpation of the specie (USFWS, 1995a).

A prominent cause of natural mortality in some years is cold stress, and major die-offs associated with the outbreaks of red tide have occurred, where manatees appear to have died because of ingestion of filter-feeding tunicates that had accumulated the neurotoxin-producing dynoflagellates responsible for causing the red tide (USFWS, 2001). The low reproductive rate and habitat loss make it difficult for manatee populations to recover.

### 2.9.2 Habitat

The West Indian manatee inhabits shallow coastal waters, estuaries, bays, rivers, and lakes. Throughout most of its range, it appears to prefer rivers and estuaries to marine habitats, although manatees inhabit marine habitats in the Greater Antilles (Lefebvre et al., 1989). It is not averse to traveling through dredged canals or using quiet marinas. Manatees are apparently not able to tolerate prolonged exposure to water colder than 68 degrees Fahrenheit (°F). In the northern portions of their range, during October through April, they congregate in warmer water bodies, such as spring-fed rivers and outfalls from power plants. They prefer waters that are at least 3.3 to 6.6 feet in depth; along coasts, they are often in water 10 to 16 feet deep. They usually avoid areas with strong currents (NatureServe, 2006).

Manatees are primarily dependent upon submergent, emergent, and floating vegetation, with the diet varying according to plant availability. They may opportunistically eat other foods such as acorns in early winter in Florida or fish caught in gill nets in Jamaica (O'Shea and Ludlow, 1992).

### 2.9.3 Range

The manatee ranges from the southeastern U.S. and coastal regions of the Gulf, through the West Indies and Caribbean, to northern South America. U.S. populations occur primarily in Florida (NatureServe,

2006), where they are effectively isolated from other populations by the cooler waters of the northern Gulf and the deeper waters of the Straits of Florida (Domning and Hayek, 1986).

### 2.9.4 Presence in the Study Area

The West Indian manatee historically inhabited the Laguna Madre, the Gulf, and tidally influenced portions of rivers. It is currently, however, extremely rare in Texas waters and the most recent sightings are likely individuals migrating or wandering from Mexican waters. Historical records from Texas waters include Cow Bayou, Sabine Lake, Copano Bay, the Bolivar Peninsula, and the mouth of the Rio Grande (Schmidly, 2004). In May 2005, a live manatee appeared in the Laguna Madre near Port Mansfield (Blankinship, 2005). Although the West Indian manatee is chiefly a marine species, its occurrence in the study area is unlikely.

## 2.10 LOUISIANA BLACK BEAR/BLACK BEAR

### 2.10.1 Reason for Status

USFWS listed the Louisiana black bear (*Ursus americanus luteolus*) as threatened on January 7, 1992 (57 FR 588–595). The Service also designates other free-living bears of the species *U. americanus*, within the Louisiana black bear's historic range, as threatened because of similarity in appearance. The primary threats to the Louisiana black bear are habitat destruction and modification. Human activities have reduced or fragmented much of the species' habitat throughout its historic range. Additional threats include human related mortality (i.e., hunting and trapping, automobile-related mortality) (USFWS, 1995b).

### 2.10.2 Habitat

Black bear habitat must have a combination of adequate food, water, cover, and denning sites within sufficiently large and remote blocks of land. The Louisiana black bear requires large, relatively remote blocks of bottomland hardwood forest (USFWS, 1995b). Forest types within the range of the species include bald cypress (*Taxodium distichum*), bald cypress-water tupelo (*T. distichum-Nyssa aquatica*), river birch-American sycamore (*Betula nigra-Platanus occidentalis*), cottonwood (*Populus deltoides*), sugarberry-American elm-green ash (*Celtis laevigata-Ulmus americana-Fraxinus pennsylvanica*), Nuttall oak-American elm-green ash (*Quercus nuttallii-Ulmus americana-F. pennsylvanica*), overcup oak-water hickory (*Q. lyrata-Carya aquatica*), sweetgum-water oak (*Liquidambar styraciflua-Q. nigra*), and swamp chestnut oak-cherrybark oak (*Q. michauxii-Q. falcata*) (USFWS, 1995b). Other habitat types include freshwater and brackish marshes, agricultural fields, wooded levees along canals and bayous, and salt domes (USFWS, 1995b).

A key component of Louisiana black bear habitat is remoteness, which is relative to forest tract size and the presence of roads (USFWS, 1995b). Optimal habitat generally consists of tracts larger than 2,500 acres that are at least 0.5 mile from well-maintained roads and development, or tracts with 0.3 mile

or less of road per 0.4 square miles of forest (USFWS, 1995b). Larger, undisturbed tracts of forest decrease the likelihood of human disturbance.

### 2.10.3 Range

While *U. americanus* is a widely distributed species, its range has declined since European colonization of North America. The species formerly ranged from northern Alaska and northern Canada, south to central northern Mexico (USFWS, 1995b). The Louisiana subspecies once occurred in southern Mississippi, all of Louisiana, and eastern Texas (USFWS, 1995b). In Texas, Louisiana black bears occurred in all counties east of and including Cass, Marion, Harrison, Upshur, Rusk, Cherokee, Anderson, Leon, Robertson, Burleson, Washington, Lavaca, Victoria, Refugio, and Aransas (USFWS, 1995b). Today, the only remaining Louisiana black bear populations occur in the Tensas and Atchafalaya river basins in Louisiana (USFWS, 1995b).

### 2.10.4 Presence in the Study Area

Garner (1996) indicates that suitable habitat for the Louisiana black bear in east Texas is restricted to the Big Thicket National Preserve, the Sulphur River Bottom, the Middle Neches Corridor, and the Lower Neches River Corridor. While recent reports of black bears exist from east Texas and southwestern Louisiana, it is unlikely that these represent individuals of the subspecies *U. a. luteolus*. Suitable black bear habitat may occur within the study area, but it is highly unlikely that black bears are present in the study area.

## 2.11 GULF STURGEON

### 2.11.1 Reason for Status

USFWS and NMFS listed the Gulf sturgeon (*Acipenser oxyrinchus desotoi*), a subspecies of the Atlantic sturgeon (*A. oxyrhinchus*), as threatened on September 30, 1991 (56 FR 49653–49658). As with other sturgeon species, the damming of rivers has been the most significant threat to the Gulf sturgeon (NMFS, 2006b). Dams are now present on all of the major rivers within the Gulf sturgeon's range (Pearl, Mississippi, and Alabama rivers), which prevents upstream migration for spawning. Other threats to the species include overexploitation, incidental catch, dredging activities, the removal of snags, and dredged material placement associated with channel improvements and maintenance (USFWS and Gulf States Marine Fisheries Commission [GSMFC], 1995; NMFS, 2006b).

### 2.11.2 Habitat

The Gulf sturgeon is anadromous, which means the species breeds in freshwater environments (i.e., river systems) but spends the remainder of the year in marine and estuarine environments. Spawning occurs in the deeper portions of rivers on clean rock or rubble bottoms. Mud and sand bottoms and seagrass communities are likely important marine habitats (USFWS and GSMFC, 1995).

### 2.11.3 Range

The Gulf sturgeon historically ranged along the northeastern Gulf, in major rivers from the Mississippi delta in Louisiana, east to Charlotte Harbor, Florida, and in marine waters of the central and eastern Gulf (USFWS and GSMFC, 1995; NMFS, 2006b). Its current range extends from Lake Pontchartrain and the Pearl River in Louisiana and Mississippi east to the Suwannee River in Florida. Sporadic records exist from as far west as the Rio Grande between Texas and Mexico, and as far east and south as Florida Bay. Viable populations exist in the Mississippi, Pearl, Escambia, Yellow, Choctawhatchee, Appachicola, and Suwannee rivers (NMFS, 2006b).

### 2.11.4 Presence in the Study Area

The study area is not within the known historic range of the Gulf sturgeon. Fish are mobile species and frequently occur outside of their normal ranges; however, it is unlikely that the species is present in the study area.

## 2.12 ELKHORN CORAL

Elkhorn coral was listed as threatened on May 9, 2006 (71 FR 26852) and is found on coral reefs in southern Florida and the Bahamas, and throughout the Caribbean. Its northern limit is Biscayne National Park, Florida. This species is particularly susceptible to damage from sedimentation. Neither the project area nor the study area are located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

## 2.13 SMALLTOOTH SAWFISH

### 2.13.1 Reason for Status

Smalltooth sawfish (*Pristis pectinata*) were listed as endangered by the NMFS on April 1, 2003 (50 CFR 224, p. 15674–15680), and the USFWS on November 16, 2005 (50 CFR 17, p. 69464–69466). They may grow up to 23 feet in length, live up to 30 years, and females give birth to live young, up to 15 to 20 at a time. Data indicate the smalltooth sawfish is found over about 10 percent of its original U.S. distribution, and the population size may have been reduced by 95 percent. These reductions probably have resulted from incidental entanglement in nets, reduced habitat, and the sawtooth's low birth rate. Additionally, little is known about the habitat utilized by juvenile sawfish (NMFS and USFWS, 2009).

### 2.13.2 Habitat

Smalltooth sawfish are usually found in shallow (typically less than 33 feet), warm (water temperatures exceeding 16 °C) coastal waters, close to shore, over muddy and sandy bottoms. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths on inshore bars, near mangrove edges, or over seagrass. Critical habitat for smalltooth sawfish has been proposed along the southwestern Florida coast from Charlotte Harbor south to Florida Bay (50 CFR 226, p. 70290–70308).

### 2.13.3 Range

The U.S. population is found only in the Atlantic Ocean and Gulf of Mexico. Historically, the U.S. population was common throughout the Gulf of Mexico from Texas to Florida, and along the East Coast from Florida to Cape Hatteras. The current range of this species has contracted to peninsular Florida, and smalltooth sawfish are relatively common only in the Everglades region at the southern tip of the state. No accurate estimates of abundance trends over time are available for this species. However, available records indicate that abundance of this species has declined dramatically in U.S. waters over the last century. The last published report of smalltooth sawfish in Texas was in 1984.

### 2.13.4 Presence in the Study Area

The most recent verified report of a smalltooth sawfish from Texas waters was in 1998. All recent observations of smalltooth sawfish have been in southwestern Florida. It is unlikely there are smalltooth sawfish in the project area. Since the smalltooth sawfish prefer shallow water, it is unlikely they would be encountered in the project areas that would be dredged.

## 2.14 STAGHORN CORAL

Staghorn coral was listed as threatened on May 9, 2006 (71 FR 26852) and is found throughout the Florida Keys, the Bahamas, and the Caribbean islands. This coral occurs in the western Gulf of Mexico, but it is absent from U.S. waters in the Gulf of Mexico. Neither the project area nor the study area are located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

## 2.15 WHALES

NMFS identifies five endangered whale species of potential occurrence in the Gulf. These are the sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), fin (or finback) whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter macrocephalus*). These species are generally restricted to deeper offshore waters; therefore, it is unlikely that any of these five species would regularly occur in the study area (NMFS, 2003).

## 2.16 SPECIES OF CONCERN

### 2.16.1 Dusky Shark

The dusky shark is a large shark with a wide-ranging distribution in warm-temperate and tropical continental waters. It is coastal and pelagic in its distribution, where it occurs from the surf zone to well offshore. Habitat for this species does exist in the project area.

### 2.16.2 Night Shark

The night shark is a deep-water shark reported in waters from Delaware south to Brazil, including the Gulf of Mexico. This shark is usually found at depths greater than 150–200 fathoms during the day and 100 fathoms at night. Habitat for this shark does not exist in the project area.

### 2.16.3 Saltmarsh Topminnow

This fish is endemic to the north-central coast of the Gulf of Mexico from Galveston Bay eastward to western Florida. They tend to live in salt marshes and brackish water. This species requires shallow flooded marsh surfaces for breeding and feeding. Coastal erosion and loss of marsh is thought to be the greatest threat to this species. It is possible that this species occurs in the project area.

### 2.16.4 Sand Tiger Shark

The sand tiger shark has a broad inshore distribution. In the western Atlantic, this shark occurs from the Gulf of Maine to Florida, in the northern Gulf of Mexico, in the Bahamas, and in Bermuda. They are generally coastal, usually being found in the surf zone down to depths around 75 feet. They may also be found in shallow bays. They usually live near the bottom, but may be found throughout the water column. Their biggest threat is over fishing. Habitat for this species may exist in the project area.

### 2.16.5 Speckled Hind

The speckled hind inhabits warm, moderately deep waters from North Carolina to Cuba, including Bermuda, the Bahamas, and the Gulf of Mexico. The preferred habitat is hard-bottom reefs in depths ranging from 150 to 300 feet. Habitat for this species does not exist in the project area.

### 2.16.6 Warsaw Grouper

The Warsaw grouper is a very large fish found in the deep-water reefs of the southeastern U.S. This fish ranges from North Carolina to the Florida Keys and throughout much of the Caribbean and Gulf of Mexico to the northern coast of South America. This species inhabits deepwater reefs on the continental shelf break in waters 350 to 650 feet deep. Habitat for this species does not exist in the project area.

### 2.16.7 Ivory Tree Coral

Colonies of ivory tree coral are found to depths of 500 feet on substrates of limestone rubble, low-relief limestone outcrops, and high-relief, steeply sloping prominences. The project area is not located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

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# 3.0 ANALYSIS OF EFFECTS

## 3.1 DIRECT EFFECTS

Direct effects of the Project are those associated with navigation channel improvements, and the placement of dredged material. They include (1) impacts to benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats resulting from dredging to construct navigation improvements, offshore placement areas, borrow areas for mitigation measures, and marsh restoration in shallow, open-water areas; (2) dredging impacts to bottom-feeding and pelagic organisms such as sea turtles, (3) impacts to marshes and upland habitats from the enlargement of placement areas; and (4) impacts to shorebirds and their habitat from the regular placement of maintenance material on the Gulf shoreline.

The discussion of direct Project impacts provided below is limited to those having the potential to affect threatened or endangered species or their Critical Habitat that may occur in the study area. The following species are unlikely to occur in the study area and, therefore, no impacts are expected: least tern (interior population), red wolf, Louisiana black bear/black bear, gulf sturgeon, and listed whale and coral species.

### 3.1.1 Sea Turtles

Sea turtles may be present in the project area during certain times of the year. Thus, construction activities could result in impacts to the sea turtle, should they be present in the project area. These impacts, however, would be temporary and local in nature. Feeding opportunities within the proposed channel could attract sea turtles, where they might be exposed to additional risks from boat traffic, contaminants, fishing activities, tangled fishing lines, and accumulated plastic detritus, but that is true at the existing channel.

A pipeline dredge would be used in those reaches of the SNWW inland of the Jetty Channel and a hopper dredge would be used in the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel. Sea turtles easily avoid pipeline dredges because of the slow movement of the dredge. The potential for incidental take of sea turtles by hopper dredges would be minimized by the use of draghead deflectors and the other measures noted in Section 4.1 of this BA. Construction dredging of the offshore channels is expected to take at least 6 years with individual contracts lasting an average of 15 months. Therefore, accommodation of a winter dredging window for construction is unlikely. An agreement between NMFS and USACE is in place and implemented regarding take of sea turtles with hopper dredges to ensure that significant impacts do not occur, but that BO only applies to maintenance dredging. Between 1996 and 2005, maintenance dredging in the Sabine Pass Outer Bar and Sabine Bank channels by hopper dredges resulted in the lethal take of two sea turtles, a Kemp's ridley in 1997 and a loggerhead in 2002 (Rob Hauch, pers. comm., 2006). In 2006, maintenance dredging in the Sabine Bank Channel resulted in the lethal take of one Kemp's ridley, but there were no lethal takes in the 2008 dredging of the Sabine Outer Bar Channel (USACE, 2009). Details of the sea turtle avoidance plan are included in Section 4.1.

The effects of placing dredged material at the proposed ODMDSs include (1) a collision potential from the vessel; (2) the deposition of dredged material on turtles and forage areas, and (3) the possibility of trash and debris from the dredge operation. Regarding the deposition of dredged material, modeling indicates that most of the dredged material is confined to a relatively small area. Because this is a short-term effect, and considering the mobility of the turtle species and the lack of limestone ledges in the proposed ODMDSs, the turtles should easily be able to avoid a descending plume, and available food sources should not be seriously reduced (NMFS, 2003). Regarding the vessel and debris possibility, it is the combined effect of many marine activities (e.g., oil spills, oil and gas operations, commercial fishing, marine transportation, etc.) that constitute the hazard and not a single activity such as a dredge operation. As noted in Section 4.11.2 of the SNWW Channel Improvement FEIS to which this document is appended, it has been determined that the proposed ODMDS designation does not constitute an adverse impact on listed sea turtles.

The existing offshore channels (Outer Bar and Sabine Bank) would be deepened with effects similar to but of longer duration than routine maintenance dredging. The Entrance Channel Extension would begin 18 miles offshore where sea turtles should be more dispersed than nearer the jetties. Only two lethal takes have been observed during maintenance dredging between 1996 and 2005, a period that entailed water temperatures ranging from 49 to 90°F. Based on the facts listed above, the proposed Project may affect and is likely to adversely affect sea turtles. No Critical Habitat for sea turtles is present within the study area; therefore, the Project is unlikely to adversely affect Critical Habitat.

### 3.1.2 Piping Plover

Dredging activities, which would occur in open water, would not directly affect the piping plover. The greatest potential for impacts to the piping plover would be associated with the placement of dredged material or beach nourishment activities in areas of suitable habitat. USFWS has designated the entire shoreline between Constance Beach and Sabine Pass (HU LA 1, in part) as Critical Habitat for the piping plover. Proposed beach nourishment activities at Louisiana Point would occur along approximately 3 miles of this unit, beginning approximately 0.5 mile east of Sabine Pass. A survey of both the Texas and Louisiana shore nourishment areas was conducted in July 2006 (see Attachment B to the BA). No habitat was found on the Texas side, just an eroding bank with marsh vegetation on the top of the bank. There was some habitat on the Louisiana side: a 1.65-mile-long, narrow tidal sand/mudflat spit that ranged from 500 yards off the beach on its western end to confluence with the beach at its eastern end; a 1-mile-long, narrow offshore sand bar that ranged from 1,400 yards offshore on the west to 400 yards offshore on the east end; and sandy beaches, ranging from 50 to 300 feet in width, beginning 2 miles east of the east jetty and extending east beyond the potential nourishment area. Shoreward of the beach was an eroded shoreline, above which there were flats with sometimes extensive stands of dense vegetation.

Therefore, Critical Habitat on Louisiana Point would only include the beach, since no other PCEs appear to be present. The current shoreline within the proposed nourishment area on Texas Point is an eroding marsh and contains no beach. Details of the beach nourishment activities are included in Section 4.2.

Placement of dredged materials (i.e., Gulf shoreline nourishment) at Texas Point and Louisiana Point would not adversely affect piping plovers or designated Critical Habitat for the piping plover. These activities should result in positive effects on the piping plover by increasing the extent of suitable habitat in the study area. On the Louisiana side, where Critical Habitat is designated, additional beach may allow saltation to create some microtopographic relief on the backbeach, providing another PCE. Based on the information listed above, the proposed Project is not likely to adversely affect the species or its Critical Habitat.

### 3.1.3 West Indian Manatee

No recent records of West Indian manatee exist from the study area, and such an occurrence would be rare. If a manatee was to enter the project area, the greatest threats to it would be from boat traffic or dredging operations. The proposed Project should have no effect on the West Indian manatee.

## 3.2 INDIRECT EFFECTS

Indirect effects of the Project result from small salinity increases, which increase wetland loss rates and decrease biological productivity in some aquatic habitats in the study area. In Texas, 33,500 acres of intertidal marsh and swamp may be negatively impacted by these small salinity increases. In Louisiana, negative impacts are projected to affect 182,000 acres of intertidal marsh. Construction of the Neches River Beneficial Use Feature and the Texas portion of the Gulf Shore Beneficial Use Feature may offset all the indirect effects in Texas and some of the indirect effects in Louisiana. These beneficial use features would result in the net creation of 2,853 acres of restored, emergent fresh, and intermediate, and brackish marsh in Texas. Additionally, a mitigation plan has been proposed to restore 2,783 acres of emergent marsh, improve 957 acres of shallow-water habitat, and nourish 4,355 acres of existing marsh in Louisiana. This mitigation plan is intended to offset the indirect negative impacts to Louisiana wetlands from the project. No loss of saline marsh or bottomland hardwood acreage is projected. Salinities are projected to increase throughout the study area. The highest projected increases are +1.1 to 1.8 parts per thousand (ppt) in the Old River Cove marsh at Sabine Lake along its north shore and in the marshes fringing the east shore of Sabine Lake, +1.6 ppt in the freshwater marshes along the north GIWW, +1.0 to 1.5 in the Sabine River south of Orange, +0.8 ppt in the Texas Point marshes at Sabine Pass, and +0.6 ppt along the Sabine River near the City of Orange and to the north. The effects of the salinity increases on tidal marshes have been mitigated by marsh restoration, and the small salinity increase on the upper Sabine River would have negligible effects on the cypress-tupelo swamps and bottomland hardwood forests. No impacts to threatened or endangered species or Critical Habitats that may occur in the study area would result from the indirect effects of salinity increases or marsh loss.

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# 4.0 VOLUNTARY AVOIDANCE AND CONSERVATION MEASURES

## 4.1 SEA TURTLE AVOIDANCE PLAN

Avoidance measures would include an avoidance plan for hopper dredge impacts to sea turtles. This avoidance plan includes reasonable and prudent measures that have largely been incorporated in USACE regulatory and civil works projects throughout the Gulf for more than a decade. These measures include use of temporal dredging windows, when possible; intake and overflow screening; use of sea turtle deflector dragheads; observer reporting requirements; and sea turtle relocation/abundance trawling:

- Hopper Dredging: Hopper dredging activities in Gulf waters from the Mexico-Texas border to Key West, Florida, up to 1 mile into rivers shall be completed, whenever possible, between December 1 and March 31 when sea turtle abundance is lowest throughout Gulf coastal waters. USACE should coordinate with National Oceanic and Atmospheric Administration (NOAA) should dredging need to occur outside of this window.

- Nonhopper-type Dredging: Pipeline or hydraulic dredges, which are not known to take turtles, must be used whenever possible between April 1 and November 30 in Gulf waters up to 1 mile into rivers.

- Observers: The USACE shall arrange for NOAA Fisheries–approved observers to be aboard the hopper dredges to monitor the hopper soil, screening, and dragheads for sea turtles and their remains. Observer coverage sufficient for 100 percent monitoring (i.e., two observers) of hopper dredging operations is required aboard the hopper dredges year-round in Texas waters between April 1 and November 30, and whenever surface water temperatures are 52°F or greater.

- Screening: When observers are required on hopper dredges, 100 percent inflow screening of dredged material is required and 100 percent overflow screening is recommended. If conditions prevent 100 percent inflow screening, screening may be reduced gradually, but 100 percent overflow screening is then required.

- Sea Turtle Deflecting Draghead: A state-of-the-art rigid deflector draghead must be used on all hopper dredges in all Gulf channels and sand-mining sites at all times of the year.

- Dredge Take Reporting: Observer reports of incidental take by hopper dredges must be reported to NOAA Fisheries by onboard endangered species observers within 24 hours of any observed sea turtle take. A preliminary report summarizing the results of the hopper dredging and any documented sea turtle takes must be submitted to NOAA Fisheries within 30 working days of completion of any dredging project. In addition, an annual report (based on fiscal year) must be

submitted to NOAA Fisheries summarizing hopper dredging projects and documented incidental takes.

- Relocation Trawling: Relocation trawling shall be undertaken by the USACE where any of the following conditions are met: (a) two or more turtles are taken in a 24-hour period in the project; (b) four or more turtles are taken in the project; or, (c) when 75 percent of a District's sea turtle species quota for a particular species has previously been met. Handling of sea turtles captured during relocation trawling in association with hopper dredging project in Gulf navigation channels and sand-mining areas shall be conducted by NOAA Fisheries–approved endangered species observers.

Other conditions may also apply. A detailed outline of the conditions of the USACE's sea turtle avoidance is included in the NMFS Biological Opinion for dredging of Gulf navigation channels and sand-mining areas using hopper dredges (Consultation Number F/SER/2000/01287).

## 4.2 GULF SHORELINE NOURISHMENT

The unconfined placement on the shoreline would have a net beneficial effect on this environment. Placement events would affect shallow nearshore waters and marsh. Benthic organisms in the nearshore zone would quickly rebound from the short-term impacts of each placement event, as would marsh areas that are nourished with additional sediment. The potential for the nourishment activity to affect threatened and endangered species was evaluated. USFWS has designated the entire shoreline between Constance Beach and Sabine Pass (HU LA 1, in part) as Critical Habitat for the piping plover; however, the shoreline in the proposed nourishment area has no, or only a narrow, beach. Therefore, minimal intertidal beaches, dunes, or sand flats used by the plover as its wintering range would be affected by this measure. Should beach nourishment occur when piping plovers are utilizing the project area, they would be temporarily displaced to nearby habitat to the east, but would not be permanently excluded from using the project area, and nourishment would only occur every 6 years. Piping plover Critical Habitat would benefit from the creation of an additional PCE. Effects to existing piping plover Critical Habitat would occur during each beach nourishment cycle, but the overall condition of the nourishment area would be improved for piping plovers. While it is unlikely that the creation of more beach on Louisiana Point would allow sea turtle nesting, it certainly would have no adverse impacts on potential nesting habitat.

# 5.0 SUMMARY

The proposed Project may affect a few federally listed endangered or threatened species. The following species are unlikely to occur in the project area and, therefore, no impacts are expected: least tern (interior population), red-cockaded woodpecker, red wolf, Louisiana black bear/black bear, gulf sturgeon, the leatherback sea turtle, and listed whale and coral species. The Project is expected to have no effect on the West Indian manatee. The Project may affect and is likely to result in adverse effects to the following species: loggerhead sea turtle, Kemp's ridley sea turtle, hawksbill sea turtle, and green sea turtle. The piping plover and its Critical Habitat would experience a beneficial effect from the proposed Project resulting from habitat enhancement (i.e., shoreline nourishment) through beneficial use of dredged material. The only designated Critical Habitat in the project area is a portion of HU LA 1 at Louisiana Point, which was designated as Critical Habitat for the wintering range of the piping plover. The Project is not likely to adversely affect the piping plover or its designated Critical Habitat since the Project is expected to have only a beneficial effect.

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# Attachment A

# Agency Correspondence

PBS&J

*An employee-owned company*

September 14, 2004

Mr. Frederick Werner
U.S. Fish and Wildlife Service
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051

Dear ~~Mr. Werner~~ Fred,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding federally protected species within the study area. You initially responded to our data request for this proposed project in a letter dated June 3, 2002, however, we are currently updating our agency contacts. Please provide written response since your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts. If there has been no change since your 2002 response (attached), please let us know and we will utilize your earlier information.

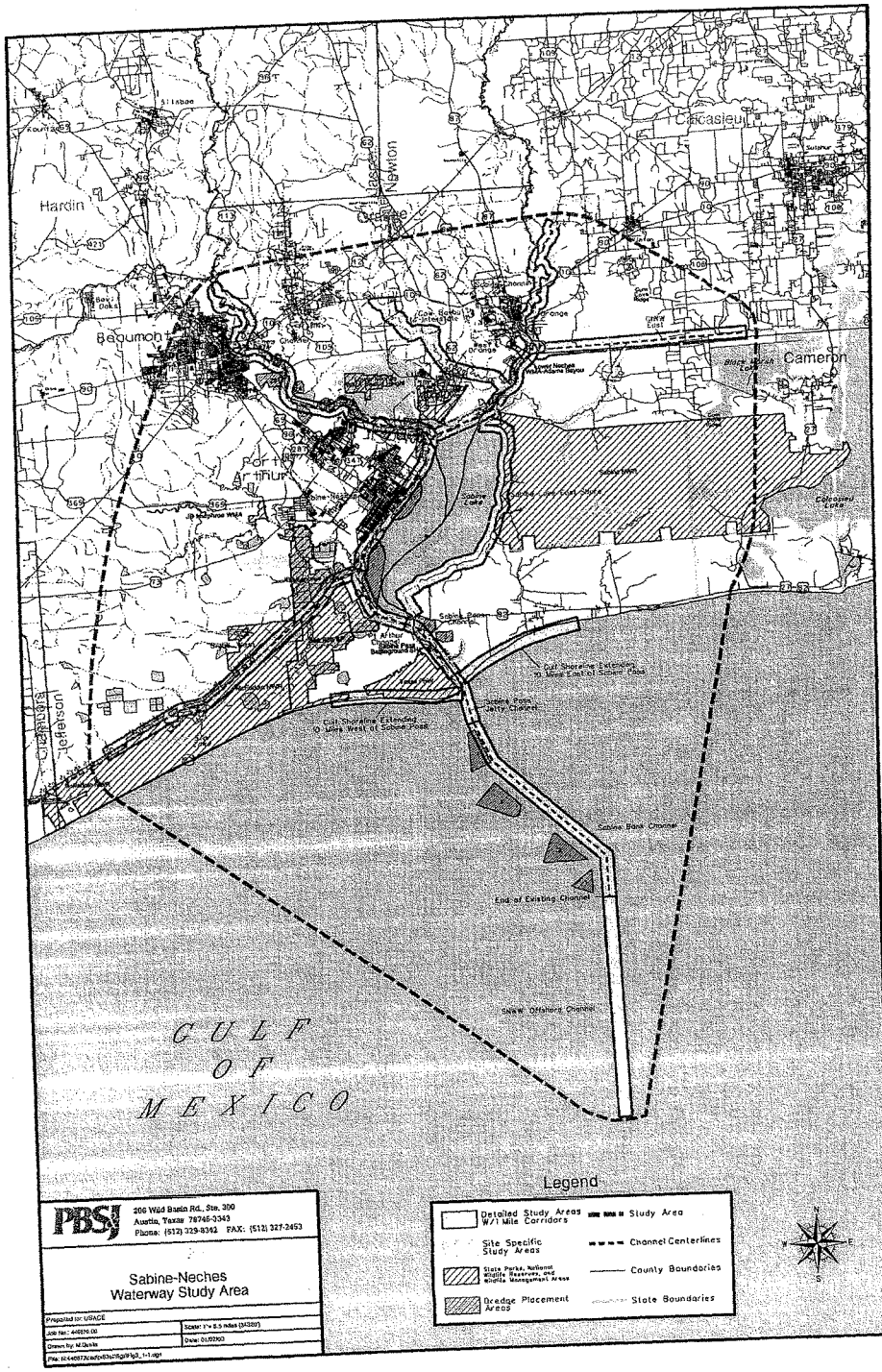
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachments

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com


Hardin
Beaumont
Port Arthur
Orange
Vidor
Lake Charles
Calcasieu
Cameron
Jefferson
Chambers
Sabine Lake
Calcasieu Lake
Sabine Pass
Sabine Pass Channel
Cut Shoreline Extended 10 Miles West of Sabine Pass
Cut Shoreline Extended 10 Miles Coastal South of Sabine Pass
Sabine Bank Channel
End of Existing Channel
Sabine Offshore Channel
GULF OF MEXICO
PBSJ
200 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453
Sabine-Neches Waterway Study Area
Prepared for: USACE
Job No.: 44876.00
Scale: 1" = 8.5 miles (34380')
Drawn By: M.Clarke
Date: 01/02/03
File: R:\44876\Cadfb\DredgingMap3_1-1.dgn
Legend
Detailed Study Areas W/1 Mile Corridors
Site Specific Study Areas
State Parks, National Wildlife Reserve, and Wildlife Management Areas
Dredge Placement Areas
Study Area
Channel Centerlines
County Boundaries
State Boundaries
N
W
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S

# United States Department of the Interior

**FISH AND WILDLIFE SERVICE**
**Division of Ecological Services**
**17629 El Camino Real #211**
**Houston, Texas 77058-3051**
**281/286-8282 / (FAX) 281/488-5882**


June 3, 2002

Lisa Vitale
PBS&J
206 Wild Basin Road, Suite 300
Austin, Texas 78746

Dear Ms. Vitale:

This responds to your March 27, 2002 letter requesting information on the Sabine-Neches Waterway Project. The Galveston District Corps of Engineers proposes to widen and deepen the entire 75 mile long deep draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and the Neches River Channel to Beaumont.

The inventory of federally listed threatened and endangered species located within our area of jurisdiction is enclosed. You should also contact our Lafayette Office for threatened and endangered species information for Calcasieu and Cameron Parishes in Louisiana. They can be reached at 646 Cajundome Boulevard, Suite 400 ,Lafayette, Louisiana 70506-4290 or at 337/291-3100.

The National Marine Fisheries Service should be contacted about potential impacts to sea turtles and marine mammals. They can be contacted at 4700 Avenue U, Building 308, Galveston, Texas 77551-5997 or at 409-766-3699.

If you have any questions or if we can be of further assistance, please contact Edith Erfling at 281/286-8282.

Sincerely,

Frederick T. Werner
Assistant Project Leader, Clear Lake ES Field Office

Enclosure

# COUNTY LISTING OF LISTED AND CANDIDATE SPECIES WITHIN CLEAR LAKE FIELD OFFICE AREA OF RESPONSIBILITY

(JANUARY 2002)

E = Federally listed as endangered T = Federally listed as threatened
H = historical occurrence only / M = migrant only / N = nesting activity / W = winter concentration
C= candidate species: sufficient information exists to support listing but is precluded by other listing actions.
* Candidates have no legal status and receive no protection under the Endangered Species Act. They are identified for project planning purposes only and to alert you to the possibility that they may be proposed for listing at some future time.

| | | |
|---|---|---|
| **ANGELINA COUNTY** | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| C | Louisiana pine snake | *Pituophis melanoleucus ruthveni* |
| **AUSTIN COUNTY** | | |
| E | HOUSTON TOAD | *Bufo houstonensis* |
| E | ATTWATER'S GREATER PRAIRIE-CHICKEN | *Tympanuchus cupido attwateri* |
| **BRAZORIA COUNTY** | | |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |
| E | BROWN PELICAN (N) | *Pelecanus occidentalis* |
| T | PIPING PLOVER (W) | *Charadrius melodus* |
| T | GREEN SEA TURTLE | *Chelonia mydas* |
| E | KEMP'S RIDLEY SEA TURTLE | *Lepidochelys kempii* |
| T | LOGGERHEAD SEA TURTLE | *Caretta caretta* |
| **CHAMBERS COUNTY** | | |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |
| E | BROWN PELICAN | *Pelecanus occidentalis* |
| T | PIPING PLOVER (W) | *Charadrius melodus* |
| T | GREEN SEA TURTLE | *Chelonia mydas* |
| E | KEMP'S RIDLEY SEA TURTLE | *Lepidochelys kempii* |
| T | LOGGERHEAD SEA TURTLE | *Caretta caretta* |
| **COLORADO COUNTY** | | |
| E | HOUSTON TOAD | *Bufo houstonensis* |
| E | ATTWATER'S GREATER PRAIRIE-CHICKEN | *Tympanuchus cupido attwateri* |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| **FAYETTE COUNTY** | | |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |
| **FORT BEND COUNTY** | | |
| E | PRAIRIE DAWN | *Hymenoxys texana* |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |
| **GALVESTON COUNTY** | | |
| E | ATTWATER'S GREATER PRAIRIE-CHICKEN | *Tympanuchus cupido attwateri* |
| E | BROWN PELICAN (N) | *Pelecanus occidentalis* |
| T | PIPING PLOVER (W) | *Charadrius melodus* |
| T | GREEN SEA TURTLE | *Chelonia mydas* |
| E | KEMP'S RIDLEY SEA TURTLE | *Lepidochelys kempii* |
| T | LOGGERHEAD SEA TURTLE | *Caretta caretta* |
| **HARDIN COUNTY** | | |
| E | TEXAS TRAILING PHLOX | *Phlox nivalis* var. *texensis* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |

| | | |
|---|---|---|
| **HARRIS COUNTY** | | |
| E | PRAIRIE DAWN | *Hymenoxys texana* |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| **HOUSTON COUNTY** | | |
| T | BALD EAGLE (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| C | Neches River rose-mallow | *Hibiscus dasycalyx* |
| **JASPER COUNTY** | | |
| E | NAVASOTA LADIES'-TRESSES | *Spiranthes parksii* |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| C | Louisiana pine snake | *Pituophis melanoleucus ruthveni* |
| **JEFFERSON COUNTY** | | |
| T | PIPING PLOVER (W) | *Charadrius melodus* |
| T | GREEN SEA TURTLE | *Chelonia mydas* |
| E | KEMP'S RIDLEY SEA TURTLE | *Lepidochelys kempii* |
| T | LOGGERHEAD SEA TURTLE | *Caretta caretta* |
| **LIBERTY COUNTY** | | |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| **MATAGORDA COUNTY** | | |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |
| E | BROWN PELICAN (N) | *Pelecanus occidentalis* |
| T | PIPING PLOVER (W) | *Charadrius melodus* |
| T | GREEN SEA TURTLE | *Chelonia mydas* |
| E | KEMP'S RIDLEY SEA TURTLE | *Lepidochelys kempii* |
| T | LOGGERHEAD SEA TURTLE | *Caretta caretta* |
| **MONTGOMERY COUNTY** | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| **NACOGDOCHES COUNTY** | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| C | Texas golden gladecress (introduced) | *Leavenworthia texana* |
| **NEWTON COUNTY** | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| T | LOUISIANA BLACK BEAR (H) | *Ursus americanus luteolus* |
| C | Louisiana pine snake | *Pituophis melanoleucus ruthveni* |
| **ORANGE COUNTY** | | |
| T | BALD EAGLE (M) | *Haliaeetus leucocephalus* |

| | | |
|---|---|---|
| **POLK COUNTY** | | |
| E | TEXAS TRAILING PHLOX | *Phlox nivalis* var. *texensis* |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| **SABINE COUNTY** | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| T | LOUISIANA BLACK BEAR (H) | *Ursus americanus luteolus* |
| C | Texas golden gladecress (H) | *Leavenworthia texana* |
| C | Louisiana pine snake | *Pituophis melanoleucus ruthveni* |
| **SAN AUGUSTINE COUNTY** | | |
| E | WHITE BLADDERPOD | *Lesquerella pallida* |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| C | Texas golden gladecress | *Leavenworthia texana* |
| **SAN JACINTO COUNTY** | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| **SHELBY COUNTY** (Sabine National Forest only) | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| T | LOUISIANA BLACK BEAR (H) | *Ursus americanus luteolus* |
| **TRINITY COUNTY** | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| C | Neches River rose-mallow | *Hibiscus dasycalyx* |
| **TYLER COUNTY** | | |
| E | TEXAS TRAILING PHLOX | *Phlox nivalis* var. *texensis* |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| C | Louisiana pine snake | *Pituophis melanoleucus ruthveni* |
| **WALKER COUNTY** | | |
| T | BALD EAGLE (N) + (W) | *Haliaeetus leucocephalus* |
| E | RED-COCKADED WOODPECKER | *Picoides borealis* |
| **WALLER COUNTY** | | |
| T | BALD EAGLE (M) | *Haliaeetus leucocephalus* |
| **WHARTON COUNTY** | | |
| T | BALD EAGLE (N) | *Haliaeetus leucocephalus* |

# United States Department of the Interior

**FISH AND WILDLIFE SERVICE**
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882


November 2, 2004

Martin Arhelger
PBS&J
6504 Bridge Point Parkway, Suite 200
Austin, Texas 78730

Dear Mr. Arhelger:

This responds to your request for updated threatened and endangered species information for Jefferson County Navigation District (JCND)'s proposed Sabine-Neches Waterway (SNWW) widening and deepening project. The SNWW is located in Jefferson and Orange Counties in Texas, and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine Neches Canal, and Neches River Channel to the Port of Beaumont, Texas.

The species list dated January 2002 accurately reflects the federally listed species that may occur in Jefferson and Orange Counties, Texas. Species information and a county by county listing of those federally listed threatened and endangered species that occur within this office's work area can be found on the Service website at (http://ifw2es.fws.gov/endangeredspecies/lists/ListSpecies.cfm). Therefore, future updates to species lists for your projects would not require contact with this office.

According to Section 7(a)(2) of the Act and the implementing regulations, it is the responsibility of each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species. You should use the updated species list and other current information to determine if the proposed project "may affect" a listed species. Should your determination indicate that the proposed project "may affect" federally listed species, this office should be contacted for further evaluation. The Service's Consultation Handbook is available online (http://endangered.fws.gov/consultations/s7hndbk/s7hndbk.htm) for further information on definitions and process.

Finally, colonial waterbird rookeries are known to occur within the project area. To avoid disturbing colonial waterbirds as they nest and rear their young, we recommend all project activity stay a minimum of 1000 feet away during the peak nesting season from February 15 to September 1.

If you have any questions, or if we can be of further assistance, please contact Catherine Yeargan at 281/286-8282.

Sincerely,

Frederick T. Werner
Assistant Field Supervisor, Clear Lake Field Office

TAKE PRIDE IN AMERICA

PBS&J

*An employee-owned company*

September 14, 2004

Mr. Darryl Clark
U.S. Fish and Wildlife Service
646 Cajundome Blvd.
Suite 4000
Lafayette, Louisiana 70506

Dear ~~Mr. Clark~~ Darryl,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding federally protected species within the study area. Please provide written response since your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

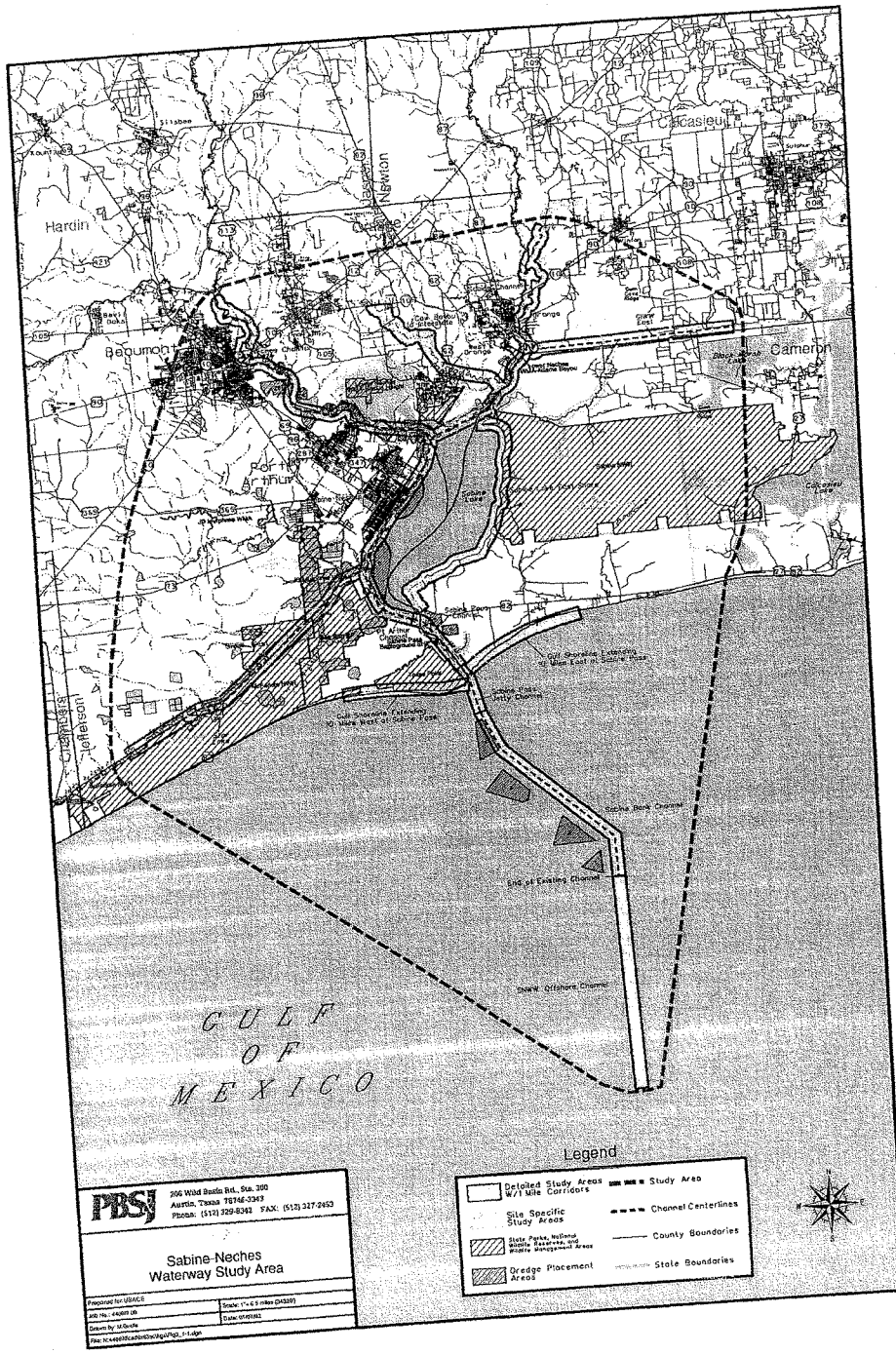
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com


Hardin
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Port Arthur
Orange
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Jefferson
Chambers
Cameron
Lake Charles
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New Offshore Channel
GULF OF MEXICO
Legend
Detailed Study Areas W/1 Mile Corridors
Study Area
Site Specific Study Areas
Channel Centerlines
State Parks, National Wildlife Refuges, and Wildlife Management Areas
County Boundaries
Dredge Placement Areas
State Boundaries
PBSJ
306 Wild Basin Rd., Ste. 200
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453
Sabine-Neches
Waterway Study Area
Prepared for USACE
Scale: 1" = 4.5 miles (24320)
Job No.: 44669.06
Date: 07/01/02
Drawn by: M.Goode
File: K:\44669\Section\Dredge\Fig3_4-1.dgn

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506


September 29, 2004

Mr. Martin Arhelger
Project Manager
PBS&J
6504 Bridge Point Parkway, Suite 200
Austin, Texas 78730

Dear Mr. Arhelger:

Please reference your September 14, 2004, letter requesting information regarding threatened and endangered species that may occur within the proposed study area for the Sabine-Neches Waterway (SNWW) project. The U.S. Army Corps of Engineers (Corps) has proposed to widen and deepen the SNWW bordering Jefferson and Orange Counties in Texas, and Calcasieu and Cameron Parishes in Louisiana. The proposed project area would include the SNWW from the Gulf of Mexico, passing through the jettied channel at Sabine Pass, the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, and an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The U.S. Fish and Wildlife Service's (Service) Lafayette, Louisiana, Field Office has reviewed the information provided, and offers the following comments on the Louisiana-portion of the proposed project, in accordance with provisions of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Migratory Bird Treaty Act (MBTA; 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.). For information regarding Federal-trust resources in Texas, please contact the Service's Houston, Texas, (i.e., Clear Lake) Field Office (17629 El Camino Real, Suite 211, Houston, TX 77058-3051, phone: 281-286-8282).

West Indian manatees (*Trichechus manatus*) may rarely occur along the Gulf coast in southwestern Louisiana during the summer months (i.e., June through September). They have declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

Bald eagles (*Haliaeetus leucocephalus*) nest in Louisiana from October through mid-May. Although we are not aware of active eagle nests within the proposed project area, there is an inactive nest located on the east side of the Sabine River and south of Interstate Highway 10; nests that are not currently listed in our database may also be present within areas containing suitable habitat. Eagles typically nest in bald cypress trees near fresh to intermediate marshes or open water. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Bald eagles usually return to the same nest year after year, but they may also use alternate nests in the same general vicinity in different years. Bald eagles are most vulnerable to disturbance during courtship, nest building, egg laying, incubation and brooding (roughly the first 12 weeks of the nesting cycle). Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus lessening their chance of survival. Should the proposed project or associated work activities encroach within 1,500 feet of an eagle nest during the nesting season (October through mid-May), further ESA consultation with this office will be necessary. We further caution that the proposed activity should not damage any portion of the eagle nest trees, including their root systems (i.e., through soil compaction or disturbance).

Federally listed as endangered, brown pelicans (*Pelecanus occidentalis*) feed along the southwestern Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance. Should you determine that the proposed project may directly or indirectly affect brown pelicans, further ESA consultation with this office will be necessary.

Federally listed as threatened, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the southwestern Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change.

On July 10, 2001, the U.S. Fish and Wildlife Service designated critical habitat for wintering piping plovers. In Louisiana, the proposed project would be located adjacent to Unit LA-1, a unit which includes ". . . the land from the seaward boundary of mean low low water to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. . ." (50 CFR Part 17, Volume 66, No. 132, Page 36127). Designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to

development, disturbance by humans and pets, and predation. Should you determine that the proposed project may directly or indirectly affect the piping plover or its critical habitat, further ESA consultation with this office will be necessary.

Endangered and threatened sea turtles forage in the near-shore waters, bays and sounds of southwestern Louisiana. The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species. Please contact Mr. Eric Hawk (727/570-5312) in St. Petersburg, Florida, for information concerning those species in the aquatic environment.

The proposed project area may encompass areas containing suitable nesting habitat for colonial wading birds. Colonies that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries may also be present. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed project area for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, depending on species present).

2. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1, depending on species present).

3. We recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and avoid impacting them during the breeding season.

The Service's Sabine National Wildlife Refuge (NWR) is located along the eastern bank of the Sabine Lake. Please be aware that the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd through 668ee) requires that activities on NWRs must be compatible with NWR purposes. Please contact the Sabine NWR Manager at 337/762-3816 for additional information, and to ascertain the need for a NWR Special Use Permit for that portion of the proposed project.

The proposed project may also affect the Black Bayou Hydrologic Restoration (CS-27), Gulf Intracoastal Waterway – Perry Ridge West Bank Stabilization (CS-30), and East Sabine Lake Hydrologic Restoration (CS-32) Projects. Those projects are authorized by the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The Service recommends avoiding direct impacts to specific project features (e.g., canal plugs, rock dikes, levees, water control structures, diversion canals, etc.). The exact locations of specific project features may be obtained at http://www.lacoast.gov/projects/list.asp, which contains detailed information on those CWPPRA projects. Please be aware that Section 303(d) of CWPPRA requires that all Federal activities be

consistent with the purposes of that Act and take into account the need to protect the public investment in the above-listed CWPPRA projects.

We appreciate the opportunity to provide comments during the early planning stages of the proposed action. If you have any questions or require further information on the Louisiana portion of the proposed project, please contact Brigette Firmin (337/291-3108) of this office.

Sincerely,

Russell C. Watson
Supervisor
Louisiana Field Office

cc: FWS, Houston, TX
Sabine NWR, Hackberry, LA
NMFS, St. Petersburg, FL
NMFS, Baton Rouge, LA
LDNR, CMD, Baton Rouge, LA
LDWF, Baton Rouge, LA
LDWF, Natural Heritage Program, Baton Rouge, LA

PBS&J

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September 14, 2004

National Marine Fisheries Service
Southeast Regional Office
Mr. Andreas Mager
9721 Executive Center Drive north
Saint Petersburg, Florida 33702-2449

Dear Mr. Mager,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding federally protected species within the study area. Your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

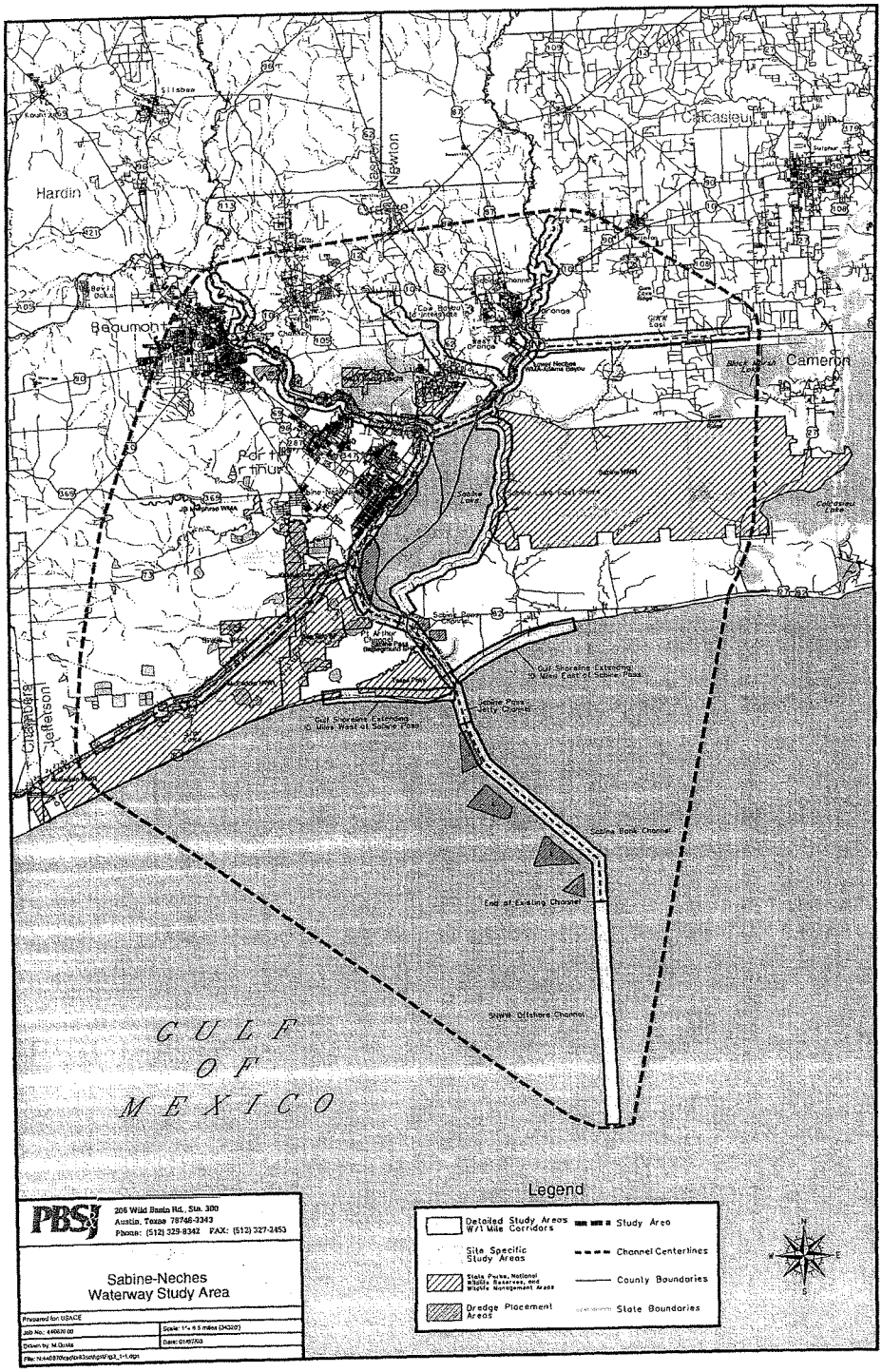
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com


Silsbee
Hardin
Newton
Jasper
Orange
Beaumont
Port Arthur
Lake Charles
Cameron
Calcasieu
Jefferson
Chambers
Sabine Pass Jetty Channel
Sabine Bank Channel
End of Existing Channel
Sabine Offshore Channel
GULF
OF
MEXICO
PBSJ
205 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453
Sabine-Neches
Waterway Study Area
Prepared for: USACE
Job No.: 440670.00
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Drawn by: M.Quiles
Date: 01/07/03
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Detailed Study Areas W/1 Mile Corridors
Study Area
Site Specific Study Areas
Channel Centerlines
State Parks, National Wildlife Reserves, and Wildlife Management Areas
County Boundaries
Dredge Placement Areas
State Boundaries

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312, FAX 570-5517
http://sero.nmfs.noaa.gov

Dear Colleague:

The National Marine Fisheries Service (NOAA Fisheries) Protected Resources Division has reviewed your letter pursuant to section 7(a)(2) of the Endangered Species Act (ESA) concerning the determination of a construction site in proximity to critical habitat (permit number LAR200000).

_____**There are no ESA-listed species** or designated critical habitat under our purview in the action area.

_____**We cannot determine** impacts to threatened or endangered species, or designated critical habitat, under NOAA Fisheries' purview because the letter lacks sufficient information to evaluate the project. **Enclosed are guidelines** to conduct a proper biological evaluation.

_____**Please provide a letter** from the lead federal action agency designating you to conduct ESA section 7 consultation with this office.

_✓_**Enclosed is a list** of federally-protected species under the jurisdiction of NOAA Fisheries for the state of **Louisiana.** Biological information on federally-protected species and candidate species can be found at the following website addresses: http://www.nmfs.noaa.gov/prot_res/prot_res.html; http://noflorida.fws.gov/SeaTurtles/seaturtle-info.htm); http://endangered.fws.gov/wildlife.html#Species; http://www.cmc-ocean.org/main.php3; http://floridaconservation.org/psm/turtles/turtle.htm; http://obis.env.duke.edu/data/sp_profiles.php; www.mote.org/~colins/Sawfish/SawfishHomePage.html; www.floridasawfish.com; www.flmnh.ufl.edu/fish/sharks/InNews/sawprop.htm;.Gulf sturgeon critical habitat rule and maps (http://alabama.fws.gov/gs/); http://www.cccturtle.org;.

_____**It is NOAA Fisheries opinion that the project will have no effect** on listed species or critical habitat protected by the ESA under NOAA Fisheries' purview. No further consultation with NOAA Fisheries pursuant to section 7(a)(2) of the ESA is required unless the project description changes.

Consultation with NOAA Fisheries, Habitat Conservation Division (HCD), pursuant to the Magnuson-Stevens Fishery Conservation and Management Act's requirements for essential fish habitat consultation may be required. Please contact HCD at (727) 570-5317. If you have any ESA questions, please contact our ESA section 7 coordinator, Eric Hawk, at (727) 570-5312, or by e-mail at eric.hawk@noaa.gov.

____**Other**: _____

Sincerely,

David Bernhart
Assistant Regional Administrator
for Protected Resources

_X_ Enclosure
Ref: I/SER/2004/
File:1514-22.

NOAA Fisheries

Endangered and Threatened Species and Critical Habitats
under the Jurisdiction of the NOAA Fisheries

## Louisiana

| Listed Species | Scientific Name | Status | Date Listed |
|---|---|---|---|
| **Marine Mammals** | | | |
| blue whale | *Balaenoptera musculus* | Endangered | 12/02/70 |
| finback whale | *Balaenoptera physalus* | Endangered | 12/02/70 |
| humpback whale | *Megaptera novaengliae* | Endangered | 12/02/70 |
| sei whale | *Balaenoptera borealis* | Endangered | 12/02/70 |
| sperm whale | *Physeter macrocephalus* | Endangered | 12/02/70 |
| **Turtles** | | | |
| green sea turtle | *Chelonia mydas* | Threatened[1] | 07/28/78 |
| hawksbill sea turtle | *Eretmochelys imbricata* | Endangered | 06/02/70 |
| Kemp's ridley sea turtle | *Lepidochelys kempii* | Endangered | 12/02/70 |
| leatherback sea turtle | *Dermochelys coriacea* | Endangered | 06/02/70 |
| loggerhead sea turtle | *Caretta caretta* | Threatened | 07/28/78 |
| **Fish** | | | |
| Gulf sturgeon | *Acipenser oxyrinchus desotoi* | Threatened | 09/30/91 |

**Designated Critical Habitat**
Gulf Sturgeon: A final rule designating Gulf sturgeon critical habitat was published on March 19, 2003 (68 FR 13370) and 14 geographic areas (units) among the Gulf of Mexico rivers and tributaries were identified. Maps and details regarding the final rule can be found ~~at alabama.fws.gov/gs~~ Enclosed

**Species Proposed for Listing**
None

**Proposed Critical Habitat**
None

[1] Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered

NOAA Fisheries

## Louisiana

| Candidate Species[2] | Scientific Name |
|---|---|
| **Invertebrates** | |
| elkhorn coral | *Acropora palmata* |
| staghorn coral | *Acropora cervicornis* |
| fused-staghorn coral | *Acropora prolifera* |

| Species of Concern[3] | Scientific Name |
|---|---|
| **Fish** | |
| dusky shark | *Carcharhinus obscurus* |
| goliath grouper | *Epinephelus itijara* |
| night shark | *Carcharinus signatus* |
| saltmarsh topminnow | *Fundulus jenkinsi* |
| sand tiger shark | *Odontaspis taurus* |
| speckled hind | *Epinephelus drummondhayi* |
| Warsaw grouper | *Epinephelus nigritus* |
| white marlin | *Tetrapturus albidus* |
| **Invertebrates** | |
| ivory bush coral | *Oculina varicosa* |

[2] The Candidate Species List has been renamed the Species of Concern List. The term "candidate species" is limited to species that are the subject of a petition to list and for which NOAA Fisheries has determined that listing may be warranted (69 FR 19975).
[3] Species of Concern are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

Federal Register

Wednesday,
March 19, 2003

Part II

# Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

# Department of Commerce

National Oceanic and Atmospheric Administration

50 CFR Part 226

## Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Gulf Sturgeon; Final Rule

PBS&J

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April 24, 2006

Rusty Swafford
National Marine Fisheries Service
Habitat Conservation Division
4700 Avenue U
Galveston, Texas 77551-5997

RE: Sabine-Neches Waterway Project
PBS&J Job Number 440870

Dear Mr. Swafford:

PBS&J has contracted with the Galveston District of the U.S. Army Corps of Engineers (Galveston District) to prepare the EIS for the Sabine-Neches Waterway Project (project) located in Jefferson and Orange Counties, Texas and Calcasieu and Cameron Parish, Louisiana. The Galveston District is engaged in a potential widening and deepening of the Sabine-Neches Waterway. The project sponsor is the Jefferson County Navigation District. Alternatives are in the process of being developed.

PBS&J is collecting data for the EIA. The level of detail for our assessment will be as necessary to describe existing conditions and to provide analysis of future conditions due to project impacts. The project study area is in the vicinity of Beaumont, Port Arthur, and Sabine Pass, Texas and encompasses the entire 75-mile long deep draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to Beaumont and adjacent areas that may be affected by proposed project alternatives.

PBS&J is submitting this letter to request information on Essential Fish Habitat occurring in the project area, which should be addressed for the project, and any conservation recommendations you may have. Please call me at (512) 342-3389 if you have any questions or need additional information.

Sincerely,

Lisa Vitale

Lisa Vitale, FP-C
Marine/Aquatic Biologist
LDV/lv

6504 Bridge Point Parkway • Austin, TX. 78730 • Telephone 512.327.6840 • Fax 512.327.2453 • www.pbsj.com

PBS&J

*An employee-owned company*

September 14, 2004

Ms. Jill Kelly
Louisiana Department of Wildlife and Fisheries
P.O. Box 98000
Baton Rouge, Louisiana 70898

Dear Ms. Kelly,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding state protected species within the study area. Your office (Mr. Gary Lester) initially responded to our data request in 2002 (attached), however, we are currently updating our agency contacts. Please provide written response since your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts. If there has been no change since your 2002 response, please let us know and we will utilize your earlier information.

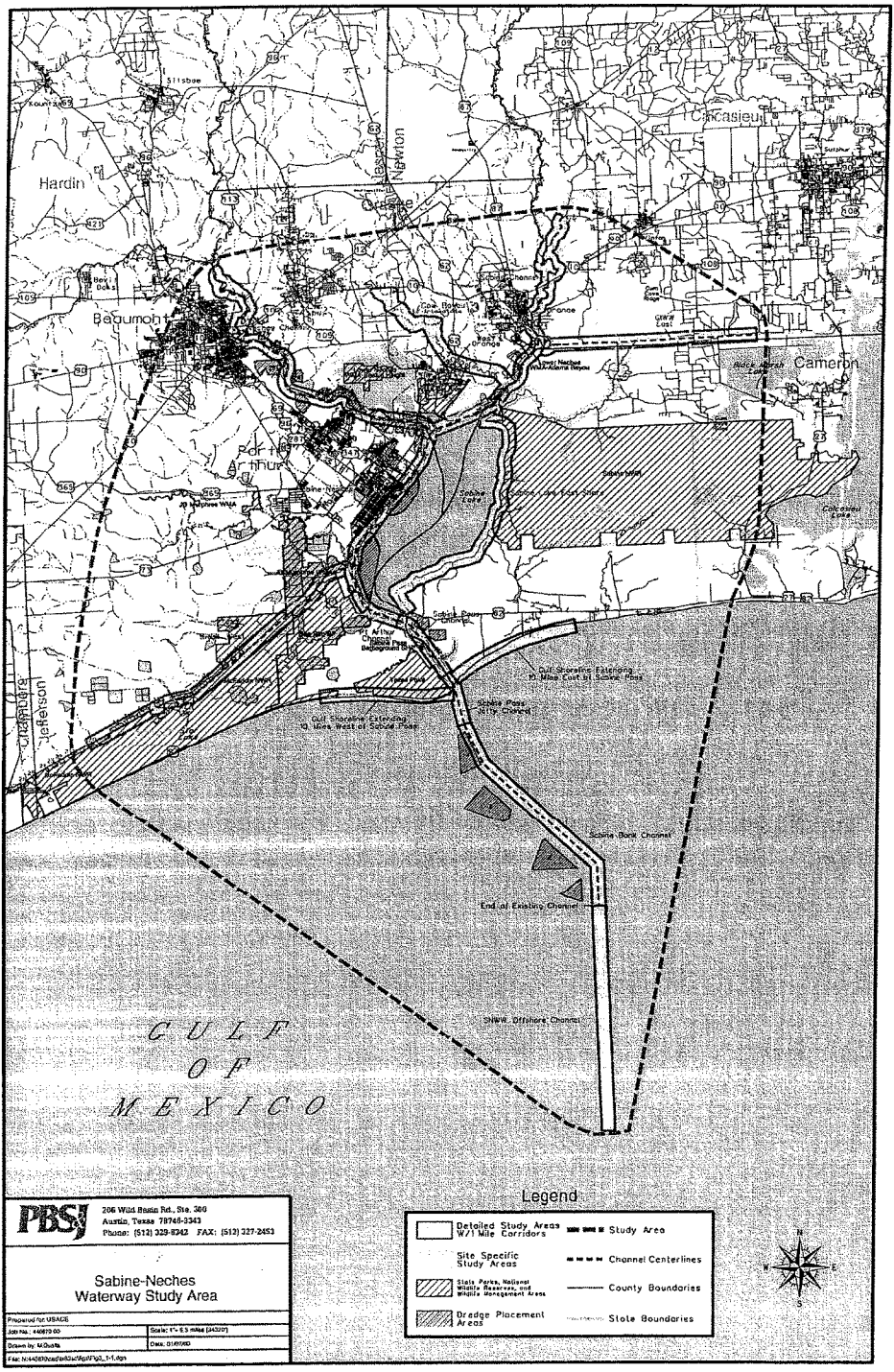
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachments

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com


Hardin
Newton
Jasper
Orange
Beaumont
Port Arthur
Cameron
Calcasieu
Jefferson
Chambers
Sabine Pass
Sabine Lake
Sabine NWR
Sabine Pass Channel
Port Arthur Channel Improvements
Gulf Shoreline Extending 10 Miles East of Sabine Pass
Gulf Shoreline Extending 10 Miles West of Sabine Pass
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Sabine-Neches
Waterway Study Area
Prepared for USACE
Job No.: 44679-00
Scale: 1"= 6.5 miles (24320')
Drawn by: M.Duttle
Date: 01/07/00

State of Louisiana

James H. Jenkins, Jr.
Secretary

Department of Wildlife & Fisheries
Post Office Box 98000
Baton Rouge, LA 70898-9000
(225) 765-2800

M.J. "Mike" Foster, Jr.
Governor

| | |
|---|---|
| ***Name*** | Mr. Dave Munson |
| ***Company*** | PBS&J |
| ***Street Address*** | 206 Wild Basin Road, Suite 300 |
| ***City, State, Zip*** | Austin, Texas 78746 |
| ***Project*** | Sabine-Neches Waterway Feasibility Study and EIS |
| ***Date*** | July 30, 2002 |
| ***Invoice Number*** | 02073001 |

Personnel of the Habitat Section of the Fur and Refuge Division have reviewed the preliminary data for the captioned project. In reviewing our database, many rare, threatened, or endangered species or critical habitats were found within the area of the captioned project that lies in Louisiana. I have attached tables containing the information for these element occurrence records, along with explanations of the data fields. Please refer to the LNHP data utilization agreement for restrictions regarding the use of these data. Element occurrence location information is given as point data and do not reflect the local extent of the occurrence. In addition, the precision of the location information may be limited. Please refer to the precision data field which defines the precision to which the element occurrence as described can be located on a topographic map. Due to the preliminary nature of the request, and the fact that no specific project details were given, the Louisiana Natural Heritage Program is unable to make specific comments concerning the project's impact on these species at this time. It will be necessary for you to contact us as your project progresses and specific project details are available, so that we may make the necessary comments in the future. In addition, please be aware that a manatee (Trichechus manatus) was observed in the Sabine River North of the I-10 Bridge in November of 1999. The manatee is listed as endangered on both the federal and state species lists. Your project area is in the Louisiana Department of Wildlife and Fisheries Sabine Island Wildlife Management Area (WMA). Please Contact the WMA Manager John Robinette at 318-491-2575 to coordinate activity. Your project area is in the USFWS Sabine National Wildlife Refuge. Please contact USFWS Wildlife Biologist Diane Borden-Billiot at 318-762-3816 to coordinate activity. Your project area is in the coastal zone. Contact the State of Louisiana Department of Natural Resources Coastal Management Division to determine if a coastal use permit is required. The Sabine Pass Lighthouse State Commemorative Area occurs in your project area. No other state or federal parks, wildlife refuges, scenic streams, or wildlife management areas are known at the specified site within Louisiana's boundaries.

The Louisiana Natural Heritage Program has compiled data on rare, endangered, or otherwise significant plant and animal species, plant communities, and other natural features throughout the state of Louisiana. Heritage reports summarize the existing information known at the time of the request regarding the

location in question. This report does not address the occurrence of wetlands at the site in question. Heritage reports should not be considered final statements on the biological elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The Louisiana Natural Heritage Program requires that this office be acknowledged in all reports as the source of all data provided here. If you have any questions or need additional information, please call Louisiana Natural Heritage Program Data Manger Jill Kelly at (225) 765-2643.

Sincerely,

Gary Lester, Coordinator
Natural Heritage Program

## LOUISIANA NATURAL HERITAGE PROGRAM (LNHP)

## DATA UTILIZATION AGREEMENT

We are pleased to provide you with information on the occurrence of threatened and endangered species. Do to the dynamic nature of the LNHP database and the sensitivity of some of the information however, some precautions are necessary in your use of the information.

Please sign and date below and return this document if you are in agreement with the conditions listed below for utilization of the LNHP database.

This agreement allows Dave Munson of PBS&J, 206 Wild Basin Road, Suite 300, Austin, Texas 78746 use of the LNHP records, at $20.00 per quad, for the Sabine-Neches Waterway Feasibility Study and EIS. The information supplied by the LNHP shall be used only for this project. As an employee of PBS&J, Dave Munson is authorized to sign this agreement.

PBS&J shall not use computer and hard copy files of LNHP data for any other projects, and PBS&J shall not release any copy of the LNHP data files to another party, without written consent of the LNHP Director.

All maps and graphs generated by PBS&J, using information provided by the LNHP shall reference in the legend the LNHP program as the source of the data. All text generated by PBS&J using information provided by the LNHP shall reference on the title or acknowledgement page the LNHP program as the source of the data, and the date the data were provided.

The quantity and quality of data collected by the LNHP are dependent on the research and observations of many individuals. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in Louisiana have not been surveyed. The LNHP database represents a compilation of information extracted from published and unpublished literature, museums and herbaria, field surveys, personal communications, and other sources. Records for new occurrences of plants and animals are continuously being added to the database and other occurrence records may change as new information is gathered. For these reasons, PBS&J is authorized to use the data for a period of one year from the date the data are received. At that time, PBS&J shall delete all computerized files containing the LNHP data, or enter into another data utilization agreement with the LNHP.

The LNHP cannot provide a definitive statement on the presence, or absence, or condition of biological elements in any part of Louisiana. LNHP reports summarize the existing information known to the LNHP at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments.

The LNHP and the State of Louisiana shall not be liable for any damages or loss whatsoever, to any person or legal entity, or property resulting from the use of the data specified here. PBS&J and/or any person or legal entity which receives said information from PBS&J agrees to indemnify and hold harmless the LNHP and the State of Louisiana from and against any and all claims, demands and causes of action of any description in favor of any person for damage or loss whatsoever to persons, legal entities, or property arising from the use of the data specified herein and/or any person or legal entity which receives said information from PBS&J

Information provided by this database transfer may not be published without prior written approval of the LNHP, and the LNHP must be credited as an information source in these publications.

Gary Lester
Director, Natural Heritage Program
Date: 7-31-02

Dave Munson
PBS&J
Date: 8/7/02

# Louisiana Natural Heritage Program
# Biological Conservation Database Field Definitions

EOCODE – (Element Occurrence Code) Represents a unique code for each element in the database

LONG – Longitude of the centrum of the element occurrence. Element Occurrence data is given as point information for the centrum of the occurrence, at this time we can not supply information about the local extent of the occurrence.

LAT – Latitude of the centrum of the element occurrence. Element Occurrence data is given as point information for the centrum of the occurrence, at this time we can not supply information about the local extent of the occurrence.

PRECISION - Precision to which the element occurrence as described can be located on a topographic map.

S = Seconds (accuracy of locality mappable within a three-second radius)
M – Minute (within a one minute radius, approximately 2 km or 1.5 miles from centerpoint)
G = general (to quad or place name precision only, precision within about 8 km or 5 miles)

SNAME – (State Name) The appropriate element name recognized in the state using standard scientific binomial (or trinomial) nomenclature

SCOMNAME– (State Common Name) Common name of the element that is recognized at the state level

USESA – (United States Endangered Species Act) Appropriate standard abbreviation for the U.S. federal register category for the element as proposed or determined by the U.S. Fish and Wildlife Service or the National Oceanic and Atmospheric Administration (marine species)

GRANK– (Global Rank) The global element rank which best characterizes the relative rarity or endangerment of the element worldwide.

SRANK – (State Rank) The state element rank which best characterizes the relative rarity or endangerment of the element in the state.

LASTOBS – (Last Observation) Date the element occurrence was last observed extant at this site; not necessarily date site was last visited.

## EXPLANATION OF RANKING CATEGORIES EMPLOYED BY NATURAL HERITAGE PROGRAMS NATIONWIDE

Each element is assigned a single global rank as well as a state rank for each state in which it occurs. Global ranking is done under the guidance of NatureServe, Arlington, VA. State ranks are assigned by each state's Natural Heritage Program, thus a rank for a particular element may vary considerably from state to state. Federal ranks are designated by the U.S. Fish & Wildlife Service under the provisions of the Endangered Species Act of 1973.

**FEDERAL RANKS (USESA FIELD):**

LE = Listed Endangered

LT = Listed Threatened

PE = Proposed endangered

PT = Proposed Threatened

C = Candidate

PDL = Proposed for delisting

E (S/A) or T (S/A) = Listed endangered or threatened because of similarity of appearance

XE = Essential experimental population

XN = Nonessential experimental population

No Rank = Usually indicates that the taxon does not have any federal status. However, because of potential lag time between publication in the Federal Register and entry in the central databases and state databases, some taxa may have a status which does not yet appear.

(Rank, Rank) = Combination values in parentheses = The taxon itself is not named in the Federal Register as having U.S. ESA status; however, all of its infraspecific taxa (worldwide) do have official status. The statuses shown in parentheses indicate the statuses that apply to infraspecific taxa or populations within this taxon. *THE SPECIES IS CONSIDERED TO HAVE A COMBINATION STATUS IN LOUISIANA*

(PS) = partial status= Status in only a portion of the species' range. Typically indicated in a "full" species record where an infraspecific taxon or population has U.S. ESA status, but the entire species does not. *THE SPECIES DOES NOT HAVE A STATUS IN LOUISIANA*

(PS: Rank) = partial status= Status in only a portion of the species' range. The value of that status appears because the entity with status does not have an individual entry in Natureserve. *THE SPECIES MAY HAVE A STATUS IN LOUISIANA*

**GLOBAL ELEMENT RANKS:**

G1 = critically imperiled globally because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extinction

G2 = imperiled globally because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extinction throughout its range

G3 = either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range (21 to 100 known extant populations)

G4 = apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery (100 to 1000 known extant populations)

G5 = demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery (1000+ known extant populations)

GH = of historical occurrence throughout its range; i.e., formerly part of the established biota, with the possibility that it may be rediscovered (e.g., Bachman's Warbler)

GU = possibly in peril range-wide, but status uncertain; need more information

G? = rank uncertain. Or a range (e.g., G3G5) delineates the limits of uncertainty

GQ = uncertain taxonomic status

GX = believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered

T = subspecies or variety rank (e.g., G5T4 applies to a subspecies with a global species rank of G5, but with a subspecies rank of G4)

**STATE ELEMENT RANKS:**

S1 = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation

S2 = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation

S3 = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations)

S4 = apparently secure in Louisiana with many occurrences (100 to 1000 known extant populations)

S5 = demonstrably secure in Louisiana (1000+ known extant populations)

(B or N may be used as qualifier of numeric ranks and indicating whether the occurrence is breeding or nonbreeding)

SA = accidental in Louisiana, including species (usually birds or butterflies) recorded once or twice or only at great intervals hundreds or even thousands of miles outside their usual range

SH = of historical occurrence in Louisiana, but no recent records verified within the last 20 years; formerly part of the established biota, possibly still persisting

SR = reported from Louisiana, but without conclusive evidence to accept or reject the report

SU = possibly in peril in Louisiana, but status uncertain; need more information

SX = believed to be extirpated from Louisiana

SZ = transient species in which no specific consistent area of occurrence is identifiable

LNHP Element Occurrence Data in or surrounding your project area on the Echo 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNKC10010*185*LA | 0934142W | 300743N | HALIAEETUS LEUCOCEPHALUS | BALD EAGLE | (PS:LT,PDL) | G4 | S2N,S3B | S | 1999 |
| AFCJC04010*014*LA | 0934035W | 301245N | CYCLEPTUS ELONGATUS | BLUE SUCKER | | G3G4 | S2S3 | S | 3/27/1996 |

LNHP Element Occurrence Data in or surrounding your project area on the Cameron Farms 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| CPCS000000*002*LA | 0933350W | 300415N | BOTTOMLAND HARDWOOD FOREST | BOTTOMLAND HARDWOOD FOREST | | | S4 | S | -1977 |
| PMCYP090Q0*001*LA | 0933130W | 300300N | ELEOCHARIS FALLAX | CREEPING SPIKE-RUSH | | G4G5 | S1? | M | 4/6/1984 |

LNHP Element Occurrence Data in or surrounding your project area on the Black Lake 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNGE05010*013*LA | 0932333W | 300255N | AJAIA AJAJA | ROSEATE SPOONBILL | | G5 | S3 | M | 5/1/1989 |
| ORKER00000*224*LA | 0932333W | 300255N | WATERBIRD NESTING COLONY | WATERBIRD NESTING COLONY | | | | M | 5/1/1989 |

LNHP Element Occurrence Data in or surrounding your project area on the West of Greens Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| CEA2000000*010*LA | 0934510W | 295715N | BRACKISH MARSH | BRACKISH MARSH | | | S3S4 | S | -1977 |

LNHP Element Occurrence Data in or surrounding your project area on the Greens Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNGE05010*030*LA | 0934436W | 295707N | AJAIA AJAJA | ROSEATE SPOONBILL | | G5 | S3 | S | 5/28/1998 |
| CTB2000000*004*LA | 0934414W | 295652N | COASTAL PRAIRIE | COASTAL PRAIRIE | | G2Q | S1 | S | -1986 |
| CTB2000000*021*LA | 0934234W | 295702N | COASTAL PRAIRIE | COASTAL PRAIRIE | | G2Q | S1 | S | 5/8/1997 |
| ORKER00000*378*LA | 0934430W | 295707N | WATERBIRD NESTING COLONY | WATERBIRD NESTING COLONY | | | | S | 5/20/1996 |

LNHP Element Occurrence Data in or surrounding your project area on the F-R Ranch 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNKD02020*002*LA | 0933108W | 295857N | CARACARA CHERIWAY | CRESTED CARACARA | (PS:LT) | G5 | S1 | M | 4/2/1987 |
| CPA1000000*015*LA | 0933554W | 295911N | FRESHWATER MARSH | FRESHWATER MARSH | | | S1S2 | S | 4/2/1987 |
| ORKER00000*075*LA | 0933300W | 295900N | WATERBIRD NESTING COLONY | WATERBIRD NESTING COLONY | | | | M | 4/26/1990 |

LNHP Element Occurrence Data in or surrounding your project area on the Port Arthur South 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| PMPOA48010*001*LA | 0935334W | 294800N | MONANTHOCHLOE LITTORALIS | SALTFLAT-GRASS | | G4G5 | S1 | M | 7/14/1984 |

Element Occurrence Data in or surrounding your project area on the West of Johnsons Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| CEA2000000*011*LA | 0934727W | 294703N | BRACKISH MARSH | BRACKISH MARSH | | | S3S4 | S | -1977 |
| CTC1000000*001*LA | 0933830W | 294506N | COASTAL LIVE OAK-HACKBERRY FOREST | COASTAL LIVE OAK-HACKBERRY FOREST | | G1G2Q | S1S2 | S | 1984-FALL |

LNHP Element Occurrence Data in or surrounding your project area on the Johnsons Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| PDAST7Z020*001*LA | 0933830W | 294603N | RATIBIDA PEDUNCULARIS | MEXICAN HAT | | G4G5 | S2S3 | S | 9/7/1984 |
| PDBOR0L070*001*LA | 0933836W | 294506N | LITHOSPERMUM INCISUM | NARROW-LEAVED PUCCOON | | G5 | S1 | G | 4/8/1966 |
| PMPOA6S010*007*LA | 0933907W | 294503N | UNIOLA PANICULATA | SEA OATS | | G5 | S2 | M | 9/4/1974 |
| CTC1000000*001*LA | 0933830W | 294506N | COASTAL LIVE OAK-HACKBERRY FOREST | COASTAL LIVE OAK-HACKBERRY FOREST | | G1G2Q | S1S2 | S | 1984-FALL |
| PDFAB1A0C0*004*LA | 0933907W | 294502N | DALEA EMARGINATA | WEDGE-LEAF PRAIRIE-CLOVER | | G5 | S2 | M | 5/8/1982 |

Element Occurrence Data in or surrounding your project area on the Texas Point 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNNB03070*011*LA | 0934644W | 294338N | CHARADRIUS MELODUS | PIPING PLOVER | (LE,LT) | G3 | S2N | S | 2/19/1988 |

Element Occurrence Data in or surrounding your project area on the Smith Bayou 7.5 minute Quadrangle Map

| Eocode | Long | Lat | Sname | Scomname | Usesa | Grank | Srank | Precision | Lastobs |
|---|---|---|---|---|---|---|---|---|---|
| ABNNB03030*002*LA | 0934024W | 294452N | CHARADRIUS ALEXANDRINUS | SNOWY PLOVER | (PS:LT) | G4 | S1B,S2N | S | 2/9/1991 |
| ABNNB03040*002*LA | 0934442W | 294405N | CHARADRIUS WILSONIA | WILSON'S PLOVER | | G5 | S1S3B,S3N | M | 4/27/1986 |
| ABNNB03070*002*LA | 0934024W | 294452N | CHARADRIUS MELODUS | PIPING PLOVER | (LE,LT) | G3 | S2N | S | 2/9/1991 |
| CTB1000000*013*LA | 0933959W | 294450N | COASTAL DUNE GRASSLAND | COASTAL DUNE GRASSLAND | | | S1S2 | S | 5/2/1989 |
| CTC1000000*001*LA | 0933830W | 294506N | COASTAL LIVE OAK-HACKBERRY FOREST | COASTAL LIVE OAK-HACKBERRY FOREST | | G1G2Q | S1S2 | S | 1984-FALL |
| PDAMA040N0*002*LA | 0933953W | 294457N | AMARANTHUS GREGGII | GREGG'S AMARANTH | | G4? | S2S3 | M | 6/30/1984 |
| PDAST7Z020*006*LA | 0933959W | 294457N | RATIBIDA PEDUNCULARIS | MEXICAN HAT | | G4G5 | S2S3 | S | 5/12/1987 |
| PDFAB0F630*008*LA | 0934321W | 294424N | ASTRAGALUS NUTTALLIANUS | A MILK-VETCH | | G5 | S2S3 | S | 5/2/1989 |
| PDFAB1A0C0*004*LA | 0933907W | 294502N | DALEA EMARGINATA | WEDGE-LEAF PRAIRIE-CLOVER | | G5 | S2 | M | 5/8/1982 |
| PDFAB1A0C0*006*LA | 0933959W | 294457N | DALEA EMARGINATA | WEDGE-LEAF PRAIRIE-CLOVER | | G5 | S2 | S | 5/12/1987 |
| PDFAB1A0C0*007*LA | 0934321W | 294424N | DALEA EMARGINATA | WEDGE-LEAF PRAIRIE-CLOVER | | G5 | S2 | S | 5/2/1989 |
| PDFAB5L0K0*007*LA | 0934321W | 294424N | PEDIOMELUM RHOMBIFOLIUM | ROUNDLEAF SCARF-PEA | | G5 | S2S3 | S | 5/2/1989 |

PBS&J

*An employee-owned company*

September 14, 2004

Ms. Kathy Boydston
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Dear Ms. Boydston,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding state protected species within the study area. Your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

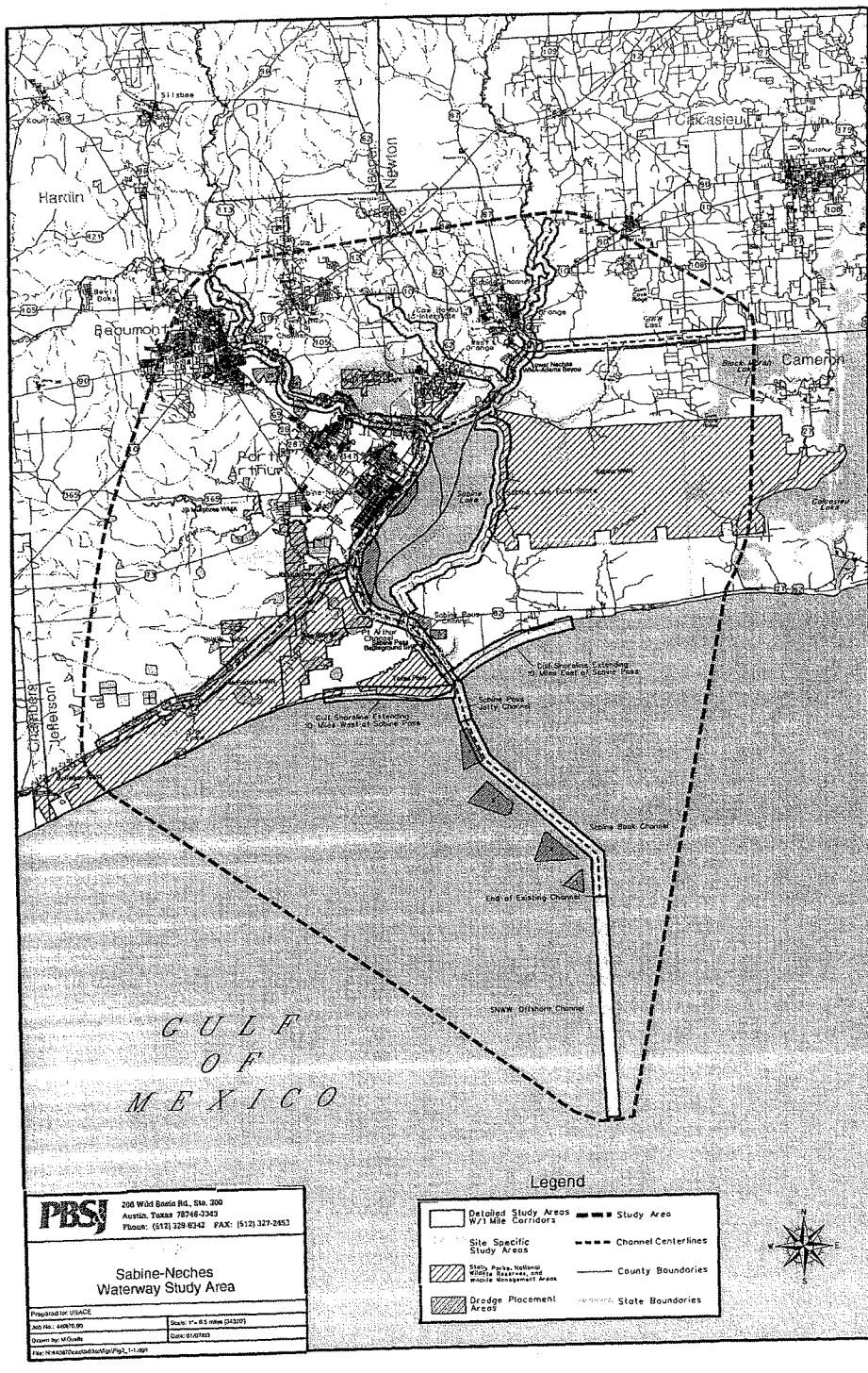
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com


Silsbee
Kountze
Hardin
Newton
Jasper
Lake Charles
Calcasieu
Beaumont
Port Arthur
Orange
Cameron
Chambers
Jefferson
Sabine Pass
Sabine Lake
Sabine Pass Jetty Channel
Sabine Pass Channel
Gulf Waterway Extending 10 Miles West of Sabine Pass
Gulf Waterway Extending 10 Miles East of Sabine Pass
Sabine Bank Channel
End of Existing Channel
SNWW Offshore Channel
GULF OF MEXICO
Legend
Detailed Study Areas W/1 Mile Corridors
Study Area
Site Specific Study Areas
Channel Centerlines
State Parks, National Wildlife Reserves, and Wildlife Management Areas
County Boundaries
Dredge Placement Areas
State Boundaries
PBSJ
208 Wild Basin Rd., Ste. 300
Austin, Texas 78746-2343
Phone: (512) 328-6242 FAX: (512) 327-2453
Sabine-Neches
Waterway Study Area
Prepared for USACE
Job No.: 440870
Scale: 1" = 8.5 miles (34320)
Drawn by: MGuelfo
Date: 01/07/03

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November 19, 2004

Martin Arhelger
Project Manager
PBS&J
6504 Bridge Point Parkway, Suite 200
Austin, Texas 78730

Re: Proposed project to widen and deepen the Sabine-Neches Waterway, Jefferson and Orange Counties.

Dear: Mr. Arhelger:

This letter is in response to your request for information concerning the state threatened and endangered fish, wildlife, and plant resources associated with the project referenced above. Texas Parks and Wildlife Department (TPWD) staff reviewed the project and provides the following comments.

The Jefferson County Navigation District proposes to widen and deepen the Sabine- Neches Waterway (SNWW). The SNWW is located in Jefferson and Orange Counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The proposed project area includes SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico.

Take a kid
hunting or fishing

Visit a state park
or historic site

Please find attached the list of special species that occur in Jefferson and Orange Counties. If rare plant or animal species are found within or near the project area, precautions should be taken to avoid adverse impacts to them. If it is determined adverse impacts could occur with completion of your project, then mitigation in the form of planning to reduce adverse impacts and/or compensation for damages should occur. More site-specific information from a search of the BCD database and review of potential project impacts to endangered and threatened species can be obtained for a $50 fee. For more information about the BCD or threatened and endangered species in the project area please contact Celeste Brancel at (512) 912-7021.

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512-389-4800
www.tpwd.state.tx.us

*To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.*

We appreciate the opportunity to review and comment on your project. If you have any questions please contact me in Victoria at (361) 576-0022.

Sincerely,

Amy Hanna

Amy Hanna
Wildlife Habitat Assessment Program
Wildlife Division

/ajh

Attachment

# JEFFERSON COUNTY

| | Federal Status | State Status |
|---|---|---|

******* DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT*******
**UNDER CONSTRUCTION **** SPECIES MIGHT BE ADDED/DELETED DURING QUALITY CONTROL**

## *** AMPHIBIANS ***

**Pig Frog** (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

## *** BIRDS ***

| | Federal Status | State Status |
|---|---|---|
| **American Peregrine Falcon** (*Falco peregrinus anatum*) - potential migrant; nests in west Texas | DL | E |
| **Arctic Peregrine Falcon** (*Falco peregrinus tundrius*) - potential migrant | DL | T |
| **Bald Eagle** (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds | LT-PDL | T |
| **Brown Pelican** (*Pelecanus occidentalis*) - largely coastal and near shore areas, where it roosts on islands and spoil banks | LE | E |
| **Henslow's Sparrow** (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking | | |
| **Interior Least Tern** (*Sterna antillarum athalassos*) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony | LE | E |
| **Piping Plover** (*Charadrius melodus*) - wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats | LT | T |
| **Reddish Egret** (*Egretta rufescens*) - resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear | | T |
| **Snowy Plover** (*Charadrius alexandrinus*) – wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats | | |
| **Sooty Tern** (*Sterna fuscata*) – predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July | | T |
| **Swallow-tailed Kite** (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees | | T |
| **White-faced Ibis** (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats | | T |
| **Wood Stork** (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960 | | T |

| | Federal Status | State Status |
|---|---|---|
| ***** BIRDS-RELATED ***** | | |
| **Colonial waterbird nesting areas** - many rookeries active annually | | |
| **Migratory songbird fallout areas** - oak mottes and other woods/thickets provide foraging/roosting sites for neotropical migratory songbirds | | |
| *****FISHES***** | | |
| **American Eel** (*Anguilla rostrata*) - most aquatic habitats with access to ocean; spawns January-February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries | | |
| **Paddlefish** (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir | | T |
| ***** MAMMALS ***** | | |
| **Black Bear** (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles | T/SA; NL | T |
| **Louisiana Black Bear** (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas | LT | T |
| **Plains Spotted Skunk** (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie | | |
| **Rafinesque's Big-eared Bat** (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures | | T |
| **Red Wolf** (*Canis rufus*) **(extirpated)** - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies | LE | E |
| **Southeastern Myotis Bat** (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures | | |
| ***** REPTILES ***** | | |
| **Alligator Snapping Turtle** (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October | | T |
| **Atlantic Hawksbill Sea Turtle** (*Eretmochelys imbricata*) - Gulf and bay system | LE | E |
| **Green Sea Turtle** (*Chelonia mydas*) – Gulf and bay system | LT | T |
| **Gulf Saltmarsh Snake** (*Nerodia clarkii*) - saline flats, coastal bays, & brackish river mouths | | |
| **Kemp's Ridley Sea Turtle** (*Lepidochelys kempii*) - Gulf and bay system | LE | E |
| **Leatherback Sea Turtle** (*Dermochelys coriacea*) - Gulf and bay system | LE | E |
| **Loggerhead Sea Turtle** (*Caretta caretta*) - Gulf and bay system | LT | T |

| | Federal Status | State Status |
|---|---|---|
| **Northern Scarlet Snake** (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September | | T |
| **Texas Diamondback Terrapin** (*Malaclemys terrapin littoralis*) - coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide | | |
| **Texas Horned Lizard** (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September | | T |
| **Timber/Canebrake Rattlesnake** (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto | | T |

## *** VASCULAR PLANTS ***

**Chapman's orchid** (*Platanthera chapmanii*) - in Texas, restricted to wetland pine savannas, one of the states most endangered habitats; flowering July-August

Status Key:

| | |
|---|---|
| LE, LT | - Federally Listed Endangered/Threatened |
| PE, PT | - Federally Proposed Endangered/Threatened |
| E/SA, T/SA | - Federally Listed Endangered/Threatened by Similarity of Appearance |
| C1 | - Federal Candidate for Listing, Category 1; information supports proposing to list as endangered/threatened |
| DL, PDL | - Federally Delisted/Proposed for Delisting |
| NL | - Not Federally Listed |
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| "blank" | - Rare, but with no regulatory listing status |

*Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.*

# ORANGE COUNTY

| | Federal Status | State Status |
|---|---|---|
| ***** DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT***** UNDER CONSTRUCTION **** SPECIES MIGHT BE ADDED/DELETED DURING QUALITY CONTROL | | |
| *** AMPHIBIANS *** | | |
| **Pig Frog** (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt | | |
| *** BIRDS *** | | |
| **American Peregrine Falcon** (*Falco peregrinus anatum*) - potential migrant; nests in west Texas | DL | E |
| **Arctic Peregrine Falcon** (*Falco peregrinus tundrius*) - potential migrant | DL | T |
| **Bald Eagle** (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds | LT-PDL | T |
| **Brown Pelican** (*Pelecanus occidentalis*) - largely coastal and near shore areas, where it roosts on islands and spoil banks | LE | E |
| **Henslow's Sparrow** (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking | | |
| **Interior Least Tern** (*Sterna antillarum athalassos*) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony | LE | E |
| **Piping Plover** (*Charadrius melodus*) - wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats | LT | T |
| **Reddish Egret** (*Egretta rufescens*) - brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear | | T |
| **Snowy Plover** (*Charadrius alexandrinus*) – wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats | | |
| **Sooty Tern** (*Sterna fuscata*) – predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July | | T |
| **Swallow-tailed Kite** (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees | | T |
| **White-faced Ibis** (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats | | T |
| **Wood Stork** (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960 | | T |

| | Federal Status | State Status |
|---|---|---|
| ***** BIRDS-RELATED ***** | | |
| **Colonial waterbird nesting areas** - many rookeries active annually | | |
| **Migratory songbird fallout areas** - oak mottes and other woods/thickets provide foraging/roosting sites for neotropical migratory songbirds | | |
| *****FISH***** | | |
| **American Eel** (*Anguilla rostrata*) - most aquatic habitats with access to ocean; spawns January-February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries | | |
| **Ironcolor Shiner** (*Notropis chalybaeus*) - spawns April-September, eggs sink to bottom of pool; pools and slow runs of low gradient small acidic streams with sandy substrate and clear well vegetated water; feeds mainly on small insects, ingested plant material not digested | | |
| **Paddlefish** (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir | | T |
| ***** MAMMALS ***** | | |
| **Black Bear** (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles | T/SA; NL | T |
| **Louisiana Black Bear** (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas | LT | T |
| **Plains Spotted Skunk** (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie | | |
| **Rafinesque's Big-eared Bat** (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures | | T |
| **Red Wolf** (*Canis rufus*) **(extirpated)** - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies | LE | E |
| **Southeastern Myotis Bat** (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures | | |
| ***** REPTILES ***** | | |
| **Alligator Snapping Turtle** (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October | | T |
| **Gulf Saltmarsh Snake** (*Nerodia clarkii*) - saline flats, coastal bays, & brackish river mouths | | |
| **Northern Scarlet Snake** (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September | | T |

| | Federal Status | State Status |
|---|---|---|
| **Sabine Map Turtle** (*Graptemys quachitensis sabinensis*) – Sabine River system; rivers and related tributaries, ponds and reservoirs with abundant aquatic vegetation; basks on fallen logs and exposed roots; eats insects, crustaceans, mollusks, and aquatic plants; breeding and egg-laying March-May, with hatchlings appearing in early fall | | |
| **Texas Diamondback Terrapin** (*Malaclemys terrapin littoralis*) - coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide | | |
| **Texas Horned Lizard** (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September | | T |
| **Timber/Canebrake Rattlesnake** (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto | | T |

## *** VASCULAR PLANTS ***

**Chapman's orchid** (*Platanthera chapmanii*) - in Texas, restricted to wetland pine savannas, one of the states most endangered habitats; flowering July-August

**Long-sepaled false dragon-head** (*Physostegia longisepala*) – moist, acid loams in the fire-maintained transition zone between pine flatwoods and coastal prairies; also, wet, borrow ditches along roadsides and moist areas in manmade clearings in pine woodlands; flowering early May to late June

Status Key:

| | |
|---|---|
| LE, LT | - Federally Listed Endangered/Threatened |
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*Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.*

# Attachment B

# PBS&J 2006 Piping Plover Habitat Survey at Texas and Louisiana Points

## 1.0 INTRODUCTION

On July 20, 2006, PBS&J performed a reconnaissance of coastal/beachfront habitat for the U.S. Army Corps of Engineers, Galveston District (USACE). The project area extends from 0.5 miles from the base of the Sabine Pass jetties to a distance of 3.5 miles west into Texas, and 3.5 miles east, into Louisiana. The purpose of the survey was to determine the presence or absence of piping plover (*Charadrius melodus*) habitat within the survey area.

## 2.0 METHODOLOGY

The habitat assessment was conducted via boat since the majority of the survey areas were inaccessible to vehicular traffic. PBS&J biologists traversed the survey area as close to beachfront habitat as water depth would allow (approximately 50-150 yards), coming ashore to further document habitat conditions when water conditions were acceptable recording habitat descriptions, and noting which bird species were present on the site.

## 3.0 RESULTS

### 3.1 TEXAS COASTLINE

Typical Texas coastal/beachfront habitat represented by Photos 1 and 2 consists of mud/clay beachfront, approximately 5 to 30 feet in width, with decaying vegetation throughout. An approximately 1 foot layer of decaying seaweed covered the majority of the Texas beachfront. Upland from the mud/clay beachfront was a 1 to 3 foot mud/clay shelf leading to narrow expanses of sand and shell. The majority of Texas beachfront did not contain any tidal flats or mud flats. The Texas coastline in the study area was typical of severely eroded beaches that lack sand replenishment.

Upland from the sand/shell areas was found dense vegetation, including saltwort (*Batis maritima*), annual glasswort (*Salicornia bigelovii)*, seashore salt grass (*Distichlis spicata*), and a variety of beach grasses. Typical birds occurring in the survey area included sanderling (*Calidris alba*), greater yellowlegs (*Tringa melanoleuca*), laughing gull (*Larus atricilla*), Herring gull (*Larus argentatus*), Least tern (*Sterna antillarum*), and common tern (*Sterna hirundo*).

Surveyed areas along the Texas coast provide little shorebird habitat, and no suitable piping plover habitat. Construction activities represented in Photo 3 are currently ongoing along the Texas shoreline. Construction activities are located approximately 2.40 miles from the western jetty extending to the western boundary of the survey area. Numerous vehicles, heavy equipment, and watercraft were traversing this area during the survey period.

### 3.2 LOUISIANA COASTLINE

The Louisiana coastline contained tidal sand/mudflats, sand bars, and sandy beaches with tidal flats. A tidal sand/mudflat (Photo 5) was located approximately 0.37 miles from base of the east jetty, approximately 500 yards off the beach, and varied from approximately 10 to 150 yards in width. The sand/mudflat extended for approximately 1.65 miles and ran parallel to the coastline, connecting to the beach approximately 2 miles from the eastern jetty. The sand/mudflat contained a variety of avian species, including great blue heron (*Ardea herodias*), great egret (*Ardea alba*), least

tern, common tern, laughing gull, and herring gull. This tidal sand/mudflat represented in Photo 5 contained suitable piping plover feeding habitat.

A sand bar (Photo 6) , resulting from beneficial use of dredged material by Cheniere Sabine Pass LNG Project, was located approximately 0.50 miles from the eastern jetty, beginning approximately 1,400 yards offshore, extended for approximately 1.00 miles, and ended approximately 400 yards offshore. The sandbar varied from approximately 10 to 150 feet in width, contained no vegetation, but was occupied by a variety of avian species. Bird species found on the sandbar included brown pelican (*Pelecanus occidentalis*), least tern, common tern, laughing gull, herring gull, and greater yellowlegs. The sandbar contains tidal flats that appeared to be suitable for piping plover feeding habitat.

Approximately 2 miles from the eastern jetty, sandy beaches began and extended to the eastern boundary of the survey area. The sandy beaches (Photos 7 and 8) varied in width from 50 to 300 feet in width and ended at an eroded shoreline. Located upland from the sandy beaches were sometimes dense stands of typical shoreline vegetation, including saltwort, annual glasswort, seashore salt grass, salt cedar (*Tamarix spp.*) and a variety of beach grasses. On other sections, the upland vegetation was scattered. Typical birds occurring in the survey area included sanderling, greater yellowlegs, laughing gull, Herring gull, least tern, common tern, and black skimmer (*Rynchops niger*). Sandy beaches found in the Louisiana coastline survey area contained tidal flats, with sparse vegetation, making this area suitable for wintering piping plovers.

## 4.0 DISCUSSION AND CONCLUSIONS

The habitat assessment of the Texas coastline identified no areas suitable for wintering piping plovers. The coastline consisted of a clay/mud shelf, varying in height from 1 to 3 feet and inhibiting tide waters from flowing over the narrow stretches of sand and shell. The likelihood of this area being utilized by piping plovers is remote.

The habitat assessment of the Louisiana coastline identified several areas suitable for wintering piping plovers. The large tidal sand/mudflats and sandbars located offshore appeared to provide piping plover feeding habitat. The sandy beaches found within the survey area contain tidal flats with sparse vegetation and appear to provide feeding and roosting habitat for wintering piping plovers.

**Photo 1 - Typical view of Texas coastline, facing northeast.**

**Photo 2 - Typical view of Texas coastline, facing west.**

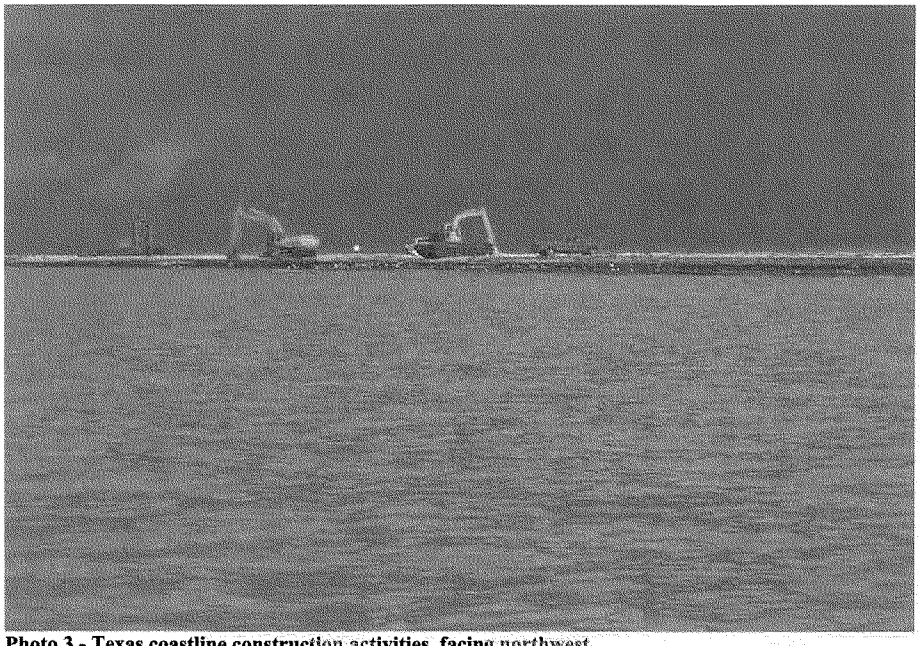

**Photo 3 - Texas coastline construction activities, facing northwest.**

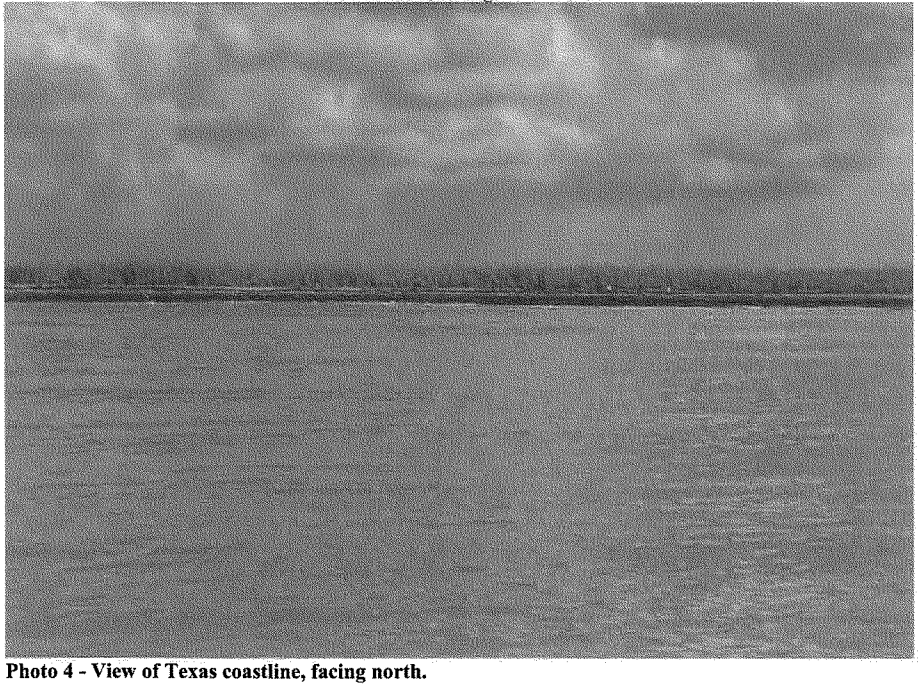

**Photo 4 - View of Texas coastline, facing north.**

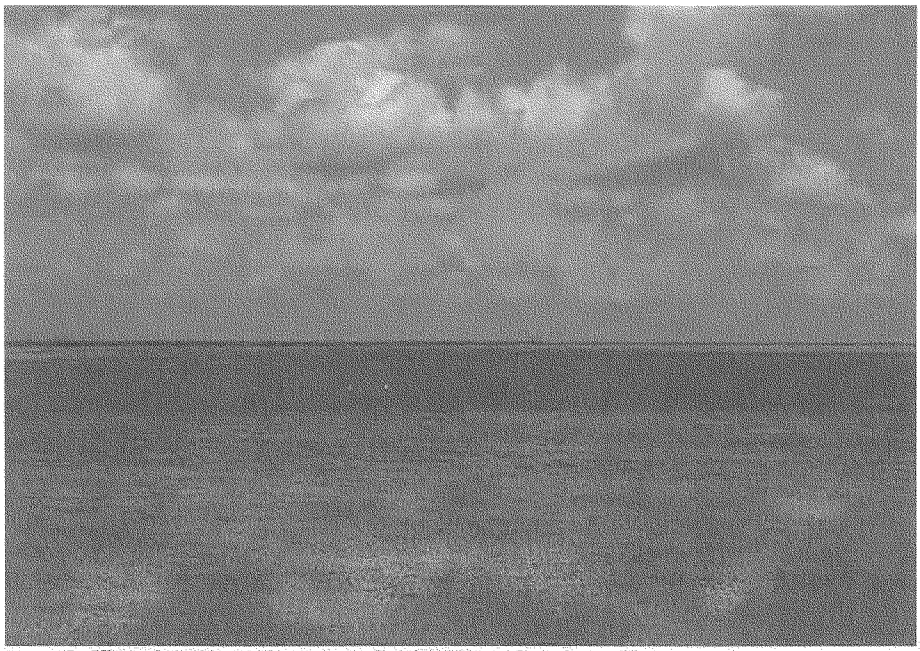

**Photo 5 - View of sand/mudflat along the Louisiana coastline, facing east.**

**Photo 6 - View of sandbar with avian species along the Louisiana coastline.**

**Photo 7 - View of Louisiana coastline, facing west.**

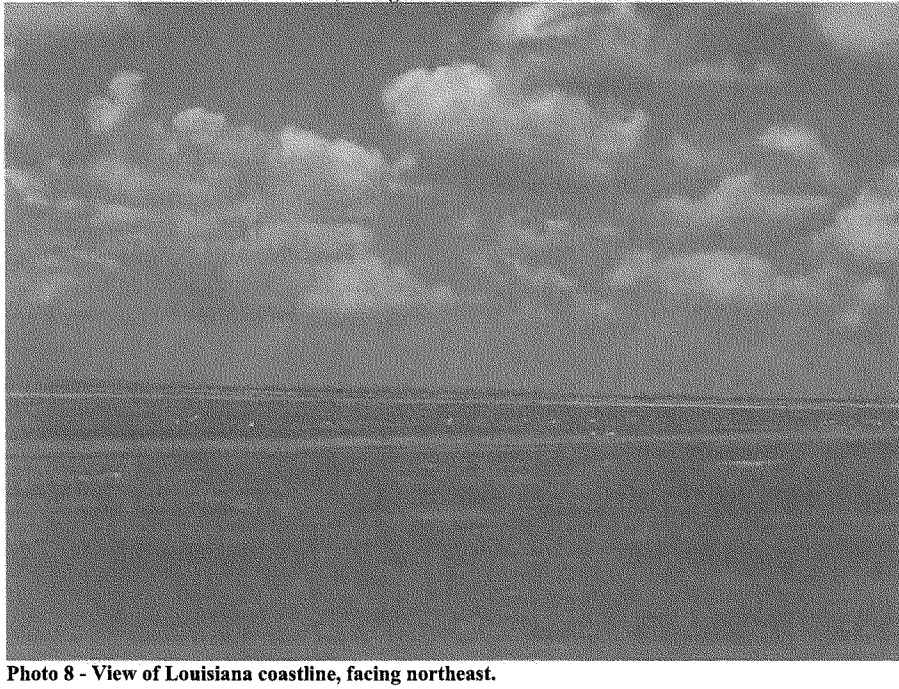

**Photo 8 - View of Louisiana coastline, facing northeast.**

# Appendix G2

# Biological Opinion

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701
(727) 824-5312; FAX (727) 824-5309
http://sero.nmfs.noaa.gov

AUG 13 2007

F/SER31:MCB

Ms. Carolyn Murphy
Galveston District, U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77553

Dear Ms. Murphy:

This constitutes the National Marine Fisheries Service's biological opinion (opinion) based on our review of the U.S. Army Corps of Engineers' (COE) proposed action to widen and deepen the Sabine-Neches Waterway involving a combination of mechanical, pipeline, and hopper dredges. The opinion analyzes the project's effects on loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*), and green *(Chelonia mydas)* sea turtles, in accordance with section 7 of the Endangered Species Act (ESA) of 1973. It is NMFS' biological opinion that the action, as proposed, is likely to adversely affect but is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, or green sea turtles.

This opinion is based on information provided in your February 21, 2007, letter and biological assessment, and a May 2, 2007, e-mail, as well as information from previous NMFS consultations conducted on the use of hopper dredges. A complete administrative record of this consultation is on file at NMFS' Southeast Regional Office.

We look forward to further cooperation with you on other COE projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Michael Barnette, fishery biologist, at the number listed above, or by e-mail at michael.barnette@noaa.gov.

Sincerely,

Thomas E. Weaver

For Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

File: 1514-22.F.1.TX
1514-22.F.1.LA
Ref: F/SER/2007/00954

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
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For Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

File: 1514-22.F.1.TX
1514-22.F.1.LA
Ref: F/SER/2007/00954

**Endangered Species Act - Section 7 Consultation**
**Biological Opinion**

**Action Agency:** U.S. Army Corps of Engineers, Galveston District (GDCOE)

**Activity:** Sabine-Neches Waterway Widening and Deepening (Consultation Number F/SER/2007/00954)

**Consulting Agency:** National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida

**Approved By:** James E. Weaver

For Roy E. Crabtree, Ph.D., Regional Administrator
NMFS, Southeast Regional Office
St. Petersburg, Florida

**Date Issued:** AUG 13 2007

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**Background**

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 *et seq.*), requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species; section 7(a)(2) requires federal agencies to consult with the appropriate Secretary on any such action. NMFS and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action "may affect" listed species or designated critical habitat. Consultation is concluded after NMFS determines that the action is not likely to adversely affect listed species or critical habitat or issues a biological opinion (opinion) that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat. The opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures - RPMs) to reduce the effect of take, and recommends conservation measures to further conserve the species. Notably, no incidental destruction or adverse modification of critical habitat can be authorized, and thus there are no reasonable and prudent measures, only reasonable and prudent alternatives that must avoid destruction or adverse modification.

This document represents NMFS' opinion based on our review of impacts associated with the proposed widening and deepening of the Sabine-Neches Waterway (SNWW). The proposed widening and deepening will occur along a 65-mile long deep draft channel on the Louisiana-Texas border, from the Gulf of Mexico through a jettied channel at Sabine Pass, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont, Texas. Deepening of the entrance channels will be accomplished with hopper dredges, while the inshore channels will be modified with hydraulic pipeline dredges. Some of the dredged material will be utilized to restore several degraded marsh areas, while the remainder will be disposed of in upland placement areas or at Ocean Dredged Material Disposal Sites (ODMDS).

The GDCOE will perform the proposed action. This opinion analyzes project effects on loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles, in accordance with section 7 of the ESA, and is based on project information provided by GDCOE and other sources of information including the published literature cited herein.

# BIOLOGICAL OPINION

## 1 CONSULTATION HISTORY

The GDCOE provided NMFS a biological assessment for the proposed project on February 21, 2007. This submission also requested ESA section 7 consultation for listed species. The biological assessment concluded the proposed action could potentially impact sea turtles.

## 2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

### 2.1 Proposed Action

The proposed widening and deepening of the SNWW will involve a combination of hydraulic pipeline and hopper dredges. Specific work includes:

1. Widening the Sabine Pass Jetty Channel, the Sabine Pass Channel, and the Port Arthur Canal to the junction of Taylors Bayou from 500 to 700 feet. Widening the entrance and connecting channels of Taylors Bayou Navigation Channel.
2. Deepening of the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont from 40 to 48 feet. Deepening the Taylors Bayou Navigation Channel and turning basins to 48 feet.
3. Deepening the existing SNWW Entrance Channel in the Gulf of Mexico from 42 to 50 feet, plus advance maintenance and allowable overdepth, and constructing an extension of the offshore entrance channel (50 x 700 feet for 13.1 miles).
4. Dredging two new anchorage basins, two new turning basins, and three turning and anchorage basins on the Neches River Channel, and reducing the existing Sabine Pass anchorage basin in size by approximately 50 percent.
5. Restoring three degraded marsh areas on the Neches River, six degraded marsh areas near Willow and Black Bayous, Louisiana, and nourish Gulf shorelines at Texas and Louisiana Points.
6. Establishing four new Ocean Dredged Material Disposal Sites (ODMDS) along the 13.1-mile extension of the offshore entrance channel.

Dredging the Sabine Pass Jetty and Entrance Channels will be conducted by hopper dredge, while hydraulic pipeline dredge will modify the remaining channels and basins. The proposed project new work would generate 110 million cubic yards of dredged material. Of that total, hopper dredges will remove approximately 44.69 million cubic yards; hydraulic pipeline dredges will remove the remainder. GDCOE informed NMFS that bed-leveling dredges will not be used in connection with the proposed action.

The dredging of the channels and basins is expected to require 4.75 years to complete, with several contracts running simultaneously. The GDCOE's Dredged Material Management Plan for the SNWW has a 50-year project life.

Future maintenance dredging of the SNWW will be covered under the revised regional biological opinion for Gulf of Mexico navigation channels (GMRBO; NMFS 2007). Because the widening and deepening of the SNWW is considered new work, the proposed action is not encompassed by the GMRBO. However, even though the dimensions of the SNWW would be expanded by the proposed action, the overall footprint (i.e., widening) of the SNWW would only have an insignificant increase in area. Therefore, since the total amount of future maintenance dredging of the SNWW would not be significantly increased, the effects of future maintenance dredging would be included in the existing GMRBO and any potential takes resulting from future maintenance dredging would be deducted from the ITS from that opinion. Subsequent placement of dredged material for shoreline restoration would occur every three years and alternate between Texas and Louisiana Points, so that placement of materials at each shoreline would occur every six years.

### 2.2 Action Area

50 CFR 404.02 defines action area as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The action area for this activity includes the 65-mile long deep draft channel running through Jefferson and Orange Counties, Texas, Cameron Parish, Louisiana, as well as waters of the Gulf of Mexico, and includes the associated ODMDS, all of which is bounded by a one-mile buffer area.

## 3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

The following endangered (E) and threatened (T) species under the jurisdiction of NMFS may occur in or near the action area:

| Common Name | Scientific Name | Status |
|---|---|---|
| **Sea Turtles** | | |
| Loggerhead sea turtle | *Caretta caretta* | T |
| Hawksbill sea turtle | *Eretmochelys imbricata* | E |
| Leatherback sea turtle | *Dermochelys coriacea* | E |
| Kemp's ridley sea turtle | *Lepidochelys kempii* | E |
| Green sea turtle | *Chelonia mydas*[1] | E/T |

There is no NMFS-designated critical habitat within the action area.

### 3.1 Species Likely to Be Affected

Pipeline and mechanical dredges (i.e., non-hopper dredges) are not known to introduce any direct impacts that may adversely affect sea turtles. While these dredges have the potential to impact habitat, which could adversely affect sea turtles, proposed dredging work will be confined to

[1] Green turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters.

existing channels devoid of preferred sea turtle foraging habitat, and, therefore, pipeline and mechanical dredges are not expected to introduce any indirect effects to sea turtles. However, loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles are all vulnerable to being taken as a result of the use of hopper dredges. NMFS believes these species may be incidentally captured in the course of the proposed action. Therefore, the remainder of the analysis in this biological opinion will focus on these species.

## 3.2 Status of Species

The sea turtle subsections focus primarily on the Atlantic Ocean populations of these species since these are the populations that may be directly affected by the proposed action; as sea turtles are highly migratory, potentially affected species in the action area may make migrations in other areas of the Gulf of Mexico, Atlantic Ocean, and Caribbean Sea. Therefore, the range-wide status of the species described below also best reflects each species' status within the action area. Furthermore, these species are listed as global populations (with the exception of Kemp's ridley and Florida green sea turtles, whose distribution is entirely in the Atlantic including the Gulf of Mexico), and the global status and trends of these species are included as well, in order to provide a basis for our final determination of the effects of the proposed action on the species as listed under the ESA.

### 3.2.1 Loggerhead Sea Turtle

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. It was listed because of direct take, incidental capture in various fisheries, and the alteration and destruction of its habitat. Loggerhead sea turtles inhabit the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. In the Atlantic, developmental habitat for small juveniles is the pelagic waters of the North Atlantic and the Mediterranean Sea (NMFS and USFWS 1991b). Within the continental United States, loggerhead sea turtles nest from Texas to New Jersey. Major nesting areas include coastal islands of Georgia, South Carolina, and North Carolina, and the Atlantic and Gulf of Mexico coasts of Florida, with the bulk of the nesting occurring on the Atlantic coast of Florida.

#### 3.2.1.1 Pacific Ocean

In the Pacific Ocean, major loggerhead nesting grounds are generally located in temperate and subtropical regions with scattered nesting in the tropics. Within the Pacific Ocean, loggerhead sea turtles are represented by a northwestern nesting aggregation located in Japan and a smaller southwestern nesting aggregation, which occurs in eastern Australia (Great Barrier Reef and Queensland) and New Caledonia (NMFS 2001a). There are no reported loggerhead nesting sites in the eastern or central Pacific Ocean basin. Data from 1995 estimated the Japanese nesting aggregation at 1,000 female loggerhead turtles (Bolten et al. 1996). Recent genetic analyses on female loggerheads nesting in Japan suggest that this "subpopulation" is comprised of genetically distinct nesting colonies (Hatase et al. 2002) with precise natal homing of individual females. As a result, Hatase et al. (2002) indicate that loss of one of these colonies would decrease the genetic diversity of Japanese loggerheads; recolonization of the site would not be expected on an ecological time scale. In Australia, long-term census data has been collected at

some rookeries since the late 1960s and early 1970s, and nearly all the data show marked declines in nesting populations since the mid-1980s (Limpus and Limpus 2003). The nesting aggregation in Queensland, Australia, was as low as 300 females in 1997.

Pacific loggerhead turtles are captured, injured, or killed in numerous Pacific fisheries including Japanese longline fisheries in the western Pacific Ocean and South China Seas; direct harvest and commercial fisheries off Baja California, Mexico; commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean; and California/Oregon drift gillnet fisheries. In addition, the abundance of loggerhead turtles on nesting colonies throughout the Pacific basin has declined dramatically over the past 10 to 20 years. Loggerhead turtle colonies in the western Pacific Ocean have been reduced to a fraction of their former abundance by the combined effects of human activities that have reduced the number of nesting females and reduced the reproductive success of females that manage to nest (e.g., due to egg poaching).

### 3.2.1.2 Atlantic Ocean

In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. There are at least five western Atlantic subpopulations, divided geographically as follows: (1) A northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29°N; (2) a south Florida nesting subpopulation, occurring from 29°N on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez 1990; TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS 2001a). Additionally, there is evidence of at least several other genetically distinct stocks, including a Cay Sal Bank, Western Bahamas stock; a Quintana Roo, Mexico stock, including all loggerhead rookeries on Mexico's Yucatan Peninsula; a Brazilian stock; and a Cape Verde stock (SWOT Report, Volume II, The State of the World's Sea Turtles, 2007). The fidelity of nesting females to their nesting beach is the reason these subpopulations can be differentiated from one another. Fidelity for nesting beaches makes recolonization of nesting beaches with sea turtles from other subpopulations unlikely.

*Life History and Distribution*
Past literature gave an estimated age at maturity of 21-35 years (Frazer and Ehrhart 1985; Frazer et al. 1994), with the benthic immature stage lasting at least 10-25 years. However, based on data from tag returns, strandings, and nesting surveys (NMFS 2001a), NMFS estimates ages of maturity ranging from 20-38 years with the benthic immature stage lasting from 14-32 years.

Mating takes place in late March through early June, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs in the southeastern United States. Individual females nest multiple times during a nesting season, with a mean of 4.1 nests/individual (Murphy and Hopkins 1984). Nesting migrations for an individual female loggerhead are usually on an interval of 2-3 years, but can vary from 1-7 years (Dodd 1988). Generally, loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years or more. Stranding records

indicate that when pelagic immature loggerheads reach 40-60 cm straight-line carapace length they begin to live in coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico, although some loggerheads may move back and forth between the pelagic and benthic environment (Witzell 2002). Benthic immature loggerheads (sea turtles that have come back to inshore and nearshore waters), the life stage following the pelagic immature stage, have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in Northeastern Mexico.

Tagging studies have shown loggerheads that have entered the benthic environment undertake routine migrations along the coast that are limited by seasonal water temperatures. Loggerhead sea turtles occur year round in offshore waters off North Carolina where water temperature is influenced by the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to immigrate to North Carolina inshore waters (e.g., Pamlico and Core Sounds) and also move up the coast (Epperly et al. 1995a; Epperly et al. 1995b; Epperly et al. 1995c), occurring in Virginia foraging areas as early as April and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some may remain in mid-Atlantic and Northeast areas until late fall. By December loggerheads have emigrated from inshore North Carolina waters and coastal waters to the north to waters offshore North Carolina, particularly off Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles ($\geq$ 11°C) (Epperly et al. 1995a; Epperly et al. 1995b; Epperly et al. 1995c). Loggerhead sea turtles are year-round residents of central and south Florida.

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988). Sub-adult and adult loggerheads are primarily coastal dwelling and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

*Population Dynamics and Status*

A number of stock assessments (TEWG 1998; TEWG 2000; NMFS 2001a; Heppell et al. 2003) have examined the stock status of loggerheads in the waters of the United States, but have been unable to develop any reliable estimates of absolute population size. Based on nesting data of the five western Atlantic subpopulations, the south Florida-nesting and the northern-nesting subpopulations are the most abundant (TEWG 2000; NMFS 2001a). Between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,014 to 92,182, annually with a mean of 73,751 (TEWG 2000). On average, 90.7 percent of these nests were of the south Florida subpopulation and 8.5 percent were from the northern subpopulation (TEWG 2000). The TEWG (2000) assessment of the status of these two better-studied populations concluded that the south Florida subpopulation was increasing at that time, while no trend was evident (may be stable but possibly declining) for the northern subpopulation. A more recent, yet-to-be-published analysis of nesting data from 1989-2005 by the Florida Wildlife Research Institute indicates there is a declining trend in nesting at beaches utilized by the south Florida nesting subpopulation (McRae letter to NMFS, October 25, 2006). Nesting data obtained for the 2006 nesting season is also consistent with the decline in loggerhead nests (Meylan pers. comm. 2006). It is unclear at this time whether the nesting decline reflects a decline in

population, or is indicative of a failure to nest by the reproductively mature females as a result of other factors (resource depletion, nesting beach problems, oceanographic conditions, etc.). NMFS has convened a new Turtle Expert Working Group for loggerhead sea turtles that will gather available data and examine the potential causes of the nesting decline and what the decline means in terms of population status. A final report by the loggerhead TEWG is expected by the end of summer 2007.

For the northern subpopulations, recent estimates of loggerhead nesting trends in Georgia from standardized daily beach surveys showed significant declines ranging from 1.5 to 1.9 percent annually (Mark Dodd, Georgia Department of Natural Resources, pers. comm., 2006). Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 3.3 percent annual decline in nesting since 1980. Another consideration that may add to the importance and vulnerability of the northern subpopulation is the sex ratios of this subpopulation. NMFS scientists have estimated that the northern subpopulation produces 65 percent males (NMFS 2001a). However, new research conducted over a limited time frame has found opposing sex ratios (Wyneken et al. 2004) so further information is needed to clarify the issue. Since nesting female loggerhead sea turtles exhibit nest fidelity, the continued existence of the northern subpopulation is related to the number of female hatchlings that are produced. Producing fewer females will limit the number of subsequent offspring produced by the subpopulation.

The remaining three subpopulations – Dry Tortugas, Florida Panhandle, and Yucatán – are much smaller, but also relevant to the continued existence of the species. Nesting surveys for the Dry Tortugas subpopulation are conducted as part of Florida's statewide survey program. Survey effort has been relatively stable during the 9-year period from 1995-2003 (although the 2002 year was missed). Nest counts ranged from 168-270 but with no detectable trend during this period (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). Nest counts for the Florida Panhandle subpopulation are focused on index beaches rather than all beaches where nesting occurs. Currently, there is not enough information to detect a trend for the subpopulation (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Index Nesting Beach Survey Database). Similarly, nesting survey effort has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation. However, there is some optimistic news. Zurita et al. (2003) found a statistically significant increase in the number of nests on seven of the beaches on Quintana Roo, Mexico, from 1987-2001 where survey effort was consistent during the period.

*Threats*

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Hurricanes are particularly destructive to sea turtle nests. Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. For example, in 1992, all of the eggs over a 90-mile length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton et al. 1994). Also, many nests were destroyed during the 2004 hurricane season. Other sources of natural mortality include cold stunning and biotoxin exposure.

Anthropogenic factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, beach armoring and nourishment, artificial lighting, beach cleaning, increased human presence, recreational beach equipment, beach driving, coastal construction and fishing piers, exotic dune and beach vegetation, and poaching. An increase in human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs and an increased presence of native species (e.g., raccoons, armadillos, and opossums) which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (e.g., Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density east Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

Loggerhead sea turtles are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation, marine pollution, underwater explosions, hopper dredging, offshore artificial lighting, power plant entrainment and/or impingement, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, poaching, and fishery interactions. Loggerheads in the pelagic environment are exposed to a series of longline fisheries, which include the Atlantic highly migratory species (HMS) pelagic longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various longline fleets in the Mediterranean Sea (Aguilar et al. 1995; Bolten et al. 1996). Loggerheads in the benthic environment in waters off the coastal United States are exposed to a suite of fisheries in federal and state waters including trawl, purse seine, hook and line, gillnet, pound net, longline, and trap fisheries (see further discussion in Section 4.2, Environmental Baseline).

### 3.2.1.3 Summary of Status for Loggerhead Sea Turtles

The abundance of loggerhead turtles on nesting beaches throughout the Pacific basin has declined dramatically over the past 10 to 20 years. Data from 1995 estimated the Japanese nesting aggregation at 1,000 female loggerhead turtles (Bolten et al. 1996), but it has probably declined since 1995 and continues to decline (Tillman 2000). The nesting aggregation in Queensland, Australia, was as low as 300 females in 1997.

In the Atlantic Ocean, absolute population size is not known, but based on extrapolation of nesting information, loggerheads are likely much more numerous than in the Pacific Ocean. NMFS recognizes five subpopulations of loggerhead sea turtles in the western north Atlantic based on genetic studies. Cohorts from all of these are known to occur within the action area of this consultation. The South Florida subpopulation may be critical to the survival of the species in the Atlantic Ocean because of its size (over 90 percent of all U.S. loggerhead nests are from this subpopulation). In the past, this nesting aggregation was considered second in size only to the nesting aggregation on islands in the Arabian Sea off Oman (Ross 1979; Ehrhart 1989; NMFS and USFWS 1991b). However, the status of the Oman colony has not been evaluated recently and it is located in an area of the world where it is highly vulnerable to disruptive events such as political upheavals, wars, catastrophic oil spills, and lack of strong protections for sea

turtles (Meylan et al. 1995). Given the lack of updated information on this population, the status of loggerheads in the Indian Ocean basin overall is essentially unknown.

All loggerhead subpopulations are faced with a multitude of natural and anthropogenic effects that negatively influence the status of the species. Many anthropogenic effects occur as a result of activities outside of U.S. jurisdiction (i.e., fisheries in international waters).

### 3.2.2 Kemp's Ridley Sea Turtle

The Kemp's ridley was listed as endangered on December 2, 1970. Internationally, the Kemp's ridley has been considered the most endangered sea turtle (Zwinenberg 1977; Groombridge 1982; TEWG 2000). Kemp's ridleys nest primarily at Rancho Nuevo, a stretch of beach in Mexico, Tamaulipas State. This species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Occasional individuals reach European waters (Brongersma 1972). Adults of this species are usually confined to the Gulf of Mexico, although adult-sized individuals sometimes are found on the east coast of the United States.

#### 3.2.2.1 Atlantic Ocean

*Life History and Distribution*
The TEWG (1998) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998). Nesting occurs from April into July and is essentially limited to the beaches of the western Gulf of Mexico, near Rancho Nuevo in southern Tamaulipas, Mexico. The mean clutch size for Kemp's ridleys is 100 eggs/nest, with an average of 2.5 nests/female/season.

Little is known of the movements of the post-hatchling stage (pelagic stage) within the Gulf of Mexico. Studies have shown the post-hatchling pelagic stage varies from 1-4 or more years, and the benthic immature stage lasts 7-9 years (Schmid and Witzell 1997). Benthic immature Kemp's ridleys have been found along the eastern seaboard of the United States and in the Gulf of Mexico. Atlantic benthic immature sea turtles travel northward as the water warms to feed in the productive, coastal waters off Georgia through New England, returning southward with the onset of winter (Lutcavage and Musick 1985; Henwood and Ogren 1987; Ogren 1989). Studies suggest that benthic immature Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud 1995).

Stomach contents of Kemp's ridleys along the lower Texas coast consisted of nearshore crabs and mollusks, as well as fish, shrimp, and other foods considered to be shrimp fishery discards (Shaver 1991). Pelagic stage Kemp's ridleys presumably feed on the available *Sargassum* and associated infauna or other epipelagic species found in the Gulf of Mexico.

*Population Dynamics and Status*
Of the seven extant species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the Rancho Nuevo beaches (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in

1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the mid-1980s nest numbers were below 1,000 (with a low of 702 nests in 1985). However, observations of increased nesting with 6,277 nests recorded in 2000, 10,000 nests in 2005, and 12,143 nests recorded during the 2006 nesting season (Gladys Porter Zoo nesting database) show the decline in the ridley population has stopped and the population is now increasing.

A period of steady increase in benthic immature ridleys has been occurring since 1990 and appears to be due to increased hatchling production and an apparent increase in survival rates of immature sea turtles beginning in 1990. The increased survivorship of immature sea turtles is attributable, in part, to the introduction of turtle excluder devices (TEDs) in the United States and Mexican shrimping fleets and Mexican beach protection efforts. As demonstrated by nesting increases at the main nesting sites in Mexico, adult ridley numbers have increased over the last decade. The population model used by TEWG (2000) projected that Kemp's ridleys could reach the Recovery Plan's intermediate recovery goal of 10,000 nesters by the year 2015.

Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath et al. 1987; Musick and Limpus 1997). The juvenile population of Kemp's ridley sea turtles in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus 1997). These juveniles frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Kemp's ridleys consume a variety of crab species, including *Callinectes spp.*, *Ovalipes spp.*, *Libinia sp.*, and *Cancer spp.* Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds, as well as smaller juveniles from New York and New England, to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus 1997; Epperly et al. 1995a; Epperly et al. 1995b).

*Threats*

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold stunning. Although cold stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, in the winter of 1999-2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and 5 green turtles were found on Cape Cod beaches (R. Prescott, pers. comm., 2001). Annual cold-stunning events do not always occur at this magnitude; the extent of episodic major cold-stunning events may be associated with numbers of turtles utilizing Northeast waters in a given year, oceanographic conditions, and the occurrence of storm events in the late fall. Many cold-stunned turtles can survive if found early enough, but cold-stunning events can still represent a significant cause of natural mortality.

Although changes in the use of shrimp trawls and other trawl gear have helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed above. For example, in the spring of 2000, five Kemp's ridley

carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. Cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gillnet fishery operating offshore in the preceding weeks. The five ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction because it is unlikely that all of the carcasses washed ashore.

#### 3.2.2.2 Summary of Kemp's Ridley Status

The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). The number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3 percent per year from 1985 to 1999. Current totals are 12,059 nests in Mexico in 2006 (August 8, 2006, e-mail from Luis Jaime Peña - Conservation Biologist, Gladys Porter Zoo). Kemp's ridleys mature at an earlier age (7-15 years) than other chelonids, thus "lag effects" as a result of unknown impacts to the non-breeding life stages would likely have been seen in the increasing nest trend beginning in 1985 (USFWS and NMFS 1992).

The largest contributors to the decline of Kemp's ridleys in the past were commercial and local exploitation, especially poaching of nests at the Rancho Nuevo site, as well as the Gulf of Mexico trawl fisheries. The advent of TED regulations for trawlers and protections for the nesting beaches has allowed the species to begin to rebound. Many threats to the future of the species remain, including interactions with fishery gear, marine pollution, foraging habitat destruction, illegal poaching of nests and potential threats to the nesting beaches from such sources as global climate change, development, and tourism pressures.

### 3.2.3 Hawksbill Sea Turtle

The hawksbill turtle was listed as endangered under the precursor of the ESA on June 2, 1970, and is considered Critically Endangered by the International Union for the Conservation of Nature (IUCN). The hawksbill is a medium-sized sea turtle, with adults in the Caribbean ranging in size from approximately 62.5 to 94.0 cm straight carapace length. The species occurs in all ocean basins, although it is relatively rare in the Eastern Atlantic and Eastern Pacific, and absent from the Mediterranean Sea. Hawksbills are the most tropical of the marine turtles, ranging from approximately 30°N to 30°S latitude. They are closely associated with coral reefs and other hard-bottom habitats, but they are also found in other habitats including inlets, bays and coastal lagoons (NMFS and USFWS 1993). There are five regional nesting populations with more than 1,000 females nesting annually. These populations are in the Seychelles, Mexico, Indonesia, and two in Australia (Meylan and Donnelly 1999). There has been a global population decline of over 80 percent during the last three generations (105 years) (Meylan and Donnelly 1999).

#### 3.2.3.1 Pacific Ocean

Anecdotal reports throughout the Pacific indicate that the current Pacific hawksbill population is well below historical levels (NMFS 2004b). It is believed that this species is rapidly

approaching extinction in the Pacific because of harvesting for its meat, shell, and eggs as well as destruction of nesting habitat (NMFS 2001). Hawksbill sea turtles nest in the Hawaiian Islands as well as the islands and mainland of southeast Asia, from China to Japan, and throughout the Philippines, Malaysia, Indonesia, Papua New Guinea, the Solomon Islands, and Australia (NMFS 2004b). However, along the eastern Pacific Rim where nesting was common in the 1930s, hawksbills are now rare or absent (NMFS 2004b).

**3.2.3.2 Atlantic Ocean**

In the Western Atlantic, the largest hawksbill nesting population occurs in the Yucatán Peninsula of Mexico (Garduño-Andrade et al. 1999). With respect to the United States, nesting occurs in Puerto Rico, the USVI, and the southeast coast of Florida. Nesting also occurs outside of the United States and its territories in Antigua, Barbados, Costa Rica, Cuba, and Jamaica (Meylan 1999a). Outside of the nesting areas, hawksbills have been seen off of the U.S. Gulf of Mexico states and along the eastern seaboard as far north as Massachusetts, although sightings north of Florida are rare (NMFS and USFWS 1993).

The best estimate of age at sexual maturity for hawksbill sea turtles is about 20-40 years (NMFS 2004b). Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest. Movements of reproductive males are less well known, but are presumed to involve migrations to their nesting beach or to courtship stations along the migratory corridor (Meylan 1999b). Females nest an average of 3-5 times per season (Meylan and Donnelly 1999). Clutch size is larger on average (up to 250 eggs) than that of other turtles (Hirth 1980). Reproductive females may exhibit a high degree of fidelity to their nest sites.

The life history of hawksbills consists of a pelagic stage that lasts from the time they leave the nesting beach as hatchlings until they are approximately 22-25 cm in straight carapace length (Meylan and Donnelly 1999), followed by residency in developmental habitats (foraging areas where juveniles reside and grow) in coastal waters. Adult foraging habitat, which may or may not overlap with developmental habitat, is typically coral reefs, although other hard-bottom communities and occasionally mangrove-fringed bays may be occupied. Hawksbills show fidelity to their foraging areas over several years (van Dam and Díez 1998).

The hawksbill's diet is highly specialized and consists primarily of sponges (Meylan 1988). Other food items, notably corallimorphs and zooanthids, have been documented to be important in some areas of the Caribbean (Leon and Díez 2000).

Estimates of the annual number of nests at hawksbill sea turtle nesting sites are of the order of hundreds to a few thousand. Nesting within the southeastern United States and U.S. Caribbean is restricted to Puerto Rico (>650 nests/yr), the USVI (~400 nests/yr), and, rarely, Florida (0-4 nests/yr) (Meylan 1999a; Florida Fish and Wildlife Conservation Commission; Florida Marine Research Institute's Statewide Nesting Beach Survey data 2002). At the two principal nesting beaches in the U.S. Caribbean where long-term monitoring has been carried out, populations appear to be increasing (Mona Island, Puerto Rico) or stable (Buck Island Reef National Monument, St. Croix, USVI) (Meylan 1999a).

As described for other sea turtle species, hawksbill sea turtles are affected by habitat loss, habitat degradation, fishery interactions, and poaching in some parts of their range. There continues to be a black market for hawksbill shell products ("tortoiseshell"), which likely contributes to the harvest of this species.

#### 3.2.3.3 Summary of Status for Hawksbill Sea Turtles

Worldwide, hawksbill sea turtle populations are declining. They face many of the same threats affecting other sea turtle species. In addition, there continues to be a commercial market for hawksbill shell products, despite protections afforded to the species under U.S. law and international conventions.

### 3.2.4 Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered throughout its global range on June 2, 1970. Leatherbacks are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans (Ernst and Barbour 1972). Leatherback sea turtles are the largest living turtles and range farther than any other sea turtle species. The large size of adult leatherbacks and their tolerance to relatively low temperatures allows them to occur in northern waters such as off Labrador and in the Barents Sea (NMFS and USFWS 1995). Adult leatherbacks forage in temperate and subpolar regions from 71°N to 47°S latitude in all oceans and undergo extensive migrations to and from their tropical nesting beaches. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). That number, however, is probably an overestimation as it was based on a particularly good nesting year in 1980 (Pritchard 1996). By 1995, the global population of adult females had declined to 34,500 (Spotila et al. 1996). Pritchard (1996) also called into question the population estimates from Spotila et al. (1996), and felt they may be somewhat low, because it ended the modeling on data from a particularly bad nesting year (1994) while excluding nesting data from 1995, which was a good nesting year. However, Spotila et al. (1996) represents the best overall estimate of adult female leatherback population size.

#### 3.2.4.1 Pacific Ocean

Based on published estimates of nesting female abundance, leatherback populations have collapsed or have been declining at all major Pacific basin nesting beaches for the last two decades (Spotila et al. 1996, NMFS and USFWS 1998, Sarti et al. 2000, Spotila et al. 2000). For example, the nesting assemblage on Terengganu, Malaysia – which was one of the most significant nesting sites in the western Pacific Ocean – has declined severely from an estimated 3,103 females in 1968 to two nesting females in 1994 (Chan and Liew 1996). Nesting assemblages of leatherback turtles are in decline along the coasts of the Solomon Islands, a historically important nesting area (D. Broderick, pers. comm., in Dutton et al. 1999). In Fiji, Thailand, Australia, and Papua New Guinea (East Papua), leatherback turtles have only been known to nest in low densities and scattered colonies.

Only an Indonesian nesting assemblage has remained relatively abundant in the Pacific basin. The largest extant leatherback nesting assemblage in the Indo-Pacific lies on the north Vogelkop

coast of Irian Jaya (West Papua), Indonesia, with over 3,000 nests recorded annually (Putrawidjaja 2000, Suarez et al. 2000). During the early-to-mid 1980s, the number of female leatherback turtles nesting on the two primary beaches of Irian Jaya appeared to be stable. More recently, this population has come under increasing threats that could cause this population to experience a collapse that is similar to what occurred at Terengganu, Malaysia. In 1999, for example, local Indonesian villagers started reporting dramatic declines in sea turtle populations near their villages (Suarez 1999). Unless hatchling and adult turtles on nesting beaches receive more protection, this population will continue to decline. Declines in nesting assemblages of leatherback turtles have been reported throughout the western Pacific region, with nesting assemblages well below abundance levels observed several decades ago (e.g., Suarez 1999).

In the western Pacific Ocean and South China Seas, leatherback turtles are captured, injured, or killed in numerous fisheries, including Japanese longline fisheries. The poaching of eggs, killing of nesting females, human encroachment on nesting beaches, beach erosion, and egg predation by animals also threaten leatherback turtles in the western Pacific.

In the eastern Pacific Ocean, nesting populations of leatherback turtles are declining along the Pacific coast of Mexico and Costa Rica. According to reports from the late 1970s and early 1980s, three beaches on the Pacific coast of Mexico supported as many as half of all leatherback turtle nests for the eastern Pacific. Since the early 1980s, the eastern Pacific Mexican population of adult female leatherback turtles has declined to slightly more than 200 individuals during 1998-99 and 1999-2000 (Sarti et al. 2000). Spotila et al. (2000) reported the decline of the leatherback turtle population at Playa Grande, Costa Rica, which had been the fourth largest nesting colony in the world. Between 1988 and 1999, the nesting colony declined from 1,367 to 117 female leatherback turtles. Based on their models, Spotila et al. (2000) estimated that the colony could fall to less than 50 females by 2003-2004. Leatherback turtles in the eastern Pacific Ocean are captured, injured, or killed in commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru, and purse seine fisheries for tuna in the eastern tropical Pacific Ocean, and California/Oregon drift gillnet fisheries. Because of the limited data, we cannot provide high-certainty estimates of the number of leatherback turtles captured, injured, or killed through interactions with these fisheries. However, between 8-17 leatherback turtles were estimated to have died annually between 1990 and 2000 in interactions with the California/Oregon drift gillnet fishery; 500 leatherback turtles are estimated to die annually in Chilean and Peruvian fisheries; 200 leatherback turtles are estimated to die in direct harvests in Indonesia; and before 1992, the North Pacific driftnet fisheries for squid, tuna, and billfish captured an estimated 1,000 leatherback turtles each year, killing about 111 of them each year.

Although all causes of the declines in leatherback turtle colonies in the eastern Pacific have not been documented, Sarti et al. (1998) suggest that the declines result from egg poaching, adult and sub-adult mortalities incidental to high seas fisheries, and natural fluctuations due to changing environmental conditions. Some published reports support this suggestion. Sarti et al. (2000) reported that female leatherback turtles have been killed for meat on nesting beaches like Píedra de Tiacoyunque, Guerrero, Mexico. Eckert (1997) reported that swordfish gillnet fisheries in Peru and Chile contributed to the decline of leatherback turtles in the eastern Pacific. The decline in the nesting population at Mexiquillo, Mexico, occurred at the same time that effort doubled in the Chilean driftnet fishery. In response to these effects, the eastern Pacific

population has continued to decline, leading some researchers to conclude that the leatherback is on the verge of extinction in the Pacific Ocean (e.g., Spotila et al. 1996, Spotila et al. 2000). The NMFS assessment of three nesting aggregations in its February 23, 2004, opinion supports this conclusion: If no action is taken to reverse their decline, leatherback sea turtles nesting in the Pacific Ocean either have high risks of extinction in a single human generation (for example, nesting aggregations at Terrenganu and Costa Rica) or they have a high risk of declining to levels where more precipitous declines become almost certain (e.g., Irian Jaya) (NMFS 2004a).

### 3.2.4.2 Atlantic Ocean

In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS SEFSC 2001). Female leatherbacks nest from the southeastern United States to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are in French Guiana and Suriname (NMFS SEFSC 2001). Genetic analyses of leatherbacks to date indicate that within the Atlantic basin there are genetically different nesting populations; the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton et al. 1999). When the hatchlings leave the nesting beaches, they move offshore but eventually utilize both coastal and pelagic waters. Very little is known about the pelagic habits of the hatchlings and juveniles, and they have not been documented to be associated with the *Sargassum* areas as are other species. Leatherbacks are deep divers, with recorded dives to depths in excess of 1,000 m (Eckert et al. 1999, Hayes et al. 2004).

*Life History and Distribution*
Leatherbacks are a long-lived species, living for over 30 years. They reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range from 3-6 years (Rhodin 1985) to 13-14 years (Zug and Parham 1996). They nest frequently (up to 10 nests per year) during a nesting season and nest about every 2-3 years. During each nesting, they produce 100 eggs or more in each clutch and, thus, can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30 percent) of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. The eggs incubate for 55-75 days before hatching. Based on a review of all sightings of leatherback sea turtles of <145 cm curved carapace length (ccl), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26°C until they exceed 100 cm ccl.

Although leatherbacks are the most pelagic of the sea turtles, they enter coastal waters on a seasonal basis to feed in areas where jellyfish are concentrated. Leatherback sea turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates.

Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between boreal, temperate, and tropical waters (NMFS and USFWS 1992). A 1979 aerial survey of the outer continental shelf from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia showed leatherbacks to be present throughout the

area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in waters where depths ranged from 1-4,151 m, but 84.4 percent of sightings were in areas where the water was less than 180 m deep (Shoop and Kenney 1992). Leatherbacks were sighted in waters of a similar sea surface temperature as loggerheads; from 7-27.2°C (Shoop and Kenney 1992). However, this species appears to have a greater tolerance for colder waters because more leatherbacks were found at the lower temperatures (Shoop and Kenney 1992). This aerial survey estimated the in-water leatherback population from near Nova Scotia, Canada to Cape Hatteras, North Carolina at approximately 300-600 animals.

*Population Dynamics and Status*

The status of the Atlantic leatherback population is less clear than the Pacific population. The total Atlantic population size is undoubtedly larger than in the Pacific, but overall population trends are unclear. In 1996, the entire western Atlantic population was characterized as stable at best (Spotila et al. 1996), with numbers of nesting females reported to be on the order of 18,800. A subsequent analysis by Spotila (pers. comm.) indicated that by 2000, the western Atlantic nesting population had decreased to about 15,000 nesting females. The nesting aggregation in French Guiana has been declining at about 15 percent per year since 1987 (NMFS SEFSC 2001). However, from 1979-1986, the number of nests was increasing at about 15 percent annually which could mean that the current 15 percent decline could be part of a nesting cycle which coincides with the erosion cycle of Guiana beaches described by Schultz (1975). In Suriname, leatherback nest numbers have shown large recent increases (with more than 10,000 nests per year since 1999 and a peak of 30,000 nests in 2001), and the long-term trend for the overall Suriname and French Guiana population may show an increase (Girondot 2002 in Hilterman and Goverse 2003). The number of nests in Florida and the U.S. Caribbean has been increasing at about 10.3 percent and 7.5 percent, respectively, per year since the early 1980s, but the magnitude of nesting is much smaller than that along the French Guiana coast (NMFS SEFSC 2001). Also, because leatherback females can lay 10 nests per season, the recent increases to 400 nests per year in Florida may represent as few as 40 individual female nesters per year.

In summary, the conflicting information regarding the status of Atlantic leatherbacks makes it difficult to characterize the current status. Numbers at some nesting sites are increasing, but are decreasing at other sites. Tag return data emphasize the wide-ranging nature of the leatherback and the link between South American nesters and animals found in U.S. waters. For example, a nesting female tagged May 29, 1990, in French Guiana was later recovered and released alive from the York River, Virginia. Another nester tagged in French Guiana on June 21, 1990, was later found dead in Palm Beach, Florida (STSSN database). Genetic studies performed within the Northeast Distant Fishery Experiment indicate that the leatherbacks captured in the Atlantic highly migratory species pelagic longline fishery were primarily from the French Guiana and Trinidad nesting stocks (over 95 percent). Individuals from West African stocks were surprisingly absent (Roden et al. In press).

There are a number of problems contributing to the uncertainty of the leatherback nest counts and population assessments. The nesting beaches of the Guianas (Guyana, French Guiana, and Suriname) and Trinidad are by far the most important in the western Atlantic. However, beaches in this region undergo cycles of erosion and reformation, so that the nesting beaches are not consistent over time. Additionally, leatherback sea turtles do not exhibit the same degree of

nest-site fidelity demonstrated by loggerhead and other hardshell sea turtles, further confounding analysis of population trends using nesting data. Reported declines in one country and reported increases in another may be the result of migration and beach changes, not true population changes. Nesting surveys, as well as being hampered by the inconsistency of the nesting beaches, are themselves inconsistent throughout the region. Survey effort varies widely in the seasonal coverage, aerial coverage, and actual surveyed sites. Surveys have not been conducted consistently throughout time, or have even been dropped entirely as the result of wars, political turmoil, funding vagaries, etc. The methods vary in assessing total numbers of nests and total numbers of females. Many sea turtle scientists agree that the Guianas (and some would include Trinidad) should be viewed as one population and that a synoptic evaluation of nesting at all beaches in the region is necessary to develop a true picture of population status (Reichart et al. 2001). No such region-wide assessment has been conducted recently.

The most recent, complete estimates of regional leatherback populations are in Spotila et al. (1996). As discussed above, nesting in the Guianas may have been declining in the late 1990s but may have increased again in the early 2000s. Spotila et al. estimated that the leatherback population for the Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa totaled approximately 27,600 nesting females, with an estimated range of 20,082-35,133. We believe that the current population probably still lies within this range, taking into account the reported nesting declines and increases and the uncertainty surrounding them. We therefore choose to rely on Spotila et al.'s (1996) published total Atlantic population estimates, rather than attempt to construct a new population estimate here, based on our interpretation of the various, confusing nesting reports from areas within the region.

*Threats*

Zug and Parham (1996) pointed out that the main threat to leatherback populations in the Atlantic is the combination of fishery-related mortality (especially entanglement in gear and drowning in trawls) and the intense egg harvesting on the main nesting beaches. Other important ongoing threats to the population include pollution, loss of nesting habitat, and boat strikes.

Of sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, possibly their method of locomotion, and perhaps their attraction to the lightsticks used to attract target species in longline fisheries. They are also susceptible to entanglement in gillnets and pot/trap lines (used in various fisheries) and capture in trawl gear (e.g., shrimp trawls).

Leatherbacks are exposed to pelagic longline fisheries in many areas of their range. Unlike loggerhead turtle interactions with longline gear, leatherback turtles do not usually ingest longline bait. Instead, leatherbacks are foul hooked by longline gear (e.g., on the flipper or shoulder area) rather than getting mouth hooked or swallowing the hook (NMFS SEFSC 2001). According to observer records, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999, of which 88 were released dead (NMFS SEFSC 2001). The U.S. fleet accounts for only 5 to 8 percent of the hooks fished in the Atlantic Ocean, and adding up the under-represented observed takes of the

other 23 countries that actively fish in the area would lead to annual take estimates of thousands of leatherbacks over different life stages. Basin-wide, Lewison et al. (2004) estimated that 30,000-60,000 leatherback sea turtle captures occurred in Atlantic pelagic longline fisheries in the year 2000 alone (note that multiple captures of the same individual are known to occur, so the actual number of individuals captured may not be as high).

Leatherbacks are also susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer et al. 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer et al. 2002). Fixed gear fisheries in the mid-Atlantic have also contributed to leatherback entanglements. In North Carolina, two leatherback sea turtles were reported entangled in a crab pot buoy inside Hatteras Inlet (D. Fletcher, pers. comm. to S. Epperly in NMFS SEFSC 2001). A third leatherback was reported entangled in a crab pot buoy in Pamlico Sound near Ocracoke. This turtle was disentangled and released alive; however, lacerations on the front flippers from the lines were evident (D. Fletcher, pers. comm. to S. Epperly in NMFS SEFSC 2001). In the Southeast, leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries. In the U.S. Virgin Islands, where one of five leatherback strandings from 1982 to 1997 was due to entanglement (Boulon 2000), leatherbacks have been observed with their flippers wrapped in the line of West Indian fish traps (R. Boulon, pers. comm. to J. Braun-McNeill in NMFS SEFSC 2001). Because many entanglements of this typically pelagic species likely go unnoticed, entanglements in fishing gear may be much higher.

Leatherback interactions with the southeast Atlantic shrimp fishery, which operates predominately from North Carolina through southeast Florida (NMFS 2002), have also been a common occurrence. Leatherbacks, which migrate north annually, are likely to encounter shrimp trawls working in the coastal waters off the Atlantic coast from Cape Canaveral, Florida, to the Virginia/North Carolina border. Leatherbacks also interact with the Gulf of Mexico shrimp fishery. For many years, TEDs required for use in these fisheries were less effective at excluding leatherbacks than the smaller, hard-shelled turtle species. To address this problem, on February 21, 2003, the NMFS issued a final rule to amend the TED regulations. Modifications to the design of TEDs are now required in order to exclude leatherbacks and large and sexually mature loggerhead and green turtles.

Other trawl fisheries are also known to interact with leatherback sea turtles. In October 2001, a Northeast Fisheries Science Center observer documented the take of a leatherback in a bottom otter trawl fishing for Loligo squid off of Delaware; TEDs are not required in this fishery. The winter trawl flounder fishery, which did not come under the revised TED regulations, may also interact with leatherback sea turtles.

Gillnet fisheries operating in the nearshore waters of the mid-Atlantic states are also suspected of capturing, injuring, and/or killing leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54 to 92 percent.

Poaching is not known to be a problem for nesting populations in the continental U.S. However, in 2001 the NMFS Southeast Fishery Science Center (SEFSC) noted that poaching of juveniles and adults was still occurring in the U.S. Virgin Islands and the Guianas. In all, four of the five strandings in St. Croix were the result of poaching (Boulon 2000). A few cases of fishermen poaching leatherbacks have been reported from Puerto Rico, but most of the poaching is on eggs.

Leatherback sea turtles may be more susceptible to marine debris ingestion than other species due to their pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding areas and migratory routes (Lutcavage et al. 1997, Shoop and Kenney 1992). Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44 percent of the 16 cases examined) contained plastic (Mrosovsky 1981). Along the coast of Peru, intestinal contents of 19 of 140 (13 percent) leatherback carcasses were found to contain plastic bags and film (Fritts 1982). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and plastic debris (Mrosovsky 1981). Balazs (1985) speculated that the object might resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks.

It is important to note that, like marine debris, fishing gear interactions and poaching are problems for leatherbacks throughout their range. Entanglements are common in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line and crab pot line. Leatherbacks are reported taken by many other nations that participate in Atlantic pelagic longline fisheries, including Taipei, Brazil, Trinidad, Morocco, Cyprus, Venezuela, Korea, Mexico, Cuba, U.K., Bermuda, People's Republic of China, Grenada, Canada, Belize, France, and Ireland (see NMFS SEFSC 2001, for a description of take records). Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo et al. 1994, Graff 1995). Gillnets are one of the suspected causes for the decline in the leatherback sea turtle population in French Guiana (Chevalier et al. 1999), and gillnets targeting green and hawksbill turtles in the waters of coastal Nicaragua also incidentally catch leatherback turtles (Lagueux et al. 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio-M 2000). An estimated 1,000 mature female leatherback sea turtles are caught annually in fishing nets off of Trinidad and Tobago with mortality estimated to be between 50 to 95 percent (Eckert and Lien 1999). However, many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS SEFSC 2001).

#### 3.2.4.3 Summary of Leatherback Status

In the Pacific Ocean, the abundance of leatherback turtle nesting individuals and colonies has declined dramatically over the past 10 to 20 years. Nesting colonies throughout the eastern and western Pacific Ocean have been reduced to a fraction of their former abundance by the combined effects of human activities that have reduced the number of nesting females. In addition, egg poaching has reduced the reproductive success of the remaining nesting females. At current rates of decline, leatherback turtles in the Pacific basin are a critically endangered species with a low probability of surviving and recovering in the wild.

In the Atlantic Ocean, our understanding of the status and trends of leatherback turtles is much more confounded, although the picture does not appear nearly as bleak as in the Pacific. The number of female leatherbacks reported at some nesting sites in the Atlantic Ocean has increased, while at others they have decreased. Some of the same factors that led to precipitous declines of leatherbacks in the Pacific also affect leatherbacks in the Atlantic: leatherbacks are captured and killed in many kinds of fishing gear and interact with fisheries in state, federal, and international waters. Poaching is a problem and affects leatherbacks that occur in U.S. waters. Leatherbacks also appear to be more susceptible to death or injury from ingesting marine debris than other turtle species.

### 3.2.5 Green Sea Turtle

Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered. The nesting range of the green sea turtles in the southeastern United States includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina, the U.S. Virgin Islands (USVI) and Puerto Rico (NMFS and USFWS 1991a). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward counties (Ehrhart and Witherington 1992). Green sea turtle nesting also occurs regularly on St. Croix, USVI, and on Vieques, Culebra, Mona, and the main island of Puerto Rico (Mackay and Rebholz 1996).

#### 3.2.5.1 Pacific Ocean

Green turtles are thought to be declining throughout the Pacific Ocean, with the exception of Hawaii, from a combination of overexploitation and habitat loss (Seminoff 2002). In the western Pacific, the only major (>2,000 nesting females) populations of green turtles occur in Australia and Malaysia, with smaller colonies throughout the area. Indonesia has a widespread distribution of green turtles, but has experienced large declines over the past 50 years. Hawaii green turtles are genetically distinct and geographically isolated, and the population appears to be increasing in size despite the prevalence of fibropapilloma and spirochidiasis (Aguirre et al. 1998 in Balazs and Chaloupka 2003). In the eastern Pacific, mitochondrial DNA analysis has indicated that there are three key nesting populations: Michoacan, Mexico; Galapagos Islands, Ecuador; and Islas Revillagigedos, Mexico (Dutton 2003). There is also sporadic green turtle nesting along the Pacific coast of Costa Rica.

### 3.2.5.2 Atlantic Ocean

*Life History and Distribution*
The estimated age at sexual maturity for green sea turtles is between 20-50 years (Balazs 1982; Frazer and Ehrhart 1985). Green sea turtle mating occurs in the waters off the nesting beaches. Each female deposits 1-7 clutches (usually 2-3) during the breeding season at 12-14 day intervals. Mean clutch size is highly variable among populations, but averages 110-115 eggs/nest. Females usually have 2-4 or more years between breeding seasons, whereas males may mate every year (Balazs 1983). After hatching, green sea turtles go through a post-hatchling pelagic stage where they are associated with drift lines of algae and other debris. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas (Bjorndal 1997).

Green sea turtles are primarily herbivorous, feeding on algae and sea grasses, but also occasionally consume jellyfish and sponges. The post-hatchling, pelagic-stage individuals are assumed to be omnivorous, but little data are available.

Green sea turtle foraging areas in the southeastern United States include any coastal shallow waters having macroalgae or sea grasses. This includes areas near mainland coastlines, islands, reefs, or shelves, and any open-ocean surface waters, especially where advection from wind and currents concentrates pelagic organisms (Hirth 1997; NMFS and USFWS 1991a). Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty 1984; Hildebrand 1982; Shaver 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957; Carr 1984), Florida Bay and the Florida Keys (Schroeder and Foley 1995), the Indian River Lagoon System, Florida (Ehrhart 1983), and the Atlantic Ocean off Florida from Brevard through Broward counties (Wershoven and Wershoven 1992; Guseman and Ehrhart 1992). Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs.

*Population Dynamics and Status*
The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Meylan et al. 1995; Johnson and Ehrhart 1994). Green sea turtle nesting in Florida has been increasing since 1989 (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). Current nesting levels in Florida are reduced compared to historical levels, reported by Dodd (1981). However, total nest counts and trends at index beach sites during the past 17 years suggest the numbers of green sea turtles that nest within the southeastern United States are increasing.

Although nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging and developmental grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the

Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1997). The summer developmental habitat for green turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus 1997).

There are no reliable estimates of the number of immature green sea turtles that inhabit coastal areas (where they come to forage) of the southeastern United States. However, information on incidental captures of immature green sea turtles at the St. Lucie Power Plant (they have averaged 215 green sea turtle captures per year since 1977) in St. Lucie County, Florida (on the Atlantic coast of Florida) show that the annual number of immature green sea turtles captured has increased significantly in the past 26 years (FPL 2002).

It is likely that immature green sea turtles foraging in the southeastern United States come from multiple genetic stocks; therefore, the status of immature green sea turtles in the southeastern United States might also be assessed from trends at all of the main regional nesting beaches, principally Florida, Yucatán, and Tortuguero. Trends at Florida beaches were previously discussed. Trends in nesting at Yucatán beaches cannot be assessed because of a lack of consistent beach surveys over time. Trends at Tortuguero (ca. 20,000-50,000 nests/year) showed a significant increase in nesting during the period 1971-1996 (Bjorndal et al. 1999), and more recent information continues to show increasing nest counts (Troëng and Rankin 2004). Therefore, it seems reasonable that there is an increase in immature green sea turtles inhabiting coastal areas of the southeastern United States; however, the magnitude of this increase is unknown.

*Threats*

The principal cause of past declines and extirpations of green sea turtle assemblages has been the over-exploitation of green sea turtles for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. However, there are still significant and ongoing threats to green sea turtles from human-related causes in the United States. These threats include beach armoring, erosion control, artificial lighting, beach disturbance (e.g., driving on the beach), pollution, foraging habitat loss as a result of direct destruction by dredging, siltation, boat damage, other human activities, and interactions with fishing gear. Sea sampling coverage in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. There is also the increasing threat from green sea turtle fibropapillomatosis disease. Presently, this disease is cosmopolitan and has been found to affect large numbers of animals in some areas, including Hawaii and Florida (Herbst 1994; Jacobson, 1990; Jacobson et al. 1991).

### 3.2.5.3 Summary of Status for Atlantic Green Sea Turtles

Green turtles range in the western Atlantic from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare in benthic areas north of Cape Hatteras (Wynne and Schwartz 1999). Green turtles face many of the same natural and anthropogenic threats as for loggerhead sea turtles described above. In addition, green turtles are also

susceptible to fibropapillomatosis, which can result in death. In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Recent population estimates for the western Atlantic area are not available. Between 1989 and 2006, the annual number of green turtle nests at core index beaches ranged from 267 to 7,158 (Florida Marine Research Institute Statewide Nesting Database). While the pattern of green turtle nesting shows biennial peaks in abundance, there is a generally positive trend since establishment of index beaches in Florida in 1989.

# 4 ENVIRONMENTAL BASELINE

This section contains a description of the effects of past and ongoing human activities leading to the current status of the species, their habitat, and the ecosystem, within the action area. The environmental baseline is a snapshot of the factors affecting the species and includes federal, state, tribal, local, and private actions already affecting the species, or that will occur contemporaneously with the consultation in progress. Unrelated, future federal actions affecting the same species that have completed formal or informal consultation are also part of the environmental baseline, as are implemented and ongoing federal and other actions within the action area that may benefit listed species.

## 4.1 Status of Sea Turtles in the Action Area

Sea turtles found in the immediate project area may travel widely throughout the Atlantic, Gulf of Mexico, and Caribbean Sea, and individuals found in the action area can potentially be affected by activities anywhere within this wide range. Thus, the status of the species in the action area is the same as the species' range-wide status discussed in section 3 above.

### 4.1.2 Federal Actions

In recent years, NMFS has undertaken numerous ESA section 7 consultations to address the effects of federally-permitted fisheries and other federal actions on threatened and endangered sea turtle species. Each of those consultations sought to develop ways of reducing the probability of adverse effects of the action on sea turtles. Similarly, recovery actions NMFS has undertaken under the ESA are addressing the problem of take of sea turtles in the fishing and shipping industries and other activities such as COE dredging operations. The summary below of anticipated sources of incidental take of sea turtles from federal actions includes only those actions which have already concluded or are currently undergoing formal section 7 consultation.

*Fisheries*
Adverse effects on threatened and endangered sea turtles from several types of fishing gear occur in the action area. These gears, including gillnet, hook-and-line (i.e., vertical line), and trawl gear; have all been documented as interacting with sea turtles. For all fisheries for which there is a fishery management plan (FMP) or for which any federal action is taken to manage that fishery, the impacts have been evaluated via section 7 consultation. Formal section 7 consultations have been conducted on the southeast shrimp trawl fishery, which is the only federally-managed fishery operating in the action area.

The southeast shrimp trawl fishery affects more sea turtles than all other activities combined (NRC 1990). On December 2, 2002, NMFS completed the opinion for shrimp trawling in the southeastern United States under proposed revisions to the TED regulations (68 FR 8456, February 21, 2003). This opinion determined that the shrimp trawl fishery under the revised TED regulations would not jeopardize the continued existence of any sea turtle species. This determination was based, in part, on the opinion's analysis that shows the revised TED regulations are expected to reduce shrimp trawl related mortality by 94 percent for loggerheads and 97 percent for leatherbacks. An incidental take statement (ITS) has been issued for the take of sea turtles in this fishery. More detailed information can be found in the opinion (NMFS 2002).

Formal section 7 consultations have also been conducted for the issuance of several exempted fishing permits (EFP). These opinions have concluded the proposed activities may adversely affect but were not likely to jeopardize the continued existence of any sea turtles. ITSs for each EFP issued were provided.

*Vessel and Military Operations*
Potential sources of adverse effects from federal vessel operations in the action area include operations of the U.S. Department of Defense (DOD), Navy (USN), Air Force and Coast Guard (USCG), the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA), and the COE. NMFS has conducted formal consultations with the USCG, the USN, and NOAA on some of their vessel operations. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. At the present time, however, they present the potential for some level of interaction. Refer to the Biological Opinions for the USCG (NMFS 1995; NMFS 1996; NMFS 1998) and the USN (NMFS 1997a) for details on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

Since the USN consultation only covered operations out of Mayport, Florida, potential still remains for USN vessels to adversely affect sea turtles within the action area. Similarly, operations of vessels by other federal agencies within the action area (NOAA, EPA, COE) may adversely affect sea turtles. However, the in-water activities of those agencies are limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a large amount of risk.

*Dredging*
The construction and maintenance of federal navigation channels and sand mining ("borrow") areas has also been identified as a source of sea turtle mortality. Hopper dredges move relatively rapidly (compared to sea turtle swimming speeds) and can entrain and kill sea turtles as the drag arm of the moving dredge overtakes the slower moving sea turtle. On September 22, 1995, NMFS completed the Regional Biological Opinion (RBO) issued to the COE, New Orleans and Galveston Districts, on hopper dredging of channels in Texas and Louisiana. NMFS reinitiated consultation with all Gulf of Mexico COE districts (i.e., Galveston, New Orleans, Mobile, and Jacksonville) on November 19, 2003, and issued an ITS for the entire Gulf of Mexico from the U.S.-Mexico border to Key West. This opinion determined that all channel dredging (i.e.,

maintenance dredging) and sand mining by hopper dredges in the Gulf of Mexico under the purview of the COE's Gulf districts would not jeopardize the continued existence of any sea turtle species. NMFS amended the GRBO on June 24, 2005 (Revision 1), and subsequently amended it a second time on January 9, 2007 (Revision 2).

*ESA Permits*
The ESA allows the issuance of permits to take ESA-listed species for the purposes of scientific research (section 10(a)(1)(a)). In addition, the ESA allows for the NMFS to enter into cooperative agreements with states developed under section 6 of the ESA, to assist in recovery actions of listed species. Prior to issuance of these authorizations, the proposal must be reviewed for compliance with section 7 of the ESA.

Sea turtles are the focus of research activities authorized by a section 10 permit under the ESA. There are currently 31 active scientific research permits (NMFS unpublished data) directed toward sea turtles that are applicable to the action area of this opinion. Authorized activities range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, blood sampling, tissue sampling (biopsy), and performing laparoscopy on intentionally captured turtles. The number of authorized takes varies widely depending on the research and species involved but may involve the taking of hundreds of turtles annually. Most takes authorized under these permits are expected to be non-lethal. Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). In addition, since issuance of the permit is a federal activity, issuance of the permit by the NMFS must also be reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species.

### 4.1.3 State or Private Actions

*Vessel Traffic*
Commercial traffic and recreational pursuits can have an adverse effect on sea turtles through propeller and boat strike damage. Private vessels participate in high-speed marine events concentrated in the southeastern United States and are a particular threat to sea turtles, and occasionally to marine mammals as well. The magnitude of these marine events is not currently known. NMFS and the USCG (who permit these events) have consulted on some of these events, but a complete analysis has not been completed. NMFS has also consulted with other agencies, such as MMS and FERC, on vessel transit interactions with listed species.

*State Fisheries*
Several coastal state fisheries are known to incidentally take listed species, but information on these fisheries is sparse (NMFS 2001a). Various fishing methods used in these commercial and recreational fisheries, including trawling, pot fisheries, gillnets, and vertical line are all known to incidentally take sea turtles, but information on these fisheries is sparse (NMFS 2001a). Most state data are based on extremely low observer coverage or sea turtles were not part of data collection; thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem. The 2001 HMS Biological Opinion (NMFS 2001b) has an excellent summary of turtles taken in state fisheries throughout the action area.

To address data gaps, several state agencies have initiated observer programs to collect information on interactions between listed species and certain gear types. Other states have closed nearshore waters to gear-types known to have high encounter rates with listed species. Depending on the fishery in question, many state permit holders also hold federal permits; therefore, existing section 7 consultations on federal fisheries may address some of the state fishery impacts.

Additional information on impact of take (i.e., associated mortality) is also needed for analysis of impacts to sea turtles from these fisheries. Certain gear types may have high levels of sea turtle takes, but very low rates of serious injury or mortality. For example, hook-and-line takes rarely are dead upon retrieval of gear, but trawls and gillnets frequently result in immediate mortality. Leatherbacks seem to be susceptible to a more restricted list of fisheries, while hardshell turtles, particularly loggerheads, seem to appear in data from almost all state fisheries. The HMS opinion also summarizes sea turtle interactions with flynets and various trawl techniques that occur within the action area.

Texas, Louisiana, Mississippi, and Florida have placed restrictions on gillnet fisheries within state waters such that very little commercial gillnetting takes place in southeastern waters.

Observations of state recreational fisheries have shown that loggerhead, leatherback, and green sea turtles are known to bite baited hooks, and loggerheads frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, piers, and beach, banks, and jetties and from commercial fishermen fishing for reef fish and for sharks with both single rigs and bottom longlines (NMFS 2001b). A detailed summary of the known impacts of hook-and-line incidental captures to loggerhead sea turtles can be found in the TEWG reports (1998; 2000).

### 4.1.4 Other Potential Sources of Impacts in the Environmental Baseline

A number of activities that may indirectly affect listed species in the action area of this consultation include ocean dumping and disposal, aquaculture, and anthropogenic marine debris. The impacts from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study impacts from these sources. Close coordination is occurring through the section 7 process on both dredging and disposal sites to develop monitoring programs and ensure that vessel operators do not contribute to vessel-related impacts.

*Marine Pollution*
Sources of pollutants in the Gulf of Mexico coastal regions include atmospheric loading of pollutants such as PCBs, stormwater runoff from coastal towns, cities and villages, runoff into rivers emptying into the bays, groundwater and other discharges, and river input and runoff. Nutrient loading from land-based sources such as coastal community discharges is known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. Although pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo et al. 1986), the impacts of many other anthropogenic toxins have not been investigated.

*Acoustic Impacts*
Acoustic impacts can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. Although focused on marine mammals, sea turtles may benefit from increased research on acoustics and reduction in noise levels.

### 4.1.5 Conservation and Recovery Actions Shaping the Environmental Baseline

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial fisheries. In particular, NMFS has required the use of TEDs in southeast U.S. shrimp trawls since 1989. It has been estimated that TEDs exclude 97 percent of the sea turtles caught in such trawls. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), floatation, and more widespread use. Analyses by Epperly and Teas (2002) indicated that the minimum requirements for the escape opening dimensions in TEDs in use at that time were too small, and that as many as 47 percent of the loggerheads stranding annually along the Atlantic Seaboard and Gulf of Mexico were too large to fit through existing openings. On February 21, 2003, NMFS published a final rule to require larger escape openings in TEDs used in the Southeast shrimp trawl fishery (68 FR 8456, February 21, 2003). Based upon the analyses in Epperly et al. (2002), leatherback and loggerhead sea turtles will greatly benefit from the new regulations, with expected reductions of 97 percent and 94 percent, respectively, in mortality from shrimp trawling. Several states (e.g., Florida, Georgia, South Carolina, Texas) have regulations requiring the use of TEDs in state-regulated shrimp trawl fisheries, and the federal regulations also apply in state waters.

NMFS has also been active in public outreach efforts to educate fishermen regarding sea turtle handling and resuscitation techniques. There is also an extensive network of Sea Turtle Stranding and Salvage Network (STSSN) participants along the Atlantic and Gulf of Mexico coasts who not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles.

Loggerheads, leatherbacks, greens, and Kemp's ridleys are known to bite a baited hook, frequently ingesting the hook. Hooked turtles have been reported by the public fishing from boats, piers, beaches, banks, and jetties. Necropsies have revealed hooks internally, which often were the cause of death. In 2006, the Marine Recreational Fishery Statistics Survey (MRFSS) added a survey question regarding sea turtle interactions within recreational fisheries; NMFS is exploring potential revisions to MRFSS to quantify recreational encounters with sea turtles on a permanent basis. Detailed summaries of the impact of hook-and-line incidental captures on loggerhead sea turtles can be found in the TEWG reports (1998; 2000).

The Recovery Plans for loggerhead and Kemp's ridley sea turtles are in the process of being updated. Recovery teams comprised of sea turtle experts have been convened and are currently working towards revising these plans based upon the latest and best available information.

# 5 EFFECTS OF THE ACTION

In this section of the opinion, we assess the probable effects of the proposed action on listed species within the action area. The analysis in this section forms the foundation for our jeopardy analysis in Section 7. A jeopardy determination is reached if we would reasonably expect a proposed action to cause reductions in numbers, reproduction, or distribution that would appreciably reduce a listed species' likelihood of surviving and recovering in the wild. The status of each listed sea turtle species likely to be adversely affected by the proposed action is reviewed in Section 3. Sea turtle species are listed because of their global status; a jeopardy determination must therefore find the proposed action will appreciably reduce the likelihood of survival and recovery of each species globally.

The quantitative and qualitative analyses in this section are based upon the best scientific and commercial data available on sea turtle biology and the effects of the proposed action. When analyzing the effects of any action, it is important to consider indirect effects as well as the direct effects. Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects include aspects such as habitat degradation, reduction of prey/foraging base, etc.

Previous biological opinions have documented that hopper dredging occasionally results in sea turtle entrainment and death, even with seasonal dredging windows, turtle deflector dragheads in place, and concurrent relocation trawling. For example, in the western Gulf of Mexico from February 1995 through March 2007, a total of 66 lethal takes (13 Kemp's ridleys, 27 loggerheads, and 26 greens) by Galveston District hopper dredging activities were documented during the dredging of 90.49 million cubic yards of material (U.S. Army Corps of Engineers Sea Turtle Data Warehouse, http://el.erdc.usace.army.mil/seaturtles/index.cfm). Of that total, two Kemp's and one loggerhead sea turtle takes occurred during maintenance dredging specifically in the SNWW area (Ibid).

Satellite telemetry work funded by COE and conducted by the NMFS Galveston Laboratory, demonstrates the nearshore occurrence of Kemp's ridleys near northern Gulf channels. Kemp's ridleys remained within 10 nm of shore for greater than 95 percent of the observed time, with 90 percent of the observed locations within 5 nm (M. Renaud, NMFS Galveston Laboratory, pers. comm.). Movements out of northern Gulf waters in response to cooling temperatures occurred during December, and Kemp's ridleys returned with warming waters in March.

Seasonal abundance of sea turtles utilizing nearshore waters of the northwest Gulf of Mexico varies with species and location. Green turtles within subtropical habitats of the Laguna Madre are the region's only year-round, inshore occupants. Other species, especially the Kemp's ridley, are transient users of the coastal zone that venture toward tidal passes and into bays during May-August when food sources and other environmental factors are favorable. The May-August period has yielded over 80 percent of the sea turtles captures (n=516) recorded by Texas A&M researchers (Landry et al. 1994). Based on strandings, reported incidental captures, observer data, aerial surveys, and telemetry tracks, loggerheads are distributed ubiquitously in the Gulf, generally occurring in all areas, both inshore and offshore.

*Habitat Effects of Hopper Dredging*
Hopper dredges widening and deepening the SNWW will directly alter the benthos through the removal of sediments. During dredging, water quality may be negatively impacted (i.e., increased turbidity) for short durations, although the area normally is extremely turbid. The widening of the SNWW will permanently and directly alter sediment quality in the portion of the SNWW to be widened. However, while sea turtles may be encountered in and near shipping channels, these areas do not provide preferred foraging opportunities. Therefore, any direct or indirect habitat impacts by dredging are expected to be insignificant in regard to ESA-listed sea turtle species.

*Estimated Turtle Takes by Dredges*
The proposed project would generate 110 million cubic yards of dredged material. However, hopper dredges will generate only 44.69 million cubic yards of material; hydraulic pipeline dredges will remove the remainder. Hopper dredging the SNWW has generated 32.57 million cubic yards of material from 1995-2007, which resulted in 3 turtle takes (2 Kemp's and 1 loggerhead). Therefore, on average, in the project area one turtle take is associated with every 10.86 million cubic yards of dredged material (32,565,321 cubic yards/3 turtles). This average would translate into an expected take of four turtles (three Kemp's ridley and one loggerhead or green sea turtle based on estimated catch rates by species for the western Gulf in Epperly et al. 2002, which is also consistent with species composition of reported takes in Galveston District dredging projects) during the course of the proposed project's hopper dredging; hydraulic pipeline dredges are not known to take turtles (NMFS 2007). This estimate is based on the implementation of relocation trawling to prevent additional lethal takes by hopper dredges; in the complete absence of relocation trawling, takes by hopper dredges could be higher.

*Disorientation Effects of Hopper Dredge and Pumpout Barge Deck Lighting*
NMFS believes that female sea turtles approaching nesting beaches, and neonates (i.e., hatchlings) emerging from nests and exiting their natal beaches, may be adversely affected by bright offshore lights from hopper dredges or hopper dredge pumpout barges operating in the nearshore (0-3 nm) environment. Females approaching the beach to nest could be deterred from nesting by bright lights in the nearshore environment. Hatchlings emerging from their nests could be attracted away from the shortest path to the water and instead crawl or swim toward the bright lights of a nearshore hopper dredge or anchored pumpout barge (instead of crawling or swimming seaward toward the open horizon), thus increasing their exposure time to predation. NMFS recently received a report from a National Park Service biologist at Gulf Islands National Seashore (M. Nicholas, pers. comm. to E. Hawk, September 29, 2003) who relocated a clutch of 97 Perdido Key hatchlings on September 28, 2003. The biologist felt that the hatchlings were in danger of being attracted to a nearby operating, brightly lit hopper dredge which was dredging one-half to one mile offshore in Pensacola Entrance Channel. NMFS considers it prudent that hopper dredges and hopper dredge pumpout barges operating within 3 nm of sea turtle nesting beaches during sea turtle nesting and sea turtle hatchling emergence season (May 1-October 31, annually), should shield essential deck lighting and reduce or extinguish non-essential deck lighting to the maximum extent possible consistent with vessel personnel safety and U.S. Coast Guard navigation requirements, to reduce potential disorientation effects, potential reduced or aborted nesting, and potential increased hatchling mortality from increased exposure to predators. This is consistent with U.S. Fish and Wildlife Service biological opinion requirements

and Florida Wildlife Commission requirements for beach nourishment projects where nesting sea turtles may be present, and was jointly developed by these agencies, the Florida Department of Environmental Protection, and the U.S. Army Corps of Engineers, Jacksonville District (R. Trindell, pers. comm. to E. Hawk, September 30, 2003). Due to the small footprint of a hopper dredge and pumpout barge, NMFS does not expect the equipment/vessels will introduce a mechanical obstacle to nesting sea turtles or hatchlings, to the extent they may be in the immediate vicinity of the SNWW.

*Effects of Relocation Trawling Activities in Association with Hopper Dredging*
Relocation trawling has been successful at temporarily displacing Kemp's ridley, loggerhead, leatherback, and green sea turtles from channels in the Atlantic and Gulf of Mexico during periods when hopper dredging was imminent or ongoing. Some turtles captured during relocation trawling operations return to the dredge site and are subsequently recaptured. Sea turtle relocation studies by Standora et al. (1993) at Canaveral Channel relocated 34 turtles to 6 release sites of varying distances north and south of the channel. Ten turtles returned from southern release sites, and seven from northern sites, suggesting that there was no significant difference between directions. Return times observed suggested that there was a direct correlation between relocation distance and likelihood of return or length of return time to the channel when sea turtles were relocated to the south. No correlation was observed between the northern release sites and the time or likelihood of return. The study found that relocation of turtles to the site 70 km (43 miles) south of the channel would result in a return time of over 30 days.

REMSA, a private company contracted to conduct relocation trawling, captured, tagged, and relocated 69 turtles in a 7-day period at Canaveral Channel in October 2002, with no recaptures; turtles were relocated a minimum of 3-4 miles away (T. Bargo, REMSA, pers. comm. to Eric Hawk, June 2, 2003). Twenty-four hour per day relocation trawling conducted by REMSA at Aransas Pass Entrance Channel (Corpus Christi Ship Channel) from April 15, 2003, to July 7, 2003, relocated 71 turtles from 1.5-5 miles from the dredge site, with 3 recaptures (T. Bargo, REMSA, pers. comm. to Eric Hawk, July 24, 2003). One turtle released on June 14, 2003, approximately 1.5 miles from the dredge site, was recaptured four days later; another turtle captured June 9, 2003, and released about three miles from the dredge site was recaptured nine days later. Subsequent releases occurred five miles away. Of these 68 subsequent capture/releases, 1 turtle released on June 22, 2003, was recaptured 13 days later (REMSA Final Report, Sea Turtle Relocation Trawling, Aransas Pass, Texas, April-July 2003).

Relocation trawling activities initiated by GDCOE in 2007 have resulted in the capture, tagging, and relocation of 65 green, 19 Kemp's ridley, and 9 loggerhead sea turtles as of April 20. Relocation trawling within the immediate project area (i.e., SNWW) has resulted in 7 Kemp's ridley and 11 loggerhead sea turtle captures since 2003.

Prior to 1997, most relocation trawling in association with hopper dredging was performed by the COE under an ESA section 10 incidental take/research permit. Since then, however, relocation trawling has primarily been conducted by private companies. Since approximately October 1999, Coastwise Consulting, Inc., has conducted over 1,600 days of relocation trawling at Wilmington, North Carolina; Kings Bay and Savannah, Georgia; Pensacola, Florida; and

Sabine Pass, Galveston, Freeport, Matagorda Pass, and Corpus Christi, Texas (C. Slay, e-mail to E. Hawk, January 25, 2007). During the course of that work, over 770 loggerhead, Kemp's ridley, green, and hawksbill, and leatherback sea turtles were successfully captured, tagged, and released; only one leatherback mortality has been documented, which was attributed to illegal artificial reef material deployed within a designated borrow area. On the Atlantic coast, REMSA has also successfully tagged and relocated over 140 turtles in the last several years, most notably, 69 turtles (55 loggerheads and 14 greens) in a 7-day period at Canaveral Channel in October 2002, with no significant injuries. Other sea turtle relocation contractors (R. Metzger in 2001; C. Oravetz in 2002) have also successfully and non-injuriously trawl-captured and released sea turtles out of the path of oncoming hopper dredges. More recently in the Gulf of Mexico, REMSA captured, tagged, and relocated 71 turtles at Aransas Pass with no apparent long-term ill effects to the turtles. Three injured turtles captured were subsequently transported to University of Texas Marine Science Institute rehabilitation facilities for treatment (two had old, non-trawl related injuries or wounds; the third turtle may have sustained an injury to its flipper, apparently from the door chain of the trawl, during capture). Three of the 71 captures were recaptures and were released around 1.5, 3, and 5 miles, respectively, from the dredge site; none exhibited any evidence their capture, tag, release, and subsequent recapture, was in any way detrimental.

The effects of this harassment of the turtles during capture and handling can result in raised levels of stressor hormones, and can cause some discomfort during tagging procedures. Based on past observations obtained during similar research trawling for turtles, these effects are expected to dissipate within a day (Stabenau and Vietti 1999). Since turtle recaptures are rare, and recaptures that do occur typically happen several days to weeks after initial capture, cumulative adverse effects of recapture are not expected.

The Gulf and South Atlantic Fisheries Development Foundation's August 31, 1998, "Alternatives to TEDs: Final Report," presents data on 641 South Atlantic shallow tows (only one tow was in water over 27.4 m), all conducted under restricted tow times (55 minutes during April through October and 75 minutes from November through March), and 584 Gulf of Mexico nearshore tows conducted under the same tow time restrictions. Offshore effort in the Gulf of Mexico consisted of 581 non-time restricted tows, which averaged 7.8 hours per tow. All totaled, 323 turtle observations were documented: 293 in the nearshore South Atlantic efforts, and 30 in the Gulf efforts (24 nearshore and 6 offshore). Of the 293 South Atlantic turtles (219 loggerhead, 68 Kemp' ridley, 5 green, and 1 leatherback), only 274 were used in the analyses (201 loggerhead, 67 Kemp's ridley, 5 green, and 1 leatherback) because 12 escaped from the nets after being seen and 7 were caught in try nets. Of the 274 South Atlantic turtles captured using restricted tow times, only 5 loggerheads and 1 Kemp's ridley died because of the interaction. For the Gulf efforts, 26 turtles (8 loggerhead, 16 Kemp's ridley, and 2 green) were captured, resulting in three mortalities (1 loggerhead inshore, 1 loggerhead, and 1 green offshore). Excluding all six offshore tows and both offshore mortalities (because of the prolonged, non-restricted tow times), we are left with 1,225 time-restricted tows (584 + 641) resulting in 298 trawl-captured turtles (274 + 24) resulting in seven mortalities, i.e., 2.3 percent of the interactions resulted in death.

Rarely, even properly conducted relocation trawling can result in accidental sea turtle deaths. Henwood (T. Henwood, pers. comm. to E. Hawk, December 6, 2002) noted that trawl-captured

loggerhead sea turtles died on several occasions during handling on deck during winter trawling in Canaveral Channel in the early 1980s, after short (approximately 30 minutes) tow times. However, Henwood also noted that a significant number of the loggerheads captured at Canaveral during winter months appeared to be physically stressed and in "bad shape" compared to loggerheads captured in the summer months from the same site, which appeared much healthier and robust. Stressed turtles or unhealthy turtles or turtles exposed to repeated forced submergences are more likely to be injured or killed during relocation trawling than healthy turtles.

In November 2002, during relocation trawling conducted in York Spit, Virginia, a Kemp's ridley sea turtle was likely struck by one of the heavy trawl doors or it may have been struck and killed by another vessel shortly before trawl net capture. The hopper dredge was not working in the area at the time (T. Bargo, pers. comms. and e-mails to E. Hawk, December 6 and 9, 2002). Additionally, during relocation trawling conducted off Destin, Florida, on December 2, 2006, a leatherback turtle was captured and killed. However, this mortality occurred after the trawler encountered a large section of debris, potentially illegally dumped artificial reef material, which likely impacted the sea turtle (C. Slay, pers. comms. and e-mails to E. Hawk, December 4, 2006).

NMFS typically limits tow times for relocation trawling to 42 minutes or less measured from the time the trawl doors enter the water when setting the net to the time the trawl doors exit the water during haulback ("doors in - doors out"). The National Research Council (NRC) report "Decline of the Sea Turtles: Causes and Prevention" (NRC 1990) suggested that limiting tow durations to 40 minutes in summer and 60 minutes in winter would yield sea turtle survival rates that approximate those required for the approval of new TED designs, i.e., 97 percent. The NRC report also concluded that mortality of turtles caught in shrimp trawls increases markedly for tow times greater than 60 minutes. Current NMFS TED regulations allow, under very specific circumstances, for shrimpers with no mechanical-advantage trawl retrieval devices on board, to be exempt from TED requirements if they limit tow times to 55 minutes during April through October and 75 minutes from November through March. The presumption is that these tow time limits will result in turtle survivability comparable to having TEDs installed.

In summary, NMFS believes that properly conducted and supervised relocation trawling (i.e., observing NMFS-recommended trawl speed and tow-time limits, and taking adequate precautions to release captured animals) and tagging is unlikely to result in adverse effects to sea turtles. NMFS estimates that, overall, sea turtle trawling and relocation efforts will result in considerably less than 0.5 percent mortality of captured turtles, primarily due to their being previously stressed or diseased or if struck by trawl doors or accidents on deck. On the other hand, hopper dredge entrainments invariably result in injury, and are almost always fatal. In the regional biological opinions on hopper dredging, NMFS requires relocation trawling and tagging as methods of reducing sea turtle entrainment in hopper dredges and to document the effects of relocation trawling, according to criteria defined in the ITS.

*Effects and Desirability of Tagging and Taking Genetic Samples From Relocated Animals*
Tagging prior to release will help NMFS learn more about the habits and identity of trawl-captured animals after they are released, and if they are recaptured they will enable improvements in relocation trawling design to further reduce the effect of the take. External and

internal flipper tagging (e.g., with Inconel and PIT tags) is not considered a dangerous procedure by the sea turtle research community, is routinely done by thousands of volunteers in the United States and abroad; and can be safely accomplished with minimal training. NMFS knows of no instance where flipper tagging has resulted in mortality or serious injury to a trawl-captured sea turtle. Such an occurrence would be extremely unlikely because the technique of applying a flipper tag is minimally traumatic and relatively non-invasive; in addition, these tags are attached using sterile techniques. Important growth, life history, and migratory behavior data may be obtained from turtles captured and subsequently relocated. Therefore, these turtles should not be released without tagging (and scanning for pre-existing tags).

Tissue sampling is performed to determine the genetic origins of captured sea turtles, and learn more about species' life history, nesting beach identification, and distribution/stock overlap. This is important information because some populations, e.g., the northern subpopulation of loggerheads nesting in the Southeast Region, may be declining. For all tissue sample collections, a sterile 4- to 6-mm punch sampler is used. Researchers who examined turtles caught two to three weeks after sample collection noted that the sample collection site was almost completely healed (Witzell, pers. comm.). NMFS does not expect that the collection of a tissue sample from each captured turtle will cause any additional stress or discomfort to the turtle beyond that experienced during capture, collection of measurements, and tagging. Tissue sampling procedures are specified in the terms and conditions of this opinion.

*Estimated Turtle Takes by Relocation Trawler*

This opinion will require the use of relocation trawling as a RPM to reduce the effect of take of turtles by hopper dredges. Even though relocation trawling involves directed take of turtles, it constitutes a legitimate RPM because it reduces the level of almost certain lethal and injurious take of sea turtles by hopper dredges, and allows the turtles captured non-injuriously by trawl to be relocated out of the path of the dredges. Without relocation trawling, the number of lethal takes of sea turtles by hopper dredging would likely be significantly greater than the estimated number discussed above and specified in the ITS. The Consultation Handbook (for Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act, U.S. Fish and Wildlife Service and National Marine Fisheries Service, March 1998) expressly authorizes such directed take as an RPM at page 4-54. Therefore, NMFS will in this section evaluate the expected level of turtle take through required relocation trawling, so that these levels can be included in the evaluation of whether the proposed action will jeopardize the continued existence of the species.

The number of turtles relocated by trawlers in association with Gulf of Mexico hopper dredging projects varies considerably by project area, amount of effort, and time of year. For example, in 2006 the dredging of the Houston-Galveston Navigation Channels, which produced 3.7 million cubic yards of material (i.e., similar to what is expected in the proposed action), resulted in 7 loggerheads relocated in 60 days of trawling. However, in 2006 over approximately 15 days, 34 green sea turtles were relocated during the dredging of the Brownsville Entrance Channel. Furthermore, sea turtle distribution can be very patchy, resulting in significant differences in number of turtle takes by relocation trawler. For example, in 2003, Aransas Pass relocation trawling associated with hopper dredging resulted in 71 turtles captured and released in 3 months

of relocation trawling, while the aforementioned Houston-Galveston project in 2006 only experienced 7 turtles in 2 months.

NMFS estimates that relocation trawling associated with the proposed action will take no more than 32 sea turtles (7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles based on frequency data in Epperly et al. 2002). This number is based on past recent history of relocation trawler takes in the Gulf of Mexico, the possibility that a significant pulse of turtles could be encountered by relocation trawlers (e.g., 2003 event at Aransas Pass), and increased presence of sea turtles in coastal waters as turtle populations recover and new TED regulations take effect leading to increased trawl capture rates. As stated in the RPMs and Terms and Conditions of this opinion's ITS, relocation trawling is required under specific circumstances. This relocation trawling may result in sea turtle takes, but these takes are not expected to be injurious or lethal due to the short duration of the tow times (15 to 30 minutes per tow; not more than 42 minutes, as per Term and Condition No. 13) and required safe-handling procedures.

The number of non-lethal sea turtles takes expected by relocation trawlers does not directly translate into potential lethal takes by hopper dredges in the absence of relocation trawling, due to the differences in footprint between the two gears. The spread of a relocation trawler is much greater than the intake of a hopper dredge, therefore, the trawler will encounter a significantly greater number of sea turtles. However, it is reasonable to assume that in the absence of relocation trawling the number of lethal takes would increase, but predicting a precise number (i.e., lethal take by hopper dredging in the absence of relocation trawling) would be problematic due to the fact that the COE has consistently used relocation trawling as a standard practice for the majority of its projects in the Gulf of Mexico in recent years.

*Effects of Dredged Material Disposal and Establishing Four New ODMDS*

Typically, dredged materials from channel maintenance dredging activities are disposed of down current of the navigation channels being maintained (by agitation dredging and sidecasting), or in designated disposal areas which are adjacent to and run approximately parallel to the navigation channels, or in nearby designated offshore disposal areas (to minimize transit time of the hopper dredge to and from the dredging site). Alternatively, they are used beneficially for barrier island restoration and creation of island, wetland, marsh, and shallow-water habitats, or to renourish eroded mainland beaches. NMFS believes that proposed disposal activities are unlikely to adversely affect sea turtles. These species are highly mobile and should be able to easily avoid a descending sediment plume discharged at the surface by a hopper dredge opening its hopper doors, or pumping its sediment load over the side. Furthermore, the disposal of dredged material will occur in areas that are not preferred sea turtle foraging habitat. Regardless, NMFS believes that foraging habitat for sea turtles is not likely a limiting factor in the Gulf of Mexico, and thus the potential temporary removal of relatively small areas (compared to remaining foraging habitat) of potential foraging habitat by burial with dredged material sediment will not measurably adversely affect sea turtles. Turtles will typically forage further offshore where non-ephemeral limestone ledges supporting algal/sponge growth are located. These ledges are not routinely covered by shifting sands, as they are prone to in the high wave-energy nearshore environment.

While the proposed project plans to dispose of dredged material in four existing ODMDS, it also proposes to dispose of material in four new ODMDS. The four new ODMDS each average approximately 3,392 acres in size, and will accommodate a total of 18.7 million cubic yards of material. They are located between 21 and 30 miles from shore in water depths ranging from 44 to 46 feet.

NMFS believes the disposal of material at four new ODMDS is unlikely to adversely affect sea turtles. These species are highly mobile and should be able to easily avoid a descending sediment plume discharged at the surface by a hopper dredge opening its hopper doors, or pumping its sediment load over the side. NMFS also believes that foraging habitat for sea turtles is not likely a limiting factor in this area of the Gulf of Mexico; thus, the temporary removal of relatively small areas (compared to remaining foraging habitat) of potential foraging habitat by burial with dredged material sediment will not significantly affect sea turtles. Turtles will typically forage further offshore where non-ephemeral limestone ledges supporting algal/sponge growth are located. There are no known limestone ledges or other associated habitat in the proposed ODMDS.

Sediment composition is a cardinal factor in controlling the settlement and viability of many marine invertebrates. In addition, benthic recovery is dependent on time of year. Placement of materials similar to ambient sediments (e.g., sand on sand or mud on mud) has been shown to produce less severe impacts in contrast to placement of dissimilar sediments, which generally results in more severe, long-term impact (Maurer et al. 1978; Maurer et al. 1986). Deposition of relatively thin layers of dredged material (<10 cm; 4 in) can minimize impacts by allowing many populations of small, shallow-burrowing infauna with characteristically high reproductive rates and wide dispersal capabilities to recover quickly. Deposits greater than 20-30 cm (8-12 in) generally eliminate all but the largest and most vigorous burrowers (Maurer et al. 1978).

Observed rates of benthic community recovery after dredged material placement range from a few months to several years. The relatively species-poor benthic assemblages associated with low salinity estuarine sediments can recover in periods of time ranging from a few months to approximately one year (Van Dolah et al. 1979; Van Dolah et al. 1984; Clarke and Miller-Way 1992), while the more diverse communities of high salinity estuarine sediments may require a year or longer (e.g., Ray and Clarke 1999). Recovery rates for sandy inshore marine sites should be similar to those reported for high salinity estuarine sites (Richardson et al. 1977; Van Dolah et al. 1984) if the overburden is comprised of similar sediments.

Most of what is known about the species-specific recovery/recolonization of benthic communities following dredge material placement in the Gulf of Mexico is the result of work by Rakocinski et al. (1991; 1996); others (e.g., Nelson 1993) have focused on benthic recovery following beach restoration. Generally, recovery/recolonization is dependent upon sediment-type, time, depth of overburden, depth, and proximity to shore. One long-term (i.e., two year) study monitored recovery and concluded recolonization occurred, although the macrobenthic community structure was different and wide fluctuations between stations were present two years post-event (Rakocinski et al. 1996). NMFS concludes that the effects of dredged material disposal on benthic communities is unlikely to adversely affect listed sea turtles because they

will avoid the sediment plumes and their foraging success is likely to be insignificantly affected by dredged material deposition.

*Effects of Marsh Restoration*
An inshore portion of the proposed project would beneficially use dredged material to restore several degraded marsh areas in Texas and Louisiana. The restoration work will convert approximately 716 acres of tidal marsh to open water, as well as produce 7,475 acres of fresh, intermediate, and brackish marsh.

NMFS believes that deposition of dredged materials in the littoral nearshore environment for creation/restoration of wetland, marsh, and shallow-water habitats in the Gulf of Mexico will not adversely affect sea turtles, and may ultimately be beneficial if restoration efforts are successful. Sea turtles are highly mobile and should be able to easily avoid marsh restoration work (i.e., placement of dredged material, marsh plantings). Nearshore habitats for foraging sea turtles are present in sufficient quantities such that removal of relatively small portions of potential foraging habitat will not cause measurable adverse effects on sea turtles.

The conversion of tidal marsh to open water and marsh restoration activities will potentially produce an increase in salinity of 0.5-3.0 parts per thousand in portions of the Sabine River, the marshes at Sabine Pass, and portions of Sabine Lake. NMFS believes the expected salinity increases in specific areas will not adversely affect sea turtles, and the restoration of 7,475 acres of fresh, intermediate, and brackish marsh will have a beneficial impact on the local ecosystem.

## 6 CUMULATIVE EFFECTS

Cumulative effects are the effects of future state, local, or private activities that are reasonably certain to occur within the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Within the action area, the major future change in human activities that is anticipated is associated with eastward expansion of oil and gas exploration and extraction in the Gulf of Mexico and would involve a federal action. The action area's present use for commercial and recreational fishing is expected to continue at the present levels of intensity in the near future. Residential development in coastal Texas and Louisiana is likely to increase as part of the nationwide trend of human migration to the coasts. This trend likely will not have a major effect on the action area's ability to function as a foraging habitat for turtles. As discussed in the Environmental Baseline Section, however, listed species of turtles migrate throughout the Gulf of Mexico and may be affected during their life cycles by non-federal activities outside the action area.

Throughout the coastal Gulf of Mexico, and particularly in Louisiana, the loss of thousands of acres of wetlands is occurring due to natural subsidence and erosion, as well as reduced sediment input from the Mississippi River. Impacts caused by residential, commercial, and agricultural developments appear to be the primary causes of wetland loss in Texas.

Oil spills from tankers transporting foreign oil, as well as the illegal discharge of oil and tar from vessels discharging bilge water will continue to affect water quality in the Gulf of Mexico.

Cumulatively, these sources and natural oil seepage contribute most of the oil discharged into the Gulf of Mexico. Floating tar sampled during the 1970s, when bilge discharge was still legal, concluded that up to 60 percent of the pelagic tars sampled did not originate from the northern Gulf of Mexico coast.

Marine debris will likely persist in the action area in spite of marine pollution prohibitions. In Texas and Florida, approximately half of the stranded turtles examined have ingested marine debris (Plotkin and Amos 1990; Bolten and Bjorndal 1991). Although entanglements affect fewer individuals than ingestion of debris, entanglement in marine debris may contribute more frequently to the death of sea turtles.

Coastal runoff and river discharges carry large volumes of petrochemical and other contaminants from agricultural activities, cities and industries into the Gulf of Mexico. The coastal waters of the Gulf of Mexico have more sites with high contaminant concentrations than other areas of the coastal United States, due to the large number of waste discharge point sources. Sea turtles may be exposed to and accumulate these contaminants during their life cycles, with unknown effects.

State regulated commercial and recreational fishing activities in Gulf of Mexico waters probably take endangered species. These takes are not reported and are unauthorized. It is expected that states will continue to license/permit large vessel and thrill-craft operations, which do not fall under the purview of a federal agency and will issue regulations that will affect fishery activities. NMFS will continue to work with states to develop ESA section 6 agreements and section 10 permits to enhance programs to quantify and mitigate these takes. Increased recreational vessel activity in inshore waters of the Gulf of Mexico will likely increase the number of turtles taken by injury or mortality in vessel collisions. Recreational hook-and-line fisheries have been known to lethally take sea turtles, including Kemp's ridleys. In a study conducted by the NMFS Galveston Laboratory between 1993 through 1995, 170 ridleys were reported associated with recreational hook-and-line gear; including 18 dead stranded turtles, 51 rehabilitated turtles, 5 that died during rehabilitation, and 96 that were released by fishermen (Cannon and Flanagan 1996). The STSSN also receives stranding reports that identify carcass anomalies that may be associated with the recreational fishery (entangled in line or net, fish line protruding, fish hook in mouth or digestive tract, fish line in digestive tract. The reports do not distinguish between commercial or recreational sources of gear, such as hook, net, and line, which may be used in both sectors. Cumulatively, fishery entanglement anomalies are noted in fewer than 4 percent of the stranded sea turtle carcasses reported between 1990 and 1996, and some carcasses carry more than one anomaly (e.g., fishing line in digestive tract/fishing line protruding from mouth or cloaca); therefore, summing these reports may result in some double counting.

## 7 JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of any ESA-listed sea turtles. In Section 5, we have outlined how the proposed dredging and sediment disposal can affect sea turtles, and the extent of those effects in terms of estimates of the numbers of sea turtles caught and/or injured/killed. Now we turn to an assessment of each species' response to this impact, in terms of overall population effects from the estimated take,

and whether those effects of the proposed action, when considered in the context of the status of the species (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), will jeopardize the continued existence of the affected species.

"To jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and the recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). Thus, in making this determination for each species, we must look at whether there will be a reduction in the reproduction, numbers, or distribution. Then, if there is a reduction in one or more of these elements, we evaluate whether it will cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

## 7.1 Effects of the Action on the Likelihood of Survival in the Wild

This section analyzes the effects of the action on the likelihood of survival of each species in the wild. In this context, the survival of the species refers to the continued existence of the species in the wild, and whether or not any anticipated take of that species will result in any reduction in reproduction, numbers, or distribution of that species that may appreciably increase a species' risk of extinction in the wild.

In the following analysis, we demonstrate that although some short-term reduction in numbers and reproduction is expected, the anticipated take of Kemp's ridley, loggerhead, and green sea turtles will not appreciably increase the risk of extinction of these species in the wild.

The lethal take of four sea turtles (three Kemp's ridley, and either one loggerhead or one green sea turtle based on estimated catch rates by species for the western Gulf in Epperly at al. 2002, which is also consistent with species composition of reported takes in Galveston District dredging projects) by hopper dredges over the duration of the proposed project could potentially result in short-term effects on individuals. Changes in distribution, even short-term, are not expected from non-lethal takes (interactions/releases from relocation trawling, vessel strikes, etc.) during the widening and deepening of the SNWW. Interactions with vessels and/or relocation trawlers may elicit startle or avoidance responses and the effects of the proposed action may result in temporary changes in behavior of sea turtles (minutes to hours) over small areas, but are not expected to reduce the distribution of any sea turtles in the action area. The removal of four sea turtles is anticipated during the proposed project. Because all the potential takes are expected to occur anywhere in the action area and sea turtles generally have large ranges in which they disperse, no reduction in the distribution of Kemp's ridley, loggerhead, and/or green sea turtles is expected from the take of these individuals.

The non-lethal take of 32 sea turtles by relocation trawlers (7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles based on frequency data in Epperly et al. 2002) is not expected to have any measurable impact on the reproduction or numbers of sea turtles. Any negative effects experienced by sea turtles captured and released by relocation trawlers are expected to be minimal and temporary in nature. Although the range of impacts of non-lethal takes are variable, all are expected to be fully recoverable such that no reductions in reproduction or numbers of Kemp's ridley, loggerhead, and/or green sea turtles are anticipated.

The removal of four sea turtles by hopper dredges would result in an instantaneous, but temporary reduction in total population numbers. Thus, the action will result in a reduction of sea turtle numbers. Sea turtle mortality resulting from hopper dredges could result in the loss of reproductive value of an adult turtle. For example, an adult loggerhead sea turtle can lay 3 or 4 clutches of eggs every 2 to 4 years, with 100 to 130 eggs per clutch. The annual loss of one adult female sea turtle, on average, could preclude the production of thousands of eggs and hatchlings, of which a small percentage are expected to survive to sexual maturity. Thus, the death of a female eliminates an individual's contribution to future generations, and the action will result in a reduction in sea turtle reproduction.

All life stages are important to the survival of the species; however, it is important to note that individuals of one life stage are not equivalent to those of other life stages. For example, loggerhead sea turtles have very long developmental times before reaching maturity (up to 38 years). Individuals in earlier life stages are subject to many potential sources of mortality, both natural and human-induced, prior to reaching sexual maturity. Only a fraction of pelagic juveniles are ever expected to contribute to the population through reproduction, and thus are not as valuable to the population as a breeding age adult. The loss of a certain number of pelagic juveniles, therefore, is less of a threat to the species' survival compared to an equal loss of sexually-mature adults.

The low number of expected sea turtle mortalities (four over the course of the project's approximately 5-year duration) is not detectable. Considering their population sizes in the Western North Atlantic, we believe the Kemp's ridley, loggerhead, and green sea turtle populations are sufficiently large enough to persist and recruit new individuals to replace those expected to be taken. For example, the TEWG (1998) estimated the total loggerhead population of benthic individuals in U.S. waters – a subset of the whole Western Atlantic population – at over 200,000. Based on this estimate, the potential mortality of 1 loggerhead over the duration of the proposed action would be less than 0.000005 percent of the current total eastern U.S. population.

The total population of Kemp's ridleys is not known, but nesting has been increasing significantly in the past several years (9 to 13 percent per year) with a trajectory that should meet or exceed recovery goals. Kemps' ridleys mature and nest at an age of 7-15 years, which is earlier than other chelonids. A younger age at maturity may be a factor in the response of this species to recovery actions. A period of steady increase in benthic immature ridleys has been occurring since 1990 and appears to be due to increased hatchling production and an apparent increase in survival rates of immature sea turtles beginning in 1990. The increased survivorship of immature sea turtles is attributable, in part, to the introduction of turtle excluder devices (TEDs) in the United States and Mexican shrimping fleets and Mexican beach protection efforts. The TEWG (2000) projected that Kemp's ridleys could reach the Recovery Plan's intermediate recovery goal of 10,000 nesters by the year 2015. Based on the above analysis, and similar to the conclusion reached for loggerhead sea turtles, the anticipated lethal take of three Kemp's ridley sea turtles on the population would not be expected to be detectable.

Although the anticipated mortalites would result in an instantaneous reduction in absolute population numbers, it is likely that the U.S. populations of sea turtles would not be appreciably affected considering the following. For a population to remain stable, sea turtles must replace themselves through successful reproduction at least once over the course of their reproductive lives, and at least one offspring must survive to reproduce itself. If the hatchling survival rate to maturity is greater than the mortality rate of the population, the loss of breeding individuals would be replaced through recruitment of new breeding individuals from successful reproduction of non-taken sea turtles. Even given a declining trend of a major nesting subpopulation (e.g., loggerhead sea turtles), the present population sizes of Kemp's ridley, loggerhead, and green sea are sufficiently large for their persistence. Although the declining numbers of major loggerhead sea turtle nesting subpopulations requires further study and analysis to determine the causes and long-term effects on population dynamics, the likelihood of survival in the wild of loggerhead, as well as Kemp's ridley and green sea turtles, will not be appreciably reduced as a result of this action.

Based on the above analysis, we believe that the lethal and non-lethal takes of Kemp's ridley, loggerhead, green, hawksbill, and leatherback sea turtles associated with the proposed action are not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of these species of sea turtles in the wild.

## 7.2 Effects of the Action on the Likelihood of Recovery in the Wild

The above analysis on the effects of the action on the likelihood of each species' survival in the wild considered the current status of each species and effects of the numbers of lethal and/or non-lethal takes anticipated for each species. Although no appreciable change in distribution was concluded for any species, we concluded lethal takes would result in an instantaneous reduction in absolute population numbers that may also reduce reproduction, but the short-term reductions are not expected to appreciably reduce the likelihood of survival of any species in the wild. The following analysis considers the effects of the take on the likelihood of recovery in the wild. We consider the recovery objectives in the recovery plans prepared for each species that relate to population numbers or reproduction that may be affected by the predicted reductions in the numbers or reproduction of sea turtles resulting from the proposed action.

The Atlantic recovery plan for the United States population of the loggerhead sea turtles (NMFS and USFWS 1991a), herein incorporated by reference, lists the following relevant recovery objective over a period of 25 continuous years:

- The adult female population in Florida is increasing and in North Carolina, South Carolina, and Georgia, it has returned to pre-listing nesting levels (NC = 800 nests/season; SC = 10,000 nests/season; GA = 2,000 nests/season).

The recovery plan for Kemp's ridley sea turtles (USFWS and NMFS 1992), herein incorporated by reference, lists the following relevant recovery objective:

- Attain a population of at least 10,000 females nesting in a season.

The Atlantic recovery plan for the population of green sea turtles (NMFS and USFWS 1991b), herein incorporated by reference, lists the following relevant recovery objectives over a period of 25 continuous years:

- The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years; and
- A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

The recovery plan for the population of the hawksbill sea turtles (NMFS and USFWS 1993), herein incorporated by reference, lists the following relevant recovery objectives over a period of 25 continuous years:

- The adult female population is increasing, as evidenced by a statistically significant trend in the annual number of nests at five index beaches, including Mona Island and BIRNM; and
- The numbers of adults, subadults, and juveniles are increasing, as evidenced by a statistically significant trend on at least five key foraging areas within Puerto Rico, USVI, and Florida.

The Atlantic recovery plan for the United States population of the leatherback sea turtles (NMFS and USFWS 1992), herein incorporated by reference, lists the following relevant recovery objective:

- The adult female population increases over the next 25 years, as evidenced by as statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, USVI, and along the east coast of Florida.

The potential lethal take of three Kemp's ridley, and either one loggerhead or one green sea turtle will result in a reduction in overall population numbers in any given year. We have already determined this take is not likely to reduce population numbers over time due to current population sizes and expected recruitment. Non-lethal takes of sea turtles by relocation trawlers will not affect the adult female nesting population or number of nests per nesting season. Thus, the effects of the proposed action will not result in an appreciable reduction in the likelihood of Kemp's ridley, loggerhead, green, hawksbill, and/or leatherback sea turtles recovery in the wild.

### 7.3 Summary

The proposed widening and deepening of the SNWW will not appreciably reduce the likelihood of the survival and recovery in the wild of any of the five species of sea turtles considered in this biological opinion. We conclude that the anticipated reduction in numbers by take of sea turtles by hopper dredges associated with the proposed action, combined with the non-lethal takes resulting from relocation trawling, when evaluated in the context of each species' status, the environmental baseline, and the cumulative effects, are not expected jeopardize the continued existence of Kemp's ridley, loggerhead, green, hawksbill, and/or leatherback sea turtles.

# 8 CONCLUSION

We have analyzed the best available data, the current status of the species, environmental baseline, effects of the proposed action, and cumulative effects to determine whether the proposed action is likely to jeopardize the continued existence of any sea turtle species.

Our sea turtle analyses focused on the impacts and population response of Kemp's ridley, loggerhead, green, hawksbill, and leatherback sea turtles in the Gulf of Mexico (i.e., Atlantic basin). However, the impact of the effects of the proposed action on the Atlantic populations must be directly linked to the global populations of the species, and the final jeopardy analysis is for the global populations as listed in the ESA. Because the proposed action will not reduce the likelihood of survival and recovery of any Atlantic populations of sea turtles, it is our opinion that the proposed action is also not likely to jeopardize the continued existence of Kemp's ridley, loggerhead, green, hawksbill, or leatherback sea turtles.

# 9 INCIDENTAL TAKE STATEMENT (ITS)

Section 9 of the ESA and protective regulations issued pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the RPMs and terms and conditions of the ITS.

Section 7(b)(4)(c) of the ESA specifies that in order to provide an incidental take statement for an endangered or threatened species of marine mammal, the taking must be authorized under section 101(a)(5) of the MMPA. Since no incidental take of listed marine mammals is expected or has been authorized under section 101(a)(5) of the MMPA, no statement on incidental take of endangered whales is provided and no take is authorized. Nevertheless, GDCOE must immediately notify (within 24 hours, if communication is possible) the NMFS' Office of Protected Resources should a take of a listed marine mammal occur.

## 9.1 Anticipated Amount or Extent of Incidental Take

Based on historical distribution data and observations from past COE projects, loggerhead, Kemp's ridley, and green sea turtles may occur in the action area and may be taken by hopper dredges and relocation trawlers used in the proposed action. Incidental take is anticipated; therefore, terms and conditions necessary to minimize and monitor takes are established. NMFS anticipates incidental lethal take will consist of 4 sea turtles (3 Kemp's ridley and 1 loggerhead or green sea turtle); and 32 non-injurious takes of sea turtles (7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles, based on frequency data in Epperly et al. 2002) by relocation trawling.

## 9.2 Effect of the Take

NMFS has determined the anticipated level of incidental take specified in Section 9.1 is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles.

## 9.3 Reasonable and Prudent Measures

NMFS has determined that the following RPMs are necessary and appropriate to minimize impacts of the incidental take of sea turtles during the proposed action. The RPMs that NMFS believes are necessary to minimize the impacts of the proposed hopper dredging have been discussed with the COE in the past and are standard operating procedures, and include the use of temporal dredging windows, intake and overflow screening, use of sea turtle deflector dragheads, observer and reporting requirements, and sea turtle relocation trawling. The following RPMS and associated terms and conditions are established to implement these measures, and to document incidental takes. Only incidental takes that occur while these measures are in full implementation are authorized. These restrictions remain valid until reinitiation and conclusion of any subsequent section 7 consultation.

*Seasonal Dredging Windows, Observer Requirements, Deflector Dragheads, and Relocation Trawling*[2]

Experience has shown that injuries sustained by sea turtles entrained in the hopper dredge dragheads are usually fatal. Current regional opinions for hopper dredging require seasonal dredging windows and observer monitoring requirements, deflector dragheads, and conditions and guidelines for relocation trawling, which NMFS believes are necessary to minimize effects of these removals on listed sea turtle species that occur in inshore and nearshore Gulf waters.

1. Temperature- and date-based dredging windows

Sea turtles generally move inshore with warming waters and offshore with cooling waters. In east coast channels, Dickerson et al. (1995) found reduced sea turtle abundance with water temperatures less than 16°C. They found that 1,008 trawls conducted at or below 16°C captured 22 turtles (4.4 percent), while 1,791 trawls conducted above 16°C resulted in 473 (95.6 percent) captures. Dickerson et al. also found that sea turtles tend to avoid water temperatures less than 15°C; however, hopper dredging Kings Bay, Georgia, between March 1-12, 1997, with surface water temperatures of 57-58°F (13.9-14.4°C) resulted in 11 turtle takes in nine days (NMFS 1997b).

[2] The COE sidecast dredges FRY, MERRITT, and SCHWEIZER, and split-hull hopper dredge CURRITUCK, are exempt from the above hopper dredging requirements (operating windows, deflectors, screening, observers, reporting requirements, etc.). Their small size and operating characteristics including small draghead sizes [2-ft by 2-ft, to 2-ft by 3-ft], small draghead openings [5-in by 5-in to 5 in by 8 in], small suction intake pipe diameters [10-14 in], and limited draghead suction [350-400 hp]) have been previously determined by NMFS to not adversely affect listed species (March 9, 1999, ESA consultation with COE Wilmington District, incorporated herein by reference). The aforementioned vessels and commercial hopper and sidecast dredges of the same or lesser sizes and operating characteristics working in the Gulf of Mexico would be considered similarly exempt by NMFS SERO after consultation with SERO.

Recognizing the relationship between water temperature and sea turtle presence and based on work by the NMFS Galveston Laboratory (Renaud et al. 1994, 1995) funded by the COE, NMFS wrote in its September 22, 1995, Regional Biological Opinion (RBO) to the Galveston and New Orleans Districts that sea turtles might be taken by hopper dredges "in all ship channels in the northern Gulf when temperatures exceed 12°C," and that "Lacking seasonal water temperature data, NMFS believes takes may occur from April through November northeast of Corpus Christi, Texas." Consequently, Term and Condition No. 3 of the 1995 RBO required that observers be aboard hopper dredges year-round from Corpus Christi southwest to the Mexican border, but "If no turtle take is observed in December, then observer coverage can be terminated during January and February or until water temperatures again reach 12°." It also required that "In channels northeast of Corpus Christi (except for Mississippi River – Southwest Pass), observers shall be aboard whenever surface water temperatures are 12°C or greater, and/or between April 1 and November 30."

NMFS published a final rule (67 FR 71895, December 3, 2002) effective January 2, 2003, to reduce the impact of large-mesh gillnet fisheries on the Atlantic Coast on sea turtles. This rule was directed primarily at the monkfish fishery, which uses large-mesh gillnets and operates in the area when sea turtles are present. The rule reduces impacts on endangered and threatened species of sea turtles by closing portions of the Mid-Atlantic Exclusive Economic Zone (EEZ) waters to fishing with gillnets with a mesh size larger than 8-inch (20.3-cm) stretched mesh. The timing of the restrictions was based upon an analysis of sea surface temperatures for the above areas. Sea turtles are known to migrate into and through these waters when the sea surface temperature is 11°C or greater (Epperly and Braun-McNeill 2002). The January 15 date for the re-opening of the areas north of Oregon Inlet, North Carolina, to the large-mesh gillnet fisheries was also based upon the 11°C threshold and is consistent with the seasonal boundary established for the summer flounder fishery-sea turtle protection area (50 CFR 223.206(d)(2) (iii)(A)). In summary, NMFS believes that the 11°C threshold established to protect East Coast sea turtles is reasonable and prudent to protect sea turtles in the Gulf of Mexico from hopper dredging operations.

A 1991 jeopardy Opinion to the COE's South Atlantic District on hopper dredging of southeastern U.S. channels first identified a December 1 and March 31 "hopper dredging window" as necessary to minimize sea turtle interactions. Subsequent studies by the COE (Dickerson et al. 1995) in six southeastern channels suggested that the existing windows were accurate. Sea turtles are generally less abundant in coastal waters of both the Southeast and the Gulf of Mexico during this time period compared to other times of the year since water temperatures are coolest.

Temperature- and date-based dredging windows appear to have been very effective in reducing sea turtle entrainments. Observer requirements and monitoring including assessment and relocation trawling have provided valuable real-time estimates of sea turtle abundance, takes, and distribution which have been helpful to COE project planning efforts. Evidence that the windows and observer requirements are effective and valuable is that, throughout its 8-year lifetime (the 1995 RBO was superseded by the GMRBO in 2003), neither the Galveston or New Orleans District's hopper dredging projects ever exceeded their anticipated incidental takes authorized by the 1995 RBO.

2. Observer Requirements

NMFS-approved observers monitor dredged material inflow and overflow screening baskets on many projects; however, screening is only partially effective and observed, documented takes provide only partial estimates of total sea turtle mortality. NMFS believes that some listed species taken by hopper dredges go undetected because body parts are forced through the sampling screens by the water pressure and are buried in the dredged material, or animals are crushed or killed but not entrained by the suction and so the takes may go unnoticed. The only mortalities that are documented are those where body parts either float, are large enough to be caught in the screens, and can be identified as from sea turtle species. However, this opinion estimates that with 4-inch inflow screening in place, the observers probably detect and record at least 50 percent of total mortality.

3. Deflector Dragheads

V-shaped, sea turtle deflector dragheads prevent an unquantifiable yet significant number of sea turtles from being entrained and killed in hopper dredges each year. Without them, turtle takes during hopper dredging operations would unquestionably be higher. Draghead tests conducted in May-June 1993 by the COE's Waterways Experimental Station (WES), now known as the Engineering Research and Development Center (ERDC), in clear water conditions on the sea floor off Fort Pierce, Florida, with 300 mock turtles placed in rows, showed convincingly that the newly-developed WES deflector draghead "performed exceedingly well at deflecting the mock turtles." Thirty-seven of 39 mock turtles encountered were deflected, 2 turtles were not deflected, and none were damaged. Also, "the deflector draghead provided better production rates than the unmodified California draghead, and the deflector draghead was easier to operate and maneuver than the unmodified California flat-front draghead." The V-shape reduced forces encountered by the draghead, and resulted in smoother operation. V-shaped deflecting dragheads are now a widely accepted conservation tool, the dredging industry is familiar with them and their operation, and they are used by all COE Districts conducting hopper dredge operations where turtles may be present.

4. Relocation Trawling

Relocation trawling has proved to be a useful conservation tool in most dredging projects where it has been implemented. The September 22, 1995, RBO included a conservation recommendation for relocation trawling which stated that "Relocation trawling in advance of an operating dredge in Texas and Louisiana channels should be considered if takes are documented early in a project that requires use of a hopper dredge during a period in which large number of sea turtles may occur." That RBO was amended by NMFS (Amendment No. 1, June 13, 2002) to change the conservation recommendation to a term and condition of the RBO. Overall, it is NMFS' opinion that the COE Districts choosing to implement relocation trawling have benefited from their decisions. For example, in the Galveston District, Freeport Harbor Project (July 13-September 24, 2002), assessment and relocation trawling resulted in one loggerhead capture. In Sabine Pass (Sabine-Neches Waterway), assessment and relocation trawling in July-August 2002 resulted in five loggerhead and three Kemp's ridley captures. One turtle was killed by the

dredge; this occurred while the relocation trawler was in port repairing its trawl net (P. Bargo, pers. comm. 2002). In the Jacksonville District, sea turtles have been relocated out of the path of hoppers dredges operating in Tampa Bay and Charlotte Harbor or their entrance channels. During St. Petersburg Harbor and Entrance Channel dredging in the fall of 2000, a pre-dredging risk assessment trawl survey resulted in capture, tagging, and relocation of two adult loggerheads and one subadult green turtle. In February 2002 during the Jacksonville District's Canaveral Channel emergency hopper dredging project for the Navy, two trawlers working around the clock captured and relocated 69 loggerhead and green turtles in seven days, and no turtles were entrained by the hopper dredge. In the Wilmington District's Bogue Banks Project in North Carolina, two trawlers successfully relocated five turtles in 15 days between March 13 and 27, 2003; one turtle was taken by the dredge. In 2003, Aransas Pass relocation trawling associated with hopper dredging resulted in 71 turtles captured and released (with three recaptures) in three months of dredging and relocation trawling. Five turtles were killed by the dredge. No turtles were killed after relocation trawling was increased from 12 to 24 hours per day (T. Bargo, pers. comm. to E. Hawk, October 27, 2003). In 2006, trawling associated with the dredging of the Houston-Galveston Navigation Channels resulted in 7 loggerheads relocated in 60 days of trawling (U.S. Army Corps of Engineers Sea Turtle Data Warehouse, http://el.erdc.usace.army.mil/seaturtles/index.cfm). From January through April 2007, relocation trawling activities in GDCOE channel projects have resulted in the capture and relocation of 65 green, 19 Kemp's ridley, and 9 loggerhead sea turtles as of April 20. (Ibid).

This opinion authorizes the per-fiscal-year non-lethal non-injurious take (minor skin abrasions resulting from trawl capture are considered non-injurious), external flipper-tagging, and taking of tissue samples of 30 sea turtles in any combination, though 7 loggerhead, 21 Kemp's ridley, and 2 green sea turtles would be expected based on frequency data in Epperly et al. 2002) in association with any relocation trawling conducted during the course of the proposed project. This take is limited to relocation trawling conducted during actual hopper dredging. Relocation trawling performed to reduce endangered species/hopper dredge interactions is subject to the requirements detailed in the terms and conditions of this opinion.

NMFS estimates that no turtles will be killed or injured pursuant to relocation trawling associated with the proposed project. NMFS shall be immediately notified of any injuries sustained by protected species during relocation/assessment trawling.

*Summary*

NMFS believes that seasonal dredging windows, deflector dragheads, observer and screening requirements, and relocation trawling have proved convincingly over the last decade to be an excellent combination of reasonable and prudent measures for minimizing the number and impact of sea turtle takes, enabling NMFS to assess the quantity of turtles being taken, and allowing the COE to meet its essential dredging requirements to keep federal navigation channels open.

There are increased costs associated with observers and relocation trawling (recent estimates are $3,500-$5,000/day for 24 hours of relocation trawling and $150-$200/day for a hopper dredge endangered species observer); delays sometimes occur, particularly when two turtles are taken in 24 hours, or when clay-like materials clog the inflow screening boxes; and dredging projects

may take longer to complete. However, overall, NMFS believes that loss of production associated with the deflector draghead is insignificant, while saving significant numbers of sea turtles from almost-certain death by dismemberment in suction dragheads; increased production costs, including costs of observers and relocation trawlers, pale in comparison to overall project costs; and NMFS' experience over the past decade with the COE's South Atlantic districts (SAD) and Gulf of Mexico's districts has shown that federal hopper dredging projects get completed in a timely fashion. Also, allowable overdredging by the COE reduces to some degree the need for frequent maintenance dredging, and the conservation measures required by the biological opinions in place result in significantly reduced dredge interactions with sea turtles–interactions which usually prove fatal.

NMFS considers that PIT tagging, external flipper tagging, and tissue sampling of turtles captured pursuant to relocation trawling, including genetic analysis of tissue samples taken from dredge- and trawl-captured turtles, will provide benefits to the species by providing data which will enable NMFS to make determinations on what sea turtle stocks are being impacted, and how that may change over time as the population growth rates change among the different stocks (S. Epperly, pers. comm. to E. Hawk).

## 9.4 Terms and Conditions

In order to be exempt from liability for take prohibited by section 9 of the ESA, the GDCOE must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

1. Hopper Dredging (RPM 1): Hopper dredging activities shall be completed, whenever possible, between December 1 and March 31, when sea turtle abundance is lowest throughout Gulf coastal waters.

2. Non-hopper Type Dredging (RPM 1): Pipeline or hydraulic dredges, because they are not known to take turtles, must be used whenever possible between April 1 and November 30.

3. Observers (RPM 2): The GDCOE shall arrange for NMFS-approved protected species observers to be aboard the hopper dredges to monitor the hopper bin, screening, and dragheads for sea turtles and their remains. Observer coverage sufficient for 100 percent monitoring (i.e., two observers) of hopper dredging operations is required aboard the hopper dredges year-round between April 1 and November 30, and whenever surface water temperatures are 11°C or greater.

4. Operational Procedures: During periods in which hopper dredges are operating and NMFS-approved protected species observers are *not* required, (as delineated in No. 3 above), the GDCOE must:

   a. Advise inspectors, operators, and vessel captains about the prohibitions on taking, harming, or harassing sea turtles.

b. Instruct the captain of the hopper dredge to avoid any turtles and whales encountered while traveling between the dredge site and offshore disposal area, and to immediately contact the GDCOE if sea turtles or whales are seen in the vicinity.

c. Notify NMFS if sea turtles are observed in the dredging area, to coordinate further precautions to avoid impacts to turtles.

d. Notify NMFS immediately by phone (727/824-5312), fax (727/824-5309), or e-mail (**takereport.nmfsser@noaa.gov**) if a sea turtle or other threatened or endangered species is taken by the dredge.

5. Screening (RPM 2): When sea turtle observers are required on hopper dredges, 100 percent inflow screening of dredged material is required and 100 percent overflow screening is recommended. If conditions prevent 100 percent inflow screening, inflow screening may be reduced gradually, as further detailed in the following paragraph, but 100 percent overflow screening is then required.

a. Screen Size: The hopper's inflow screens should have 4-inch by 4-inch screening. If the GDCOE, in consultation with observers and the draghead operator, determines that the draghead is clogging and reducing production substantially, the screens may be modified sequentially: mesh size may be increased to 6-inch by 6-inch, then 9-inch by 9-inch, then 12-inch by 12-inch openings. Clogging should be greatly reduced with these flexible options; however, further clogging may compel removal of the screening altogether, in which case effective 100 percent overflow screening is mandatory. The GDCOE shall notify NMFS beforehand if inflow screening is going to be reduced or eliminated, and provide details of how effective overflow screening will be achieved.

b. Need for Flexible, Graduated Screens: NMFS believes that this flexible, graduated-screen option is necessary, since the need to constantly clear the inflow screens will increase the time it takes to complete the project and therefore increase the exposure of sea turtles to the risk of impingement or entrainment. Additionally, there are increased risks to sea turtles in the water column when the inflow is halted to clear screens, since this results in clogged intake pipes, which may have to be lifted from the bottom to discharge the clay by applying suction.

6. Dredging Pumps: Standard operating procedure shall be that dredging pumps shall be disengaged by the operator when the dragheads are not firmly on the bottom, to prevent impingement or entrainment of sea turtles within the water column. This precaution is especially important during the cleanup phase of dredging operations when the draghead frequently comes off the bottom and can suck in turtles resting in the shallow depressions between the high spots the draghead is trimming off.

7. Sea Turtle Deflecting Draghead (RPM 3): A state-of-the-art rigid deflector draghead must be used on all hopper dredges at all times.

8. Dredge Take Reporting and Final Report: Observer reports of incidental take by hopper dredges must be faxed to NMFS' Southeast Regional Office (phone: 727/824-5312, fax: 727/824-5309, or electronic mail: **takereport.nmfsser@noaa.gov**) by onboard NMFS-approved protected species observers, the dredging company, or the GDCOE within 24 hours of any sea turtle or other listed species take observed.

   A final report summarizing the results of the hopper dredging and any documented sea turtle or other listed species takes must be submitted to NMFS within 30 working days of completion of the dredging project. Reports shall contain information on project location (specific channel/area dredged), start-up and completion dates, cubic yards of material dredged, problems encountered, incidental takes and sightings of protected species, mitigative actions taken (if relocation trawling, the number and species of turtles relocated), screening type (inflow, overflow) utilized, daily water temperatures, name of dredge, names of endangered species observers, percent observer coverage, and any other information the GDCOE deems relevant.

9. Sea Turtle Strandings: The GDCOE Project Manager or designated representative shall notify the Sea Turtle Stranding and Salvage Network (STSSN) state representative (contact information available at: http://www.sefsc.noaa.gov/seaturtleSTSSN.jsp) of the start-up and completion of hopper dredging operations and bed-leveler dredging operations and ask to be notified of any sea turtle strandings in the project area that, in the estimation of STSSN personnel, bear signs of potential draghead impingement or entrainment, or interaction with a bed-leveling type dredge.

   Information on any such strandings shall be reported in writing within 30 days of project end to NMFS' Southeast Regional Office. Because the deaths of these turtles, if hopper dredge or bed-leveler dredge related, have already been accounted for in NMFS' jeopardy analysis, these strandings will not be counted against the GDCOE's take limit.

10. Reporting - Strandings: The GDCOE shall provide NMFS' Southeast Regional Office with a report detailing incidents, with photographs when available, of stranded sea turtles that bear indications of draghead impingement or entrainment.

11. Relocation Trawling Report (RPM 4): The GDCOE shall provide NMFS' Southeast Regional Office with an end-of-project report within 30 days of completion of any relocation trawling. This report may be incorporated into the final report summarizing the results of the hopper dredging project.

12. Conditions Requiring Relocation Trawling (RPM 4): Handling of sea turtles captured during relocation trawling in association with the dredging project shall be conducted by NMFS-approved protected species observers. Because the authorized ITS permits the lethal take of only two sea turtles, relocation trawling shall be undertaken by the GDCOE after the take of one sea turtle during the project.

13. Relocation Trawling (RPM 4): Any relocation trawling conducted or contracted by the GDCOE to temporarily reduce or assess the abundance of these listed species during a

hopper dredging project in order to reduce the possibility of lethal hopper dredge interactions, is subject to the following conditions:

a. Trawl Time: Trawl tow-time duration shall not exceed 42 minutes (doors in - doors out) and trawl speeds shall not exceed 3.5 knots.

b. Handling During Trawling: Sea turtles captured pursuant to relocation trawling shall be handled in a manner designed to ensure their safety and viability, and shall be released over the side of the vessel, away from the propeller, and only after ensuring that the vessel's propeller is in the neutral, or disengaged, position (i.e., not rotating). Resuscitation guidelines are attached (Appendix I).

c. Captured Sea Turtle Holding Conditions: Sea turtles may be held briefly for the collection of important scientific measurements, prior to their release. Captured sea turtles shall be kept moist, and shaded whenever possible, until they are released, according to the requirements of Term and Condition No. 13-e, below.

d. Scientific Measurements: When safely possible, all turtles shall be measured (standard carapace measurements including body depth), tagged, weighed, and a tissue sample taken prior to release. Any external tags shall be noted and data recorded into the observers log. Only NMFS-approved protected species observers or observer candidates in training under the direct supervision of a NMFS-approved protected species observer shall conduct the tagging/measuring/weighing/tissues sampling operations.

NMFS-approved protected species observers may conduct more invasive scientific procedures (e.g., blood letting, laparoscopies, external tumor removals, anal and gastric lavages, mounting satellite or radio transmitters, etc.) and partake in or assist in "piggy back" research projects but only if the observer holds a valid federal sea turtle research permit (and any required state permits) authorizing the activities, either as the permit holder, or as designated agent of the permit holder, and has first notified NMFS' Southeast Regional Office, Protected Resources Division.

e. Take and Release Time During Trawling - Turtles: Turtles shall be kept no longer than 12 hours prior to release and shall be released not less than 3 nm from the dredge site. If two or more released turtles are later recaptured, subsequent turtle captures shall be released not less than 5 nm away. If it can be done safely, turtles may be transferred onto another vessel for transport to the release area to enable the relocation trawler to keep sweeping the dredge site without interruption.

f. Injuries: Injured sea turtles shall be immediately transported to the nearest sea turtle rehabilitation facility. Minor skin abrasions resulting from trawl capture are considered non-injurious. The GDCOE shall ensure that logistical arrangements and support to accomplish this are pre-planned and ready. The GDCOE shall bear the financial cost of sea turtle transport, treatment, and rehabilitation.

g. Flipper Tagging: All sea turtles captured by relocation trawling shall be flipper-tagged prior to release with external tags which shall be obtained prior to the project from the University of Florida's Archie Carr Center for Sea Turtle Research. This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard these relocation trawlers to flipper-tag with external tags (e.g., Inconel tags) captured sea turtles. Columbus crabs or other organisms living on external sea turtle surfaces may also be sampled and removed under this authority.

h. PIT-Tag Scanning: This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard a relocation trawler to PIT-tag captured sea turtles. PIT tagging of sea turtles is not required to be done if the NMFS-approved protected species observer does not have prior training or experience in said activity; however, if the observer has received prior training in PIT tagging procedures, then the observer shall PIT tag the animal prior to release (in addition to the standard external tagging):

Sea turtle PIT tagging must then be performed in accordance with the protocol detailed at NMFS' Southeast Fisheries Science Center's Web page: http://www.sefsc.noaa.gov/seaturtlefisheriesobservers.jsp. (See Appendix C on SEFSC's "Fisheries Observers" Web page);

PIT tags used must be sterile, individually-wrapped tags to prevent disease transmission. PIT tags should be 125-kHz, glass-encapsulated tags–the smallest ones made. Note: If scanning reveals a PIT tag and it was not difficult to find, then do not insert another PIT tag; simply record the tag number and location, and frequency, if known. If for some reason the tag is difficult to detect (e.g., tag is embedded deep in muscle, or is a 400-kHz tag), then insert one in the other shoulder.

i. Other Sampling Procedures: All other tagging and external or internal sampling procedures (e.g., blood letting, laparoscopies, external tumor removals, anal and gastric lavages, mounting satellite or radio transmitters, etc.) performed on live sea turtles are not permitted under this opinion unless the observer holds a valid sea turtle research permit authorizing the activity, either as the permit holder or a designated agent of the permit holder.

j. PIT-Tag Scanning and Data Submission Requirements: All sea turtles captured by relocation trawling or dredges shall be thoroughly scanned for the presence of PIT tags prior to release using a multi-frequency scanner powerful enough to read multiple frequencies (including 125-, 128-, 134-, and 400-kHz tags) and read tags deeply embedded in muscle tissue (e.g., manufactured by Trovan, Biomark, or Avid). Turtles whose scans show they have been previously PIT tagged shall nevertheless be externally flipper tagged. Sea turtle data collected (PIT tag scan data and external tagging data) shall be submitted to NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Attn: Lisa Belskis, 75 Virginia Beach Drive, Miami, Florida 33149. All sea turtle data collected shall be submitted in electronic format within 60 days of project completion to Lisa.Belskis@noaa.gov and Sheryan.Epperly@noaa.gov. Sea turtle

external flipper tag and PIT tag data generated and collected by relocation trawlers shall also be submitted to the Cooperative Marine Turtle Tagging Program (CMTTP), on the appropriate CMTTP form, at the University of Florida's Archie Carr Center for Sea Turtle Research.

k. Handling Fibropapillomatose Turtles: NMFS-approved protected species observers are not required to handle viral fibropapilloma tumors if they believe there is a health hazard to themselves and choose not to. When handling sea turtles infected with fibropapilloma tumors, observers must maintain a separate set of sampling equipment for handling animals displaying fibropapilloma tumors or lesions.

14. Requirement and Authority to Conduct Tissue Sampling for Genetic Analyses (RPM 2): This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard a relocation trawler or hopper dredge to tissue-sample live- or dead-captured sea turtles without the need for an ESA section 10 permit.

All live or dead sea turtles captured by relocation trawling and hopper dredging (for both GDCOE-conducted and GDCOE-permitted activities) shall be tissue-sampled prior to release. Sampling shall continue uninterrupted until such time as NMFS determines and notifies the GDCOE in writing.

Sea turtle tissue samples shall be taken in accordance with NMFS' SEFSC procedures for sea turtle genetic analyses (Appendix II of this opinion). The GDCOE shall ensure that tissue samples taken during the dredging project are collected and stored properly and mailed every three months until completion of the dredging project to: NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Attn: Lisa Belskis, 75 Virginia Beach Drive, Miami, Florida 33149.

15. Training - Personnel on Hopper Dredges: The GDCOE must ensure that all contracted personnel involved in operating hopper dredges (whether privately-funded or federally-funded projects) receive thorough training on measures of dredge operation that will minimize takes of sea turtles. It shall be the goal of the hopper dredging operation to establish operating procedures that are consistent with those that have been used successfully during hopper dredging in other regions of the coastal United States, and which have proven effective in reducing turtle/dredge interactions. Therefore, COE Engineering Research and Development Center experts or other persons with expertise in this matter shall be involved both in dredge operation training, and installation, adjustment, and monitoring of the rigid deflector draghead assembly.

16. Dredge Lighting (RPM 1): From May 1 through October 31, sea turtle nesting and emergence season, all lighting aboard hopper dredges and hopper dredge pumpout barges operating within 3 nm of sea turtle nesting beaches shall be limited to the minimal lighting necessary to comply with U.S. Coast Guard and/or OSHA requirements. All non-essential lighting on the dredge and pumpout barge shall be minimized through reduction, shielding, lowering, and appropriate placement of lights to minimize illumination of the water to reduce potential disorientation effects on female sea turtles

approaching the nesting beaches and sea turtle hatchlings making their way seaward from their natal beaches.

## 10 CONSERVATION RECOMMENDATIONS

Pursuant to section 7(a)(1) of the ESA, the following conservation recommendations are made to assist the GDCOE in contributing to the conservation of sea turtles by further reducing or eliminating adverse impacts that result from hopper dredging.

1. Channel Conditions and Seasonal Abundance Studies: Channel-specific studies should be undertaken to identify seasonal relative abundance of sea turtles within Gulf of Mexico channels. The December 1 through March 31 dredging window and associated observer requirements listed above may be adjusted (after consultation and authorization by NMFS) on a channel-specific basis, if (a) the GDCOE can provide sufficient scientific evidence that sea turtles are not present or that levels of abundance are extremely low during other months of the year, or (b) the GDCOE can identify seawater temperature regimes that ensure extremely low abundance of sea turtles in coastal waters, and can monitor water temperatures in a real-time manner. Surveys may indicate that some channels do not support significant turtle populations, and hopper dredging in these channels may be unrestricted on a year-round basis. To date, sea turtle deflector draghead efficiency has not reached the point where seasonal restrictions can be lifted.

2. Draghead Modifications and Bed-Leveling Studies: The GDCOE should supplement other efforts to develop modifications to existing dredges to reduce or eliminate take of sea turtles, and develop methods to minimize sea turtle take during "cleanup" operations when the draghead maintains only intermittent contact with the bottom. Some method to level the "peaks and valleys" created by dredging would reduce the amount of time dragheads are off the bottom. NMFS is ready to assist the GDCOE in conducting studies to evaluate bed- leveling devices and their potential for interaction with sea turtles, and develop modifications if needed.

3. Draghead Evaluation Studies and Protocol: Additional research, development, and improved performance is needed before the V-shaped rigid deflector draghead can replace seasonal restrictions as a method of reducing sea turtle captures during hopper dredging activities. Development of a more effective deflector draghead or other entrainment-deterring device (or combination of devices, including use of acoustic deterrents) could potentially reduce the need for sea turtle relocation or result in expansion of the winter dredging window. NMFS should be consulted regarding the development of a protocol for draghead evaluation tests. NMFS recommends that GDCOE coordinate with ERDC, SAD, the Association of Dredge Contractors of America, and dredge operators (Manson, Bean-Stuyvesant, Great Lakes, Natco, etc.) regarding additional reasonable measures they may take to further reduce the likelihood of sea turtle takes.

4. Continuous Improvements in Monitoring and Detecting Takes: The GDCOE should seek continuous improvements in detecting takes and should determine, through research and

development, a better method for monitoring and estimating sea turtle takes by hopper dredge. Observation of overflow and inflow screening is only partially effective and provides only partial estimates of total sea turtle mortality.

Overflow Screening: The GDCOE should encourage dredging companies to develop or modify existing overflow screening methods on their company's dredge vessels for maximum effectiveness of screening and monitoring. Horizontal overflow screening is preferable to vertical overflow screening because NMFS considers that horizontal overflow screening is significantly more effective at detecting evidence of protected species entrainment than vertical overflow screening.

Preferential Consideration for Horizontal Overflow Screening: The GDCOE should give preferential consideration to hopper dredges with horizontal overflow screening when awarding hopper dredging contracts for areas where new materials, large amounts of debris, or clay may be encountered, or have historically been encountered. Excessive inflow screen clogging may in some instances necessitate removal of inflow screening, at which point effective overflow screening becomes more important.

5. Section 10 Research Permits, Relocation Trawling, Piggy-Back Research, and 50 CFR Part 223 Authority to Conduct Research on Salvaged, Dead Specimens: NMFS recommends that GDCOE, either singly or combined with other COE Districts, apply to NMFS for an ESA section 10 research permit to conduct endangered species research on species incidentally captured during relocation trawling. For example, satellite tagging of captured turtles could enable the GDCOE to gain important knowledge on sea turtle seasonal distribution and presence in navigation channels and also, as mandated by section 7(a)(1) of the ESA, to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of listed species. SERO shall assist the GDCOE with the permit application process.

NMFS also encourages the GDCOE to cooperate with NMFS' scientists, other federal agencies' scientists, and university scientists holding appropriate research permits to make fuller use of turtles taken or captured by hopper dredges and relocation trawlers pursuant to the authority conferred by this opinion. NMFS encourages "piggy-back" research projects by duly-permitted individuals or their authorized designees. Section 10-permitted piggy-back projects could include *non-lethal* research of many types, including blood letting, laparoscopies, anal and gastric lavages, mounting satellite or radio transmitters, etc.

Important research can be conducted without a section 10 permit on salvaged dead specimens. Under current federal regulations (see 50 CFR 223.206 (b): Exception for injured, dead, or stranded [threatened sea turtle] specimens), "Agents. . . of a Federal land or water management agency may. . . salvage a dead specimen which may be useful for scientific study." Similar regulations at 50 CFR 222.310 provide "salvaging" authority for endangered sea turtles.

6. Draghead Improvements - Water Ports: NMFS recommends that the GDCOE require or at least recommend to dredge operators that all dragheads on hopper dredges contracted by the GDCOE for dredging projects be eventually outfitted with water ports located in the *top* of the dragheads to help prevent the dragheads from becoming plugged with sediments. When the dragheads become plugged with sediments, the dragheads are often raised off the bottom (by the dredge operator) with the suction pumps on in order to take in enough water to help clear clogs in the dragarm pipeline, which increases the likelihood that sea turtles in the vicinity of the draghead will be taken by the dredge. Water ports located in the top of the dragheads would relieve the necessity of raising the draghead off the bottom to perform such an action, and reduce the chance of incidental take of sea turtles.

   NMFS supports and recommends the implementation of proposals by ERDC and SAD personnel for various draghead modifications to address scenarios where turtles may be entrained during hopper dredging (Dickerson and Clausner 2003). These include: 1) An adjustable visor, 2) water jets for flaps to prevent plugging and thus reduce the requirement to lift the draghead off the bottom, and 3) a valve arrangement (which mimics the function of a "Hoffer" valve used on cutterhead type dredges to allow additional water to be brought in when the suction line is plugging) that will provide a very large amount of water into the suction pipe thereby significantly reducing flow through the visor when the draghead is lifted off the bottom, reducing the potential to take a turtle.

7. Economic Incentives for No Turtle Takes: The GDCOE should consider devising and implementing some method of significant economic incentives to hopper dredge operators such as financial reimbursement based on their satisfactory completion of dredging operations, or *X* number of cubic yards of material moved, or hours of dredging performed, *without taking turtles*. This may encourage dredging companies to research and develop "turtle friendly" dredging methods; more effective, deflector dragheads; pre-deflectors; top-located water ports on dragarms; etc.

8. Sedimentation Limits to Protect Resources (Hardbottoms/Reefs): NMFS recommends water column sediment load deposition rates of no more than 200 $mg/cm^2/day$, averaged over a 7-day period, to protect coral reefs and hardbottom communities from dredging-associated turbidity impacts to listed species foraging habitat.

9. Sodium Vapor Lights on Offshore Equipment: On offshore equipment (i.e., hopper dredges, pumpout barges) shielded low-pressure sodium vapor lights are highly recommended for lights that cannot be eliminated.

## 11 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed widening and deepening of the SNWW involving a combination of mechanical, pipeline, and hopper dredges. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) The amount or extent of taking specified in the incidental take statement is exceeded; (2) new

information reveals effects of the action may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

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**APPENDIX I**

## SEA TURTLE HANDLING AND RESUSCITATION GUIDELINES

Any sea turtles taken incidentally during the course of fishing or scientific research activities must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to the following procedures:

A) Sea turtles that are actively moving or determined to be dead (as described in paragraph (B)(4) below) must be released over the stern of the boat. In addition, they must be released only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels.

B) Resuscitation must be attempted on sea turtles that are comatose or inactive by:

1) Placing the turtle on its bottom shell (plastron) so that the turtle is right side up and elevating its hindquarters at least 6 inches (15.2 cm) for a period of 4 to 24 hours. The amount of elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches (7.6 cm) then alternate to the other side. Gently touch the eye and pinch the tail (reflex test) periodically to see if there is a response.

2) Sea turtles being resuscitated must be shaded and kept damp or moist but under no circumstance be placed into a container holding water. A water-soaked towel placed over the head, carapace, and flippers is the most effective method in keeping a turtle moist.

3) Sea turtles that revive and become active must be released over the stern of the boat only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Sea turtles that fail to respond to the reflex test or fail to move within 4 hours (up to 24, if possible) must be returned to the water in the same manner as that for actively moving turtles.

4) A turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot; otherwise, the turtle is determined to be comatose or inactive and resuscitation attempts are necessary.

Any sea turtle so taken must not be consumed, sold, landed, offloaded, transshipped, or kept below deck.

*These requirements are excerpted from 50 CFR 223.206(d)(1). Failure to follow these procedures is therefore a punishable offense under the Endangered Species Act.*

## APPENDIX II

# PROTOCOL FOR COLLECTING TISSUE FROM SEA TURTLES FOR GENETIC ANALYSIS

**Method for Dead Turtles**

**<<<IT IS CRITICAL TO USE A NEW SCALPEL BLADE AND GLOVES FOR EACH TURTLE TO AVOID CROSS-CONTAMINATION OF SAMPLES>>>**

1) Put on a new pair of latex gloves.
2) Use a new disposable scalpel to cut out an approx. 1 cm (½ in) cube (bigger is NOT better) piece of muscle. Easy access to muscle tissue is in the neck region or on the ventral side where the front flippers "insert" near the plastron. It does not matter what stage of decomposition the carcass is in.
3) Place the muscle sample on a hard uncontaminated surface (plastron will do) and make slices through the sample so the buffer solution will penetrate the tissue.
4) Put the sample into the plastic vial containing saturated NaCl with 20 percent DMSO.*
5) Use the pencil to write the stranding ID number (observer initials, year, month, day, turtle number by day), species, state and carapace length on the waterproof paper label and place it in the vial with the sample. EXAMPLE: For a 35.8 cm curved carapace length green turtle documented by Jane M. Doe on July 15, 2001 in Georgia, the label should read "JMD20010715-01, C. mydas, Georgia, CCL=35.8 cm". If this had been the third turtle Jane Doe responded to on July 15, 2001, it would be JMD20010715-03.
6) Label the outside of the vial with the same information (stranding ID number, species, state and carapace length) using the permanent marker.
7) Place clear scotch tape over the writing on the vial to protect it from being smeared or erased.
8) Wrap parafilm around the cap of the vial by stretching it as you wrap.
9) Place vial within whirl-pak and close.
10) Dispose of the scalpel.
11) Note on the stranding form that a part was salvaged, indicating that a genetic sample was taken and specify the location on the turtle where the sample was obtained.
12) Submit the vial with the stranding report to your state coordinator. State coordinators will forward the reports and vials to NMFS for processing and archiving.

**Method for Live Turtles**

**<<< IT IS CRITICAL TO USE A NEW BIOPSY PUNCH AND GLOVES FOR EACH TURTLE TO AVOID CROSS-CONTAMINATION OF SAMPLES >>>**

1) Turn the turtle over on its back.
2) Put on a new pair of latex gloves.
3) Swab the entire cap of the sample vial with alcohol.
4) Wipe the ventral and dorsal surfaces of the rear flipper 5-10 cm from the posterior edge with the Betadine/iodine swab.
5) Place the vial under the flipper edge to use the cleaned cap as a hard surface for the punch.
6) Press a new biopsy punch firmly into the flesh as close to the posterior edge as possible and rotate one complete turn. Cut all the way through the flipper to the cap of the vial.
7) Wipe the punched area with Betadine/iodine swab; rarely you may need to apply pressure to stop bleeding.
8) Use a wooden skewer to transfer the sample from the biopsy punch into the plastic vial containing saturated NaCl with 20 percent DMSO.*

9) Use the pencil to write the stranding ID number (observer initials, year, month, day, turtle number by day), species, state and carapace length on the waterproof paper label and place it in the vial with the sample. EXAMPLE: For a 35.8 cm curved carapace length green turtle documented by Jane M. Doe on July 15, 2001 in Georgia, the label should read "JMD20010715-01, C. mydas, Georgia, CCL=35.8 cm". If this had been the third turtle Jane Doe responded to on July 15, 2001, it would be JMD20010715-03.

10) Label the outside of the vial with the same information (stranding ID number, species, state and carapace length) using the permanent marker.

11) Place clear scotch tape over the writing on the vial to protect it from being smeared or erased.

12) Wrap parafilm around the cap of the vial by stretching it as you wrap.

13) Place vial within whirl-pak and close.

14) Dispose of the biopsy punch.

15) Note on the stranding form that a part was salvaged, indicating that a genetic sample was taken and specify the location on the turtle where the sample was obtained.

16) Submit the vial with the stranding report to your state coordinator. State coordinators will forward the reports and vials to NMFS for processing and archiving.

***The 20 percent DMSO buffer in the plastic vials is nontoxic and nonflammable. Handling the buffer without gloves may result in exposure to DMSO. This substance soaks into skin very rapidly and is commonly used to alleviate muscle aches. DMSO will produce a garlic/oyster taste in the mouth along with breath odor. The protocol requires that you WEAR gloves each time you collect a sample and handle the buffer vials.**

**The vials (both before and after samples are taken) should be stored at room temperature or cooler. If you don't mind the vials in the refrigerator, this will prolong the life of the sample. DO NOT store the vials where they will experience extreme heat (like in your car!) as this could cause the buffer to break down and not preserve the sample properly.**

Questions:
Sea Turtle Program
NOAA/NMFS/SEFSC
75 Virginia Beach Drive
Miami, FL 33149
305-361-4207

**THANK YOU FOR COLLECTING SAMPLES FOR SEA TURTLE GENETIC RESEARCH!!**

**Genetic Sample Kit Materials**

- latex gloves
- alcohol swabs
- Betadine/iodine swabs
- 4-6 mm biopsy punch – sterile, disposable (Moore Medical Supply 1-800-678-8678, part #0052442)
- wooden skewer
- single-use scalpel blades (Fisher Scientific 1-800-766-7000, cat. # 08-927-5A)
- plastic screw-cap vial containing saturated NaCl with 20 percent DMSO, wrapped in parafilm
- waterproof paper label, ¼" x 4"
- pencil to write on waterproof paper label
- permanent marker to label the plastic vials
- scotch tape to protect writing on the vials

- piece of parafilm to wrap the cap of the vial
- whirl-pak to return/store sample vial

## Stokes, Janelle S SWG

**From:** Michael Barnette [Michael.Barnette@noaa.gov]
**Sent:** Wednesday, May 14, 2008 9:58 AM
**To:** Stokes, Janelle S SWG
**Cc:** Hauch, Robert G SWG; Murphy, Carolyn E SWG; Michael Barnette
**Subject:** Re: SNWW Biological Opinion - discrepancy in relocation trawling take number

**Attachments:** Michael.Barnette.vcf

Michael.Barnette.vcf (410 B)

Hi Jan-
Yes, after review it was determined the RPM language was in error, and it should read as:

This opinion authorizes the per-fiscal-year non-lethal non-injurious take (minor skin abrasions resulting from trawl capture are considered non-injurious), external flipper-tagging, and taking of tissue samples of 32 sea turtles in any combination, though 7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles would be expected based on frequency data in Epperly et al. (2002), in association with any relocation trawling conducted during the course of the proposed project.

Mike

Stokes, Janelle S SWG wrote:
>
> Good morning, Michael,
>
> We are getting ready to finalize the draft EIS for the SNWW navigation
> project and have noticed a discrepancy in the relocation trawling take
> number cited in the NMFS Biological Opinion dated Aug 13, 2007. A
> scanned copy of the document is attached.
>
> The Incidental Take statement in section 9.1 (page 43) states "NMFS
> anticipates ..... 32 non-injurious takes of sea turtles (7 loggerhead,
> 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea
> turtles), based on frequency data in Epperly et al. 2002) by
> relocation trawling."
>
> The Reasonable and Prudent Measures, in section 9.3.4 (page 47) states
> "This opinion authorizes the per-fiscal-year non-lethal take
> non-injurious take (minor skin abrasions resulting from trawl capture
> are considered non-injurious), external flipper tagging, and taking of
> tissue samples of 30 sea turtles in any combination, though 7
> loggerhead, 21 Kemp's ridley, and 2 green sea turtles would be
> expected based on frequency data in Epperly et al. 2002) in
> association with any relocation trawling conducted during the course
> of the proposed project."
>
> In our phone conversation this morning, you indicated that you might
> be able resolve the discrepancy with an email response and with
> replacement page (or pages as needed) after review of the document.
> Specifically, we need to know if we are authorized 30 or 32
> non-injurious takes and whether the aurthorized takes are by species
> or are "in any combination" as stated on page 47.
>
> Thanks for your help with this.
>
> Jan
>

# Appendix H

# Historic Properties Programmatic Agreement

# PROGRAMMATIC AGREEMENT
# REGARDING COMPLIANCE WITH SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT FOR THE CONSTRUCTION AND MAINTENANCE MEASURES FOR THE SABINE – NECHES WATERWAY, SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA
# AMONG
# THE U.S. ARMY CORPS OF ENGINEERS GALVESTON DISTRICT
# THE TEXAS STATE HISTORIC PRESERVATION OFFICER
# THE LOUISIANA STATE HISTORIC PRESERVATION OFFICER
# AND
# THE SABINE NECHES NAVIGATION DISTRICT

WHEREAS, the U.S. Army Corps of Engineers, Galveston District (USACE) has determined that the proposed construction and ongoing maintenance of the Sabine-Neches Waterway (hereinafter, "undertaking") may have an effect on properties eligible for inclusion in the National Register of Historic Places (NRHP) (hereinafter, "historic properties) pursuant to Section 106 of the National Historic Preservation Act (16.U.S.C § 470) (hereinafter NHPA) and its implementing regulation, "Protection of Historic Properties," (36 CFR 800); and

WHEREAS, the existing Sabine-Neches Waterway Project (SNWW) is administered by the USACE under the authority of the Rivers and Harbors Act of 1962 and improvements are being studied under authorization contained in the Senate Committee on Environment and Public Works Resolution adopted on 5 June 1997; and

WHEREAS, the Sabine Neches Navigation District (SNND) is the non-federal partner with the USACE for this undertaking and is providing all lands, easements, rights-of-way, relocations, removals, and upland placement areas necessary for the project construction and operation; and

WHEREAS, the size of the project area and the number of alternatives being studied for proposed channel improvements make it necessary to defer final identification and evaluation of historic properties until authorization of proposed improvements is obtained; and

WHEREAS, the USACE, the Texas and Louisiana State Historic Preservation Officers (SHPOs), and the SNND agree that it is advisable to accomplish compliance with Section 106 through the development and execution of this Programmatic Agreement (PA) in accordance with § 800.6 and § 800.14(b)(3); and

WHEREAS, the USACE has invited the Advisory Council on Historic Preservation (Council) to determine whether the Council wishes to enter into the Section 106 process; and

NOW, THEREFORE, the USACE, the SHPOs and the SNND, agree that the proposed undertaking shall be implemented in accordance with the following stipulations in order to take into account the effects of the undertaking on historic properties and to satisfy the USACE Section 106 responsibilities for all individual aspects of the undertaking.

**Stipulation I**

Identification, Evaluation, Effect Determination and Resolution

A. *Scope of Undertaking.* This PA shall be applicable to all new construction activities related to the proposed SNWW channel improvement project and activities related to maintenance dredging. The Area of Potential Effects (APE) shall be established by the USACE in consultation with the appropriate SHPO and shall include all areas to be directly affected by new dredging and channel construction, construction staging and access areas, new or extensions of existing placement areas, ecological mitigation features, areas affected by the beneficial uses of dredged material, and ongoing maintenance dredging activities related to the SNWW project.

B. *Qualifications and Standards.* The USACE shall ensure that all work conducted in conjunction with this PA is performed in a manner consistent with the Secretary of Interior's "Standards and Guidelines for Archeology and Historic Preservation (48 Federal Register 44716-44740; September 23, 1983), as amended, or the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR 68), as appropriate.

C. *Definitions.* The definitions set forth in § 800.16 are incorporated herein by reference and apply throughout this PA.

D. *Identification of Historic Properties.* Prior to the initiation of construction or maintenance activities, the USACE shall make a reasonable and good faith effort to identify historic properties located in the APE. These steps may include, but are not limited to, background research, consultation, oral history interviews, sample field investigation and field survey. The level of effort for these activities shall be determined in consultation with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party. If no historic properties are identified in APE, the USACE shall document this finding pursuant to § 800.11(d) and retain this documentation in USACE files for at least seven (7) years.

E. *Evaluation of National Register Eligibility.* If cultural resources are identified within the APE, the USACE shall determine their eligibility for the National Register of Historic Places in accordance with the process described in § 800.4(c) and criteria established in 36 CFR 60. The determination of cultural significance shall be conducted in consultation with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party. Should the USACE and the appropriate SHPO agree that a property is

or is not eligible, such consensus shall be deemed conclusive for the purpose of the PA. Should the USACE and appropriate SHPO not agree regarding the eligibility of a property, the USACE shall obtain a determination of eligibility from the Keeper of the National Register pursuant to 36 CFR 63.

F. *Assessment of Adverse Effects.*

1. *No Historic Properties Affected.* The USACE shall make a reasonable and good faith effort to evaluate the effect of each undertaking on historic properties in the APE. The USACE may conclude that no historic properties are affected by an undertaking if no historic properties are present in the APE, or the undertaking will have no effect as defined in §800.16(i). This finding shall be documented in compliance with § 800.11(d) and the documentation shall be retained by the USACE for at least seven (7) years. The USACE shall provide information on the finding to the public upon request, consistent with the confidentiality requirements of § 800.11(c).

2. *Finding of No Adverse Effect.* The USACE, in consultation with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party, shall apply the criteria of adverse effect to historic properties within the APE in accordance with § 800.5. The USACE may propose a finding of no adverse effect if the undertaking's effects do not meet the criteria of § 800.5(a)(1) or the undertaking is modified to avoid adverse effects in accordance with 36 CFR 68. The USACE shall provide to the appropriate SHPO documentation of this finding meeting the requirements of § 800.11(e). The SHPO shall have 30 calendar days in which to review the findings and provide a written response to the USACE. The USACE may proceed upon receipt of written concurrence from the SHPO. Failure of the SHPO to respond within 30 days of receipt of the finding shall be considered agreement with the finding. The USACE shall maintain a record of the finding and provide information on the finding to the public upon request, consistent with the confidentiality requirements of § 800.11(c).

3. *Resolution of Adverse Effect.* If the USACE determines that the undertaking will have an adverse effect on historic properties as measured by criteria in § 800.5.(a)(1), the agency shall consult with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party to resolve adverse effects in accordance with § 800.6.

a. For historic properties that the USACE and the appropriate SHPO agree will be adversely affected, the USACE shall:

1) Consult with the appropriate SHPO to identify other individuals or organizations to be invited to become consulting parties. If additional consulting parties are identified, the USACE shall provide them copies of documentation specified in § 800.11(e) subject to confidentiality provisions of § 800.11(c).

2) Afford the public an opportunity to express their views on resolving adverse effects in a manner appropriate to the magnitude of the project and its likely effects on historic properties.

3) Consult with the appropriate SHPO, the SNND and Native American tribes which have indicated an interest in the undertaking, and consulting parties to seek ways to avoid, minimize or mitigate adverse effects.

4) Prepare an historic property treatment plan which describes mitigation measures the USACE proposes to resolve the undertaking's adverse effects and provide this plan for review and comment to the appropriate SHPO, consulting parties and Native American tribes that have indicated an interest in the undertaking. All parties shall have 30 calendar days in which to provide a written response to the USACE.

b. If the USACE and appropriate SHPO fail to agree on how adverse effects will be resolved, the USACE shall request that the Council join the consultation and provide the Council with documentation pursuant to § 800.11(g).

1) If the Council agrees to join the consultation, the USACE shall proceed in accordance with § 800.9.

2) If, after consulting to resolve adverse effects pursuant to Stipulations I, II or IV of this PA, the Council, USACE or SHPOs determines that further consultation will not be productive, then any party may terminate consultation in accordance with the notification requirement and process prescribed by § 800.7.

**Stipulation II**
Post Review Changes and Discoveries

A. *Changes in the Undertaking.* If construction on the undertaking has not commenced and the USACE determines that it will not conduct the undertaking as originally coordinated, the USACE shall reopen consultation pursuant to Stipulation I E – F.

B. *Unanticipated Discoveries or Effects.* Pursuant to § 800.13(a)(2), if historic properties are discovered or unanticipated effects on historic properties are found after construction on an undertaking has commenced, the USACE shall develop a treatment plan to resolve adverse effects and notify the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party within two working days of the discovery. The notification shall include the USACE assessment of National Register eligibility of

affected properties and proposed actions to resolve the adverse effects. Comments received from the SHPO, the Native American tribes or other consulting party within two working days of the notification shall be taken into account by the USACE in carrying out the proposed treatment plan. The USACE may assume SHPO concurrence in its eligibility assessment unless otherwise notified by the SHPO. The USACE shall provide the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party which have expressed an interest in the undertaking a report of the USACE actions when they are completed.

**Stipulation III**

Curation and Disposition of Recovered Materials and Records

The USACE shall ensure that all archeological materials and associated records owned by the State of Texas or Sponsor, which result from identification, evaluation, and treatment efforts conducted under this PA, are accessioned into a curational facility that has been certified or granted provisional status by the Texas SHPO in accordance with the Texas Administrative Code, Title 13, Part 2, Chapter 29.6 and meets the standards of 36 CFR 79, except as specified in Stipulation IV for human remains. Management and care of artifacts and collections shall follow the Texas Administrative Code, Title 13, Part 2, Chapter 29. Archeological items and materials from privately-owned lands in Texas shall be returned to their owners upon completion of analyses required for Section 106 compliance under this PA. Archeological collections generated from Louisiana lands shall be prepared for curation according to the collections standards of the Louisiana Division of Archeology and curated with the Louisiana Division of Archeology. Archeological items and materials from privately-owned lands may be returned to owners if requested. Private property owners in Louisiana shall be encouraged to curate with the state of Louisiana to ensure long-term preservation and future research potential of non-state owned collections. All associated records from archeological sites in Louisiana shall be curated with the Louisiana Division of Archeology.

**Stipulation IV**

Treatment of Human Remains

A. *Prior Consultation of Native American Burials*: If the USACE investigations conducted pursuant to Stipulation I of this PA indicate a high likelihood that Native American Indian human remains may be encountered, the USACE shall develop a treatment plan for these remains in consultation with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party. The USACE shall ensure that tribes indicating an interest in the undertaking are afforded a reasonable opportunity to identify concerns, advise on identification and evaluation, and participate in the resolution of adverse effects in compliance with the terms of this PA.

B. *Inadvertent Discovery in Texas*. Immediately upon the inadvertent discovery of human remains during historic properties investigations or construction activities

conducted pursuant to this PA, the USACE shall ensure that all ground disturbing activities cease in the vicinity of the human remains and any associated grave goods. Within two working days of the discovery, the USACE shall initiate consultation with the appropriate SHPO, Native American Indian tribes and any other consulting party that might attach religious and cultural significance to identified historic properties. The USACE shall consult with the appropriate SHPO, Native American Indian tribes and other consulting party which have expressed an interest in the undertaking in an effort to develop a plan for resolving the adverse effects.

C. *Inadvertent Discovery in Louisiana*: If an unmarked burial site or human skeletal remains are discovered, the USACE shall notify the local law enforcement office within 24 hours and the Louisiana SHPO within 72 hours. Upon discovery, all disturbing activity shall cease and shall not resume until the USACE has consulted with the Louisiana SHPO and the Louisiana Division of Archeology regarding a plan for the disposition of the remains. This shall be done within 30 days. The USACE, in consultation with the Louisiana SHPO and the Louisiana Division of Archeology, shall take every reasonable action to restore the burial site and avoid disturbing the remains. All burial artifacts found in an unmarked burial site shall become the property of the State of Louisiana and the Louisiana Division of Archeology shall have control over their disposition pursuant to the Louisiana Revised Stat. Ann. Title 8, §671 – 681, "Louisiana Unmarked Human Burial Sites Preservation Act."

D. *Advisory Council on Historic Preservation Policy Statement regarding Treatment of Burial Sites, Human Remains and Funerary Objects effective 23 February 2007:* This policy applies to all Federal Agencies with Undertakings that are subject to review under Section 106 of the NHPA. To be considered under Section 106, the burial site must be or be a part of an historic property, meaning that it is listed or eligible for listing in the National Register of Historic Places. This policy shall be applied if the burial meets this criterion.

E. *Dispute Resolution.* If, during consultations conducted under paragraphs A, B and C of this stipulation, all consulting parties cannot agree upon an consensus plan for resolving adverse effects, the matter shall be referred to the Council for resolution in accordance with the procedures outlined in § 800.9.

**Stipulation V**

PA Amendments, Disputes and Termination

A. *Amendments.* Any party to this PA may propose to the other parties that it be amended, whereupon the parties shall consult in accordance with § 800.6(c)(7) to consider such an amendment.

B. *Disputes.* Disputes regarding the completion of the terms of this agreement shall be resolved by the signatories. If the signatories cannot agree regarding a dispute, any one of the signatories may request the participation of the Council in resolving the dispute in accordance with the procedures outlined in § 800.9.

C. *Termination of PA.* Any party to this PA may terminate it by providing sixty (60) days notice to the other parties, provided that the parties shall consult during the period prior to the termination to seek agreement on amendments or other actions that will avoid termination. In the event of termination of this PA by the appropriate SHPO, the USACE shall comply with the provisions of § 800 Subpart B.

**Stipulation VI**
Termination of Consultation

If, after consulting to resolve adverse effects pursuant to Stipulation I, II or IV of this PA, the USACE or appropriate SHPO determines that further consultation will not be productive, then either party may terminate consultation in accordance with the notification requirements and process prescribed by § 800.7.

**Stipulation VII**
Term of this Agreement

This PA remains in force for a period of ten (10) years from the date of its execution by all signatories. Sixty (60) days prior to the conclusion of the ten (10) year period, the USACE shall notify all parties in writing of the end of the ten year period to determine if they have any objections. If there are no objections received prior to expiration, the PA shall continue to remain in force for a new ten (10) year period.

**DISTRICT ENGINEER, U.S. ARMY CORPS OF ENGINEERS, GALVESTON**

11/13/2007

**Colonel David C. Weston, District Engineer** **Date**

**TEXAS STATE HISTORIC PRESERVATION OFFICER**

1/31/08

**F. Lawerence Oaks, Texas State Historic Preservation Officer** **Date**

**LOUISIANA STATE HISTORIC PRESERVATION OFFICER**

1-29-08

**Pam Breaux, Louisiana State Historic Preservation Officer** **Date**

**SABINE-NECHES NAVIGATION DISTRICT**

12/11/07

**Paul Beard, Chairman of the Board of Commissioners** **Date**

# Appendix I

# Compliance with the Texas and Louisiana Coastal Management Programs

# Appendix I1

# Compliance with Texas Coastal Management Program

# Appendix I1

## Compliance with Goals and Policies – Section 501.25(a)–(f)
## Dredging and Dredged Material Disposal and Placement
## Sabine-Neches Waterway Channel Improvement Project
## Environmental Impact Statement
## Texas Coastal Zone Management Program
## Consistency Determination

## INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Galveston District proposes to modify the navigation channels servicing the Ports of Beaumont, Port Neches, Port Arthur, and Orange, Texas, in the interests of commercial navigation. These channels are collectively referred to as the Sabine-Neches Waterway (SNWW), and the project to modify the SNWW is referred to as the Channel Improvement Project (CIP). The purpose of the CIP is to improve the transportation efficiency of the SNWW's deep-draft navigation system, while protecting the quality of the area's coastal and estuarine resources.

The existing 40-foot inshore SNWW project is a federally authorized and maintained waterway located in Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana. The existing SNWW consists of the following channel reaches, as listed from offshore to inshore: (1) Sabine Bank Channel; (2) Sabine Pass Outer Bar Channel; (3) Sabine Pass Jetty Channel; (4) Sabine Pass Channel; (5) Port Arthur Channel; (6) Sabine-Neches Channel; and (7) Neches River Channel.

The authorized depth of the channel in the Preferred Alternative would be deepened by 8 feet along the entire existing channel and the offshore Entrance Channel would extend 13.2 miles farther into the Gulf of Mexico (Gulf). The Sabine Pass Jetty Channel, Sabine Pass Channel, Port Arthur and Sabine-Neches canals, and the Neches River Channel would be deepened from 40 feet to 48 feet. The authorized depth of the existing offshore Entrance Channel (Sabine Pass Outer Bar Channel and Sabine Bank Channel) is currently 42 feet; the additional depth is needed to accommodate fluctuations in offshore surface water elevation. These channels and the proposed Sabine Bank Extension Channel would be deepened from 42 to 50 feet. This would increase the SNWW from 64 miles to approximately 77 miles in length. No modifications to the existing Sabine Pass Jetties would be required as part of the Preferred Alternative.

The Sabine Pass Jetty Channel and the majority of the inshore channels (Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel) would remain at their existing widths. With the exception of wider sections at anchorages or channel intersections, these channels transition from 500 feet wide between the jetties to 400 feet wide upstream of the Martin Luther King Bridge on the Sabine-Neches Canal and Neches River Channel. The Taylor Bayou Channels and Basins would also be widened and deepened to 48 foot. Although the Sabine-Neches Canal and Neches River Channel would

not be widened, navigation efficiency would be improved with short stretches of selective widening and bend easings in both reaches, and the addition or enlargement of one anchorage and two turning/anchorage basins on the Neches River Channel. Up to five additional anchorage/turning basins could also be added on the Neches River.

Environmental affects addressed in the SNWW CIP Final Environmental Impact Statement (FEIS), particularly pertaining to coastal resources, have been analyzed in a large surrounding area that includes Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River channel up to the new Neches River Saltwater Barrier, the Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and offshore in the Gulf to 13.2 miles beyond the end of the current navigation channel.

The SNWW study area contains a high concentration of significant coastal wetlands. The USACE, in coordination with an Interagency Coordination Team (ICT) comprised of numerous State and Federal agencies, including the Texas General Land Office, developed a dredged material management plan (DMMP) that uses dredged material from the proposed SNWW CIP in an environmentally acceptable and economically practical manner. The ICT identified, within the proposed study area, 109,175 acres (171 square miles) in Texas and 197,530 acres (309 square miles) in Louisiana of coastal marsh, bottomland hardwood, and cypress-tupelo swamp habitats.

No net loss of coastal wetlands was a specific goal of the SNWW CIP ICT and alternatives evaluation. Several components of the DMMP and mitigation plan involve restoration, protection, and enhancement of coastal wetlands. Beneficial Use (BU) features of the DMMP that would offset project-induced impacts within Texas, as well as mitigation features that would offset project-induced impacts in Louisiana, are described further below.

Neches River BU Feature – Rose City would restore 345 acres of fresh marsh, 72 acres of shallow water, and nourish 151 acres of existing marsh. New Work material (approximately 2.1 million cubic yards) would be used to restore a 225-acre marsh, including the construction of hydraulic containment levees and higher-elevation features. Maintenance material (approximately 540,000 cubic yards) from the first maintenance cycle would be used to restore an additional 120 acres of marsh. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

Neches River BU Feature – Bessie Heights East would restore 679 of brackish and 1,190 acres of intermediate marsh, 660 acres of shallow-water habitat, and nourish 651 acres of existing marsh. The Bessie Heights East site is located within the much larger Bessie Heights Marsh. This was a natural emergent marsh that over time has seen the majority of its marsh acreage convert to open water. The site is located on Texas Parks and Wildlife Department (TPWD) property and privately owned land. Bessie

Heights East totals 3,180 acres. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

Neches River BU Feature – Old River Cove is located north of the Neches River on property owned by TPWD and would involve and restoration of 639 acres of brackish marsh, enhancement of 139 acres of shallow water habitat, and nourishment of 432 acres of existing marsh, as suspended fine-grained sediments disperse beyond restored emergent marsh areas. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora.

Gulf Shore BU Feature (Texas and Louisiana Points – TX 8-11 and LA 5-2/6-2) are located on the east and west sides of the Sabine Pass jetties. Each area begins approximately 0.5 mile from the respective jetty and extends about 3.5 miles away. The land on the Texas side is part of the Texas Point National Wildlife Refuge (NWR), while the land on the Louisiana side is privately owned. The conceptual plan calls for placing maintenance material at the shoreline in an unconfined manner. Placement would alternate between the Louisiana and Texas shorelines with each complete maintenance cycle, so that each side receives material every 6 years for the 50-year period of analysis, or eight placement episodes. The plan anticipates that much of the material would be redistributed into the littoral system.

All CIP impacts in Texas would be minimized and offset by beneficially using dredged material as described in the DMMP and therefore no mitigation is required; unavoidable impacts of the SNWW CIP remain only in Louisiana. Therefore, all of the mitigation measures would be located in Louisiana. The mitigation plan for Louisiana consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The mitigation efforts would compensate for the Preferred Alternative's salinity increase and associated losses in marsh and productivity by marsh creation activities that would influence a total of 8,095 acres of marshes in the Willow and Black Bayou watersheds. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone.

## IMPACTS ON COASTAL NATURAL RESOURCE AREAS

Several of the Coastal Natural Resource Areas (CNRAs) listed in 31 TAC §501.3 are found reasonably close to the areas discussed in the FEIS. A short description of each CNRA near the project and of attempts to minimize or avoid potential impacts is provided below.

### Waters of the Open Gulf of Mexico

New work and future dredged material generated from within the Sabine Bank Channel, Sabine Pass Outer Bar Channel, and the Sabine Pass Jetty Channel would be placed in four open Gulf existing Ocean,

Dredged Material Disposal Sites (ODMDSs), where only two occur in Texas waters (i.e., portion of Placement Area [PA] 3 and all of PA 4) and were designated in 1987 (52 FR 34218). All other project ODMDSs occur beyond Texas waters. The areas within the existing maintenance ODMDSs' footprint (i.e., portion of PA 3 and all of PA 4) would be disturbed during construction and intermittently for the life of the project, as it has since designation in 1987. Impacts to these areas are minimized by placement of dredged material into either historically used and/or dispersive offshore PAs. The overall footprint of these offshore PAs would be minimized by mounding the dredged material vertically to the maximum extent practical. These offshore PAs are dispersive by nature and would likely revert to the in situ topography prior to the next maintenance dredged material disposal sequence.

### Waters Under Tidal Influence

The entire project is located in a tidally influenced region. Dredging and placement activities represent a minimal impact because the localized and temporary release of suspended solids is minimized by refraining from open-bay placement and using existing, confined upland PAs. Additionally, beneficial use of dredged material would restore subsided, tidal wetlands.

### Submerged Lands

The areas within the channel alignment and Neches River BU Feature (restoration areas located at Rose City East [TX 3-1E], Bessie Heights East [TX 5-2], and Old River Cove [TX 6-1A]) are characterized as submerged lands. These submerged lands are PAs for dredged material generated from the Neches River reach. Dredged material placement within the Neches River BU Feature would result in a net increase in several CNRAs from restoration and enhancement efforts, as noted below. The DMMP (Appendix D) and Chapter 5 of the FEIS provide more information regarding project impacts and coastal wetlands.

### Coastal Wetlands

No net loss of coastal wetlands was a specific goal of the SNWW CIP ICT and alternatives evaluation. Several components of the DMMP and mitigation plan for Louisiana involve restoration, protection, and enhancement of coastal wetlands. All impacts within Texas are offset by the DMMP and BU features. The Neches River BU Feature would restore 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat. Impacts within Louisiana would be mitigated by restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. This mitigation measure would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing, adjacent marsh.

### Submerged Aquatic Vegetation

The Preferred Alternative is located near areas not characterized as having large expanses of seagrasses. There would be negligible, if any, direct or indirect adverse impacts to seagrass beds as result of the Preferred Alternative.

### Tidal Sand and Mudflats

The only potential impacts to tidal sand would be from the nourishment of the shoreline at both Texas and Louisiana Points to provide shoreline protection; this effort would be considered a long-term positive effect as these areas are eroding. Similarly, mudflats may occur within subsided marshes receiving material. Several subsided marshes would receive material for restoration and enhancement, as outlined in the DMMP (Appendix D) and Chapter 5 of the FEIS.

### Oyster Reefs

The majority of oyster reefs in the study area are located in the southern part of Sabine lake near Blue Buck Point, in Sabine Pass, and in Keith Lake. Oysters are not commercially harvested from Sabine Lake. Sabine Lake has not been classified or delineated by Texas and, therefore, the Texas Department of State Health Services (TDSHS) has prohibited the harvesting of molluscan shellfish from this system since the late 1970s. Louisiana has designated Sabine Lake as a "Public Oyster Area." Commercial harvesting is prohibited and public harvesting methods are restricted to tonging; however, no harvesting is currently allowed due to water quality issues. There are no oyster reefs identified within the Preferred Alternative footprint. While no impacts to extant live oyster reefs are likely because salinities are too fresh for oyster development, prior to construction of the access channel and borrow trench, a full water-bottom assessment would be conducted by the USACE within Louisiana in accordance with Louisiana Department of Wildlife and Fisheries (LDWF) survey standards. This survey would be necessary in order for LDWF to consider a waiver of compensation for impacts to the water bottoms of the Sabine Lake public oyster area.

### Hard-substrate Reefs

There are no naturally occurring hard-substrate formations in the vicinity of the project. The closest serpulid worm reefs within Texas waters are located several hundred miles south in the Laguna Madre and Baffin Bay.

### Coastal Barriers

The coastal barrier downdrift of Sabine Pass primarily consists of state parks and NWR areas, which are undeveloped with marshes in the backshore and with narrow beaches and overwash terrace on the foreshore. The DMMP includes the placement of dredged material for beneficial use (Gulf Shoreline BU Feature) immediately downdrift of Sabine Pass on Texas and Louisiana Points to provide for shore

protection and marsh creation. Placement and placement operations are not expected to have any adverse impacts to the coastal barriers. Shoreline nourishment would yield ecological benefits to coastal barriers.

### Coastal Shore Areas

These resource areas function as buffers, protecting upland habitats from erosion and storm damage and adjacent marshes and waterways from water quality degradation. This type of area is located west of Sabine Pass, and protect against wetlands located behind these shores from McFaddin NWR, Texas Point NWR, and Sea Rim State Park. The Texas Point NWR coastal shore would be improved by shore nourishment; therefore, the Preferred Alternative would have a beneficial effect on the Texas Point coastal shore, and would not have adverse impacts to other coastal shore areas as a result of dredging and dredged material operations.

### Gulf Beaches

Sabine Pass forms the southern entrance of the Sabine-Neches Ship Channel from the Gulf into the area studied. In this area, on the Texas side (or west side) of Sabine Pass, is the Texas Point NWR. Farther west along the Gulf of Mexico coastline is Sea Rim State Park and McFadden NWR. This area is characterized by (mostly) undeveloped marshland and beaches, with numerous small lakes and wetland areas. It is predicted approximately 3,100 acres of shoreline west of Sabine Pass would erode over the next 50 years, under future conditions. However, a DMMP feature of the Preferred Alternative would use maintenance dredged material generated from the Sabine Pass Channel to nourish Texas and Louisiana Points.

### Critical Dune Areas

The Gulf beaches on the Texas side of the study area include dune systems at McFaddin NWR and Sea Rim State Park. Adverse impacts to the dune complexes are not expected to occur as a result of dredging and dredged material placement operations. Gulf Shoreline BU Features would not result in placement of material on critical dune areas.

### Special Hazard Areas

Special hazard areas are areas designated by the administrator of the Federal Insurance Administration under the National Flood Insurance Act as having special flood, mudslide, and/or flood-related erosion hazards. The SNWW and Sabine Lake area are covered under the Flood Insurance Studies for Jefferson and Orange counties in Texas and Cameron and Calcasieu parishes in Louisiana. The land along the SNWW within the area studied is predominantly located in, or adjacent to, the 100-year floodplain. Except from improvements caused by shore nourishment and shoreline protection measures in the DMMP, project dredging and placement activities do not affect these low-lying areas because dredging is within and adjacent to the existing channel and disposal is within contained PAs and sites in open waters.

### Critical Erosion Areas

These areas are those Gulf and bay shorelines that are undergoing erosion and are designated by the Commissioner of the General Land Office under Texas Natural Resources Code, §33.601(b). The shoreline from downdrift of Sabine Pass, including the Texas Point NWR and Sea Rim State Park, are classified as critical erosion areas. Erosion in these areas threatens wetlands at McFaddin NWR, Texas Point NWR, and Sea Rim State Park. The Texas Point NWR shoreline would be nourished by the Gulf Shoreline BU Feature; therefore, the Preferred Alternative would have a beneficial effect for critical erosion areas on Texas Point.

### Coastal Historic Areas

Sites listed or eligible for listing in the National Register of Historic Places or for designation as State Archeological Landmarks are present in the project area. Compliance with the Texas Coastal Management Program (TCMP) regarding coastal historic areas is accomplished through procedures established by Section 106 of the National Historic Preservation Act of 1965, as amended. These coastal historic sites, as well as noncoastal historic sites, are discussed in Section 4.14 of the FEIS. Coordination with the Texas Historic Commission is ongoing, but it is expected that impacts to significant sites would be avoided.

While no specific impacts to historic resources have been identified at this time, the Preferred Alternative has the potential to adversely affect significant historic properties because numerous prehistoric and historic sites, structures, and shipwrecks are present in the project vicinity. A Historic Properties Programmatic Agreement has been negotiated and executed with the Texas and Louisiana State Historic Preservation Officers to ensure that significant historic properties are identified and mitigation, if necessary, is completed prior to construction. It is attached to the FEIS as Appendix H.

### Coastal Preserves

This CNRA includes state parks and NWRs. There are several preserves within the vicinity of the coastal shoreline that include the Texas Point NWR, Sea Rim State Park, McFadden NWR, J.D. Murphree WMA, Sabine Pass Battleground State Park and Historic Site, Lower Neches WMA (Nelda Stark Unit), and Lower Neches WMA (Old River Unit). Direct placement of dredged material would occur within Texas Point NWR, Sabine NWR, and the Lower Neches WMA (Nelda Stark and Old River units) for restoration, enhancement, and creation of coastal wetlands in specific BU features and mitigation areas. Appendix D and Chapter 5 of the FEIS provides more information about project impacts and coastal preserves.

## COMPLIANCE WITH GOALS AND POLICIES

The following goals and policies of the TCMP were reviewed for compliance.

- §501.25 – Dredging and Dredged Material Disposal and Placement
- §501.15 – Policy for Major Actions

### Compliance with §501.15 – Policy for Major Actions

This project involves action subject to §506.12 and constitutes a major action. Therefore, a Federal Environmental Impact Statement (EIS) is required under the National Environmental Policy Act (NEPA), 42 USC, §4321, et seq. Both State and Federal agencies involved with the SNWW CIP have met and coordinated on the identification and mitigation of project impacts and beneficial uses of dredged material. The purpose of this appendix to the FEIS is to demonstrate that the Preferred Alternative is consistent with the TCMP.

Section 501.25 Dredging and Dredged Material Disposal and Placement

*(a) Dredging and the disposal and placement of dredged material shall avoid and otherwise minimize adverse effects to coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches to the greatest extent practicable. The policies of this section are supplemental to any further restrictions or requirements relating to the beach access and use rights of the public. In implementing this section, cumulative and secondary adverse effects of dredging and the disposal and placement of dredged material and the unique characteristics of affected sites shall be considered.*

**Compliance: Dredged material would be placed on a variety of areas and would have some effects on coastal waters and submerged lands such as temporarily burying benthic organisms and increasing turbidity in the area. One beneficial use, shore nourishment, would result in temporary restrictions to specific shore areas. Habitat losses and gains would result from measures outlined in the Wetland Value Assessment (WVA) (Appendix C to the FEIS). In some instances, impacts include loss of submerged lands. Although these measures would result in reducing the amount of submerged lands, fresh, intermediate, and brackish marsh would be created, restored, or enhanced, to mitigate this loss. In other instances, losses in coastal waters occur due to shore nourishment, but would result in providing shoreline protection at Texas and Louisiana Points and creating a new saline marsh along a 3-mile stretch of Gulf coastline. Other actions include placement of new work and maintenance dredged material in two ODMDSs occurring within Texas waters (i.e., portion of PA 3 and PA 4); other ODMDSs are associated with the Preferred Alternative's DMMP but occur beyond Texas waters. These ODMDSs are naturally dispersive; therefore, bottom impacts are expected to be temporary. Project features and measures as described in the WVA and DMMP are the result of coordination among agency personnel and other interested parties. All project induced impacts within Texas would be offset by the BU features and as described in the DMMP.**

*(1) Dredging and dredged material disposal and placement shall not cause or contribute, after consideration of dilution and dispersion, to violation of any applicable surface water quality standards established under §501.21 of this title.*

**Compliance: For all PAs, adequate dilution and dispersion occurs so that applicable surface water standards are not violated (FEIS Sections 4.4 and 4.6).**

*(2) Except as otherwise provided in paragraph (4) of this subsection, adverse effects on critical areas from dredging and dredged material disposal or placement shall be avoided and otherwise minimized, and appropriate and practicable compensatory mitigation shall be required, in accordance with §501.23 of this title.*

**Compliance: CNRAs would be impacted by the Preferred Alternative, as discussed above; however, DMMP measures consisting of beneficially used dredged material would result in creation, enhancement, and restoration of critical areas. All impacts within Texas would be offset by the DMMP and BU features. For example, in the Neches River BU area, DMMP measures would have a direct impact on submerged lands or open water, but would create 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat. Additionally, protection of the shorelines and creation, restoration, and enhancement of saline marshes would result from placement of dredged material on a 6-mile stretch of Gulf beach at Texas and Louisiana Points. The WVA (Appendix C) and sections 4.1, 4.2, and 5.0 of the FEIS discuss ecological impacts and benefits, modeling approaches, and mitigation.**

*(3) Except as provided in paragraph (4) of this subsection, dredging and the disposal and placement of dredged material shall not be authorized if:*

*(A) there is a practicable alternative that would have fewer adverse effects on coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches, so long as that alternative does not have other significant adverse effects;*

**Compliance: Channel construction and placement of new work and maintenance material have been designed to minimize adverse impacts to the environment. Placement of new work and maintenance material only in existing PAs was not an available option for this project due to the size and 50-year time frame. Sufficient upland sites are not available. The DMMP (Appendix D of the FEIS) provides a detailed description of all PAs and alternatives that were evaluated. The WVA (Appendix C of the FEIS) provides descriptions of the features that would offset all project-induced impacts within Texas.**

*(B) all appropriate and practicable steps have not been taken to minimize adverse effects on coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches; or*

**Compliance: All practicable steps (including use of confined upland PAs, existing PAs, selection of minimum channel size to meet the project needs, extensive beneficial uses, mitigation, and interagency coordination) have been taken to minimize adverse affects on these resources. For a discussion of all PAs that were evaluated, refer to the DMMP (Appendix D) and Chapter 2 of the FEIS. Associated minimization of adverse effects is described in the WVA (Appendix C) and Chapter 5 of the FEIS. All impacts within Texas would be offset by the BU features and as described in the DMMP.**

*(C) Significant degradation of critical areas under §501.23(a)(7)(E) of this title would result.*

**Compliance: Some critical areas would be affected by the project, as noted above. However, impacts to critical areas have been minimized to the greatest extent practicable, and net environmental benefits would result from the Preferred Alternative as discussed above. For a discussion of all PAs that were evaluated, refer to the DMMP (Appendix D) and Chapter 2 of the FEIS. Associated minimization of adverse effects is described in the WVA (Appendix C) and Chapter 5 of the FEIS. All impacts within Texas would be offset by the BU features as described in the DMMP.**

*(4) A dredging or dredged material disposal or placement project that would be prohibited solely by application of paragraph (3) of this subsection may be allowed if it is determined to be of overriding importance to the public and national interest in light of economic impacts on navigation and maintenance of commercially navigable waterways.*

**Compliance: Dredging and placement is not precluded by paragraph (3), as noted above.**

*(b) Adverse effects from dredging and dredged material disposal and placement shall be minimized as required in subsection (a) of this section. Adverse effects can be minimized by employing the techniques in this subsection where appropriate and practicable.*

**Compliance: Adverse effects of dredging and disposal, as described in the FEIS and associated DMMP, have been minimized as described under "Compliance" for paragraph (1) of this subsection. For a discussion of all PAs that were evaluated, refer to the DMMP (Appendix D) and Chapter 2 of the FEIS. Associated minimization of adverse effects is described in the WVA (Appendix C) and Chapter 5 of the FEIS. All impacts within Texas would be offset by the BU features as described in the DMMP.**

*(1) Adverse effects from dredging and dredged material disposal and placement can be minimized by controlling the location and dimensions of the activity. Some of the ways to accomplish this include:*

*(A) locating and confining discharges to minimize smothering of organisms;*

*(B) locating and designing projects to avoid adverse disruption of water inundation patterns, water circulation, erosion and accretion processes, and other hydrodynamic processes;*

*(C) using existing or natural channels and basins instead of dredging new channels or basins, and discharging materials in areas that have been previously disturbed or used for disposal or placement of dredged material;*

*(D) limiting the dimensions of channels, basins, and disposal and placement sites to the minimum reasonably required to serve the project purpose, including allowing for reasonable overdredging of channels and basins, and taking into account the need for capacity to accommodate future expansion without causing additional adverse effects;*

*(E) discharging materials at sites where the substrate is composed of material similar to that being discharged;*

*(F) locating and designing discharges to minimize the extent of any plume and otherwise control dispersion of material; and*

*(G) avoiding the impoundment or drainage of critical areas.*

**<u>Compliance:</u> PAs have been designed to minimize open-water impacts by using vertical storage of dredged material to create marshes or uplands or using existing and expanded upland confined placement, wherever practical. Changes in water circulation and salinity were modeled extensively, and mitigation and BU measures were conceptually designed based on modeling results. Mitigation within Louisiana and BU efforts were designed to improve or maintain ecological functions of the area studied. Erosion would be slowed by shore nourishment, a BU feature of the Preferred Alternative, in critically eroding areas along Texas and Louisiana Points. Channel morphology would change by deepening the navigation channels' existing footprint, by easing bends within the Sabine-Neches Canal, and by adding and/or modifying turning and anchorage basins within the Neches River reach and the Taylor Bayou subreach; however, the extent of improvements to the SNWW navigation features are limited by the net benefits derived as a result of the project, and by constraining the improvements to stay within the existing channel and basin boundaries as much as practicable. Maximum use of existing active and inactive PAs would be employed. Material would be beneficially used to provide shoreline protection and creation, enhancement, and restoration of marshes, both along the Gulf Coast and upstream within the SNWW system. Discharges would be confined with reinforced levees where applicable. Only appropriate material would be used for certain substrates and uses. No impoundment or draining of critical areas would occur as a result of the Preferred Alternative.**

*(2 Dredging and disposal and placement of material to be dredged shall comply with applicable standards for sediment toxicity. Adverse effects from constituents contained in materials*

*discharged can be minimized by treatment of or limitations on the material itself. Some ways to accomplish this include:*

*(A) disposal or placement of dredged material in a manner that maintains physiochemical conditions at discharge sites and limits or reduces the potency and availability of pollutants;*

*(B) limiting the solid, liquid, and gaseous components of material discharged;*

*(C) adding treatment substances to the discharged material; and*

*(D) adding chemical flocculants to enhance the deposition of suspended particulates in confined disposal areas.*

**Compliance: Sediments to be dredged from the SNWW have been tested for a variety of chemical parameters of concern. Samples yielded no cause for concern and sediments are safe for placement in the Gulf or beneficial use. A summary of these results is included in Section 3.4 of the FEIS.**

*(3) Adverse effects from dredging and dredged material disposal or placement can be minimized through control of the materials discharged. Some ways of accomplishing this include:*

*(A) use of containment levees and sediment basins designed, constructed, and maintained to resist breaches, erosion, slumping, or leaching;*

*(B) use of lined containment areas to reduce leaching where leaching of chemical constituents from the material is expected to be a problem;*

*(C) capping in-place contaminated material or, selectively discharging the most contaminated material first and then capping it with the remaining material;*

*(D) properly containing discharged material and maintaining discharge sites to prevent point and nonpoint pollution; and*

*(E) timing the discharge to minimize adverse effects from unusually high water flows, wind, wave, and tidal actions.*

**Compliance: Construction of reinforced containment levees would be used where necessary. PAs are confined with levees. Small, temporary levees may be created during marsh restoration efforts. Shore nourishment measures and placement in ODMDSs may have some temporary and local impacts by increasing turbidity; however, material to be generated from construction activities has been tested and found not to contain harmful concentrations of pollutants. Future maintenance material is anticipated to mirror existing maintenance material, which also has been extensively**

**tested and found to have no causes for concern (Section 3.4 of the FEIS). Discharges would not occur during conditions involving high water flows, waves, or tidal action.**

*(4) Adverse effects from dredging and dredged material disposal or placement can be minimized by controlling the manner in which material is dispersed. Some ways of accomplishing this include:*

*(A) where environmentally desirable, distributing the material in a thin layer;*

*(B) orienting material to minimize undesirable obstruction of the water current or circulation patterns;*

*(C) using silt screens or other appropriate methods to confine suspended particulates or turbidity to a small area where settling or removal can occur;*

*(D) using currents and circulation patterns to mix, disperse, dilute, or otherwise control the discharge;*

*(E) minimizing turbidity by using a diffuser system or releasing material near the bottom;*

*(F) selecting sites or managing discharges to confine and minimize the release of suspended particulates and turbidity and maintain light penetration for organisms; and*

*(G) setting limits on the amount of material to be discharged per unit of time or volume of receiving waters.*

**Compliance: All of the sites minimize or avoid adverse dispersal effects to the greatest extent practicable and incorporated hydrodynamic and sedimentation modeling of the area of interest. Material to be used as shore nourishment would be hydraulically discharged into the nearshore zone, with some material expected to flow over the existing marsh while the remainder flows into the nearshore waters. Sequenced discharge points would be used to disperse material across the ODMDSs. There are no sediments of concern.**

*(5) Adverse effects from dredging and dredged material disposal or placement operations can be minimized by adapting technology to the needs of each site. Some ways of accomplishing this include:*

*(A) using appropriate equipment, machinery, and operating techniques for access to sites and transport of material, including those designed to reduce damage to critical areas;*

*(B) having personnel on site adequately trained in avoidance and minimization techniques and requirements; and*

*(C) designing temporary and permanent access roads and channel spanning structures using culverts, open channels, and diversions that will pass both low and high water flows, accommodate fluctuating water levels, and maintain circulation and faunal movement.*

**Compliance: Where applicable, all sites in this project would meet this requirement; contracts would be written to ensure compliance with all standards.**

*(6) Adverse effects on plant and animal populations from dredging and dredged material disposal or placement can be minimized by:*

*(A) avoiding changes in water current and circulation patterns that would interfere with the movement of animals;*

*(B) selecting sites or managing discharges to prevent or avoid creating habitat conducive to the development of undesirable predators or species that have a competitive edge ecologically over indigenous plants or animals;*

*(C) avoiding sites having unique habitat or other value, including habitat of endangered species;*

*(D) using planning and construction practices to institute habitat development and restoration to produce a new or modified environmental state of higher ecological value by displacement of some or all of the existing environmental characteristics;*

*(E) using techniques that have been demonstrated to be effective in circumstances similar to those under consideration whenever possible and, when proposed development and restoration techniques have not yet advanced to the pilot demonstration stage, initiating their use on a small scale to allow corrective action if unanticipated adverse effects occur;*

*(F) timing dredging and dredged material disposal or placement activities to avoid spawning or migration seasons and other biologically critical time periods; and*

*(G) avoiding the destruction of remnant natural sites within areas already affected by development.*

**Compliance: BU sites meet these requirements. Currents would not be detrimentally affected by the Preferred Alternative. No sites that are advantageous for colonization of predators or nonindigenous species are proposed. Proper coordination with U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), under the requirements of the Endangered Species Act, was implemented and no impacts to endangered species or their habitats are anticipated. Cutterhead suction dredges do not impact spawning or migration. Impacts to sea**

**turtles would be avoided or minimized: (1) hopper dredging would be limited to the cooler months, when possible, when sea turtle activity and abundance is lowest; (2) dredges would employ trawls to safely remove sea turtles before being adversely affected by dredge equipment; and (3) qualified turtle observers would be used to document any turtles that become entrained by the hopper dredge dragheads (any information would be submitted accordingly to the USFWS and NMFS).**

*(7) Adverse effects on human use potential from dredging and dredged material disposal or placement can be minimized by:*

*(A) selecting sites and following procedures to prevent or minimize any potential damage to the aesthetically pleasing features of the site, particularly with respect to water quality;*

*(B) selecting sites which are not valuable as natural aquatic areas;*

*(C) timing dredging and dredged material disposal or placement activities to avoid the seasons or periods when human recreational activity associated with the site is most important; and*

*(D) selecting sites that will not increase incompatible human activity or require frequent dredge or fill maintenance activity in remote fish and wildlife areas.*

**Compliance: Placement of dredged material to provide for shore nourishment and creation of saline marsh may temporarily restrict recreational use of the area by the public at the Texas and Louisiana Points shoreline. Temporary and minor adverse effects to fisheries may result from altering or removing productive fishing grounds and interfering with fishing activity near or in the ODMDSs. However, BU and mitigation features would contribute significantly to the human use potential, particularly recreational fishing, by creating, restoring, and enhancing estuarine habitats necessary for marine life cycles (particularly several commercially and recreationally important species). During dredging cycles, some existing designated PAs can provide habitat for birds and wildlife species that pose an aircraft strike hazard, however; no new PAs would be constructed within the Federal Aviation Administration separation perimeters (refer to sections 3.14.4.1.2 and 4.15.2.11 of the FEIS for more details).**

*(8) Adverse effects from new channels and basins can be minimized by locating them at sites:*

*(A) that ensure adequate flushing and avoid stagnant pockets; or*

*(B) that will create the fewest practicable adverse effects on CNRAs from additional infrastructure such as roads, bridges, causeways, piers, docks, wharves, transmission line crossings, and ancillary channels reasonably likely to be constructed as a result of the project; or*

*(C) with the least practicable risk that increased vessel traffic could result in navigation hazards, spills, or other forms of contamination which could adversely affect CNRAs;*

*(D) provided that, for any dredging of new channels or basins subject to the requirements of §501.15 of this title (relating to Policy for Major Actions), data and information on minimization of secondary adverse effects need not be produced or evaluated to comply with this paragraph if such data and information is produced and evaluated in compliance with §501.15(b)(1) of this title.*

**Compliance: The SNWW deepening constitutes new work dredging to the existing ship channel. Some new access channels would have to be dredged to allow construction of mitigation sites within Louisiana but these would be as minimal as possible and would not create stagnant pockets and navigation hazards, and would not impact any CNRAs (except submerged lands). All impacts within Texas would be offset by the BU features and as described in the DMMP.**

*(c) Disposal or placement of dredged material in existing contained dredge disposal sites identified and actively used as described in an environmental assessment or environmental impact statement issued prior to the effective date of this chapter shall be presumed to comply with the requirements of subsection (a) of this section unless modified in design, size, use, or function.*

**Compliance: All PAs were reviewed by the Habitat Evaluation Workgroup (HW) of the ICT and no further environmental review was recommended for the existing PAs in active use. Existing upland confined placement areas are being modified to increase levee heights with new work material, but this work would not enlarge the footprint of the existing PAs. In addition, the renewed use of inactive PAs was also determined to not constitute adverse change to the existing environmental conditions. The ICT HW identified one existing upland PA (PA 24) required to be expanded that would result in converting 86 acres of freshwater wetlands into a confined placement area. However, the ICT HW concluded impacts to the 86-acre freshwater wetland would be fully offset by benefits derived from restoration features within the Neches River BU Feature.**

*(d) Dredged material from dredging projects in commercially navigable waterways is a potentially reusable resource and must be used beneficially in accordance with this policy.*

**Compliance: New work and future maintenance dredged material to be generated by the Preferred Alternative would be used beneficially for shoreline protection and restoring, creating, and enhancing wetlands where economically feasible, physically compatible, and environmentally beneficial. All impacts within Texas would be offset by the BU features and as described in the DMMP.**

*(1) If the costs of the beneficial use of dredged material are reasonably comparable to the costs of disposal in a non-beneficial manner, the material shall be used beneficially.*

*(2) If the costs of the beneficial use of dredged material are significantly greater than the costs of disposal in a non-beneficial manner, the material shall be used beneficially unless it is demonstrated that the costs of using the material beneficially are not reasonably proportionate to the costs of the project and benefits that will result. Factors that shall be considered in determining whether the costs of the beneficial use are not reasonably proportionate to the benefits include, but are not limited to:*

*(A) environmental benefits, recreational benefits, flood or storm protection benefits, erosion prevention benefits, and economic development benefits;*

*(B) the proximity of the beneficial use site to the dredge site; and*

*(C) the quantity and quality of the dredged material and its suitability for beneficial use.*

*(3) Examples of the beneficial use of dredged material include, but are not limited to:*

*(A) projects designed to reduce or minimize erosion or provide shoreline protection;*

*(B) projects designed to create or enhance public beaches or recreational areas;*

*(C) projects designed to benefit the sediment budget or littoral system;*

*(D) projects designed to improve or maintain terrestrial or aquatic wildlife habitat;*

*(E) projects designed to create new terrestrial or aquatic wildlife habitat, including the construction of marshlands, coastal wetlands, or other critical areas;*

*(F) projects designed and demonstrated to benefit benthic communities or aquatic vegetation;*

*(G) projects designed to create wildlife management areas, parks, airports, or other public facilities;*

*(H) projects designed to cap landfills or other waste disposal areas;*

*(I) projects designed to fill private property or upgrade agricultural land, if cost-effective public beneficial uses are not available; and*

*(J) projects designed to remediate past adverse impacts on the coastal zone.*

*(e) If dredged material cannot be used beneficially as provided in subsection (d)(2) of this section, to avoid and otherwise minimize adverse effects as required in subsection (a) of this section, preference will be given to the greatest extent practicable to disposal in:*

*(1) contained upland sites;*

*(2) other contained sites; and*

*(3) open water areas of relatively low productivity or low biological value.*

**<u>Compliance:</u> New work and future maintenance dredged material whose sediment characteristics preclude being used beneficially or are not economically feasible to be used beneficially would be placed in either the ODMDSs or upland confined PAs (see sections 2.1, 2.2.3, and 2.3.2 in the FEIS).**

*(f) For new sites, dredged materials shall not be disposed of or placed directly on the boundaries of submerged lands or at such location so as to slump or migrate across the boundaries of submerged lands in the absence of an agreement between the affected public owner and the adjoining private owner or owners that defines the location of the boundary or boundaries affected by the deposition of the dredged material.*

**<u>Compliance</u>: Placement areas are designed to prevent impacts to adjoining private lands. All property rights and boundaries associated with submerged lands would be observed.**

# Appendix I2

# Compliance with Louisiana Coastal Management Program

# Appendix I2

## Compliance with Goals and Policies – Part I, Chapter 7, §700–§729
## Dredging and Dredged Material Disposal and Placement
## Sabine-Neches Waterway Channel Improvement Project
## Environmental Impact Statement
## Louisiana Coastal Zone Management Program
## Consistency Determination

### INTRODUCTION

Section 307 of the Coastal Zone Management Act of 1972, 16 USC 141 et seq., requires that "each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with state approved management programs." In compliance with Section 307, a consistency determination has been prepared for the Sabine-Neches Waterway (SNWW) Channel Improvement Project (CIP). Coastal Use Guidelines were written to implement the policies and goals of the Louisiana Coastal Resources Program and to serve as a set of performance standards for evaluating projects. Compliance with the Louisiana Coastal Resources Program and, therefore, Section 307, requires compliance with applicable Coastal Use Guidelines.

### PROJECT DESCRIPTION

The U.S. Army Corps of Engineers (USACE), Galveston District proposes to modify the navigation channels servicing the ports of Beaumont, Port Neches, Port Arthur, and Orange, Texas, in the interests of commercial navigation. These channels are collectively referred to as the SNWW, and the project to modify the SNWW is referred to as the CIP. The purpose of the CIP is to improve the transportation efficiency and safety of the SNWW's deep-draft navigation system, while protecting the quality of the area's coastal and estuarine resources.

The existing 40-foot inshore and 42-foot offshore SNWW project is a federally authorized and maintained waterway located in Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana. The existing SNWW consists of the following channel reaches, as listed from offshore to inshore: (1) Sabine Bank Channel; (2) Sabine Pass Outer Bar Channel; (3) Sabine Pass Jetty Channel; (4) Sabine Pass Channel; (5) Port Arthur Channel; (6) Sabine-Neches Channel; and (7) Neches River Channel.

The authorized depth of the channel in the Preferred Alternative would increase from 40 to 48 feet along the entire existing channel, and the offshore entrance channel would extend 13.2 miles farther into the Gulf of Mexico (Gulf). The Sabine Pass Jetty Channel, Sabine Pass Channel, Port Arthur and Sabine-Neches canals, and the Neches River Channel would be deepened from 40 feet to 48 feet. The authorized depth of the existing offshore Entrance Channel (Sabine Pass Outer Bar Channel and Sabine Bank

Channel) is currently 42 feet; the additional depth is needed to accommodate fluctuations in offshore surface water elevation. These channels and the proposed Sabine Bank Extension Channel would be deepened from 42 to 50 feet. This would increase the SNWW from 64 miles to approximately 77 miles in length. No modifications to the existing Sabine Pass Jetties would be required as part of the Preferred Alternative.

The Sabine Pass Jetty Channel and the majority of the inshore channels (Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel) would remain at their existing widths. With the exception of wider sections at anchorages or channel intersections, these channels transition from 500 feet wide between the jetties to 400 feet wide upstream of the Martin Luther King Bridge on the Sabine-Neches Canal and Neches River Channel. The Taylor Bayou Channels and Basins would also be widened and deepened to 48 feet. Although the Sabine-Neches Canal and Neches River Channel would not be widened, navigation efficiency would be improved with short stretches of selective widening and bend easings in both reaches, and the addition or enlargement of one anchorage and two turning/anchorage basins on the Neches River Channel.

Environmental affects addressed in the SNWW CIP Final Environmental Impact Statement (FEIS), particularly pertaining to coastal resources, have been analyzed in a large surrounding area that includes Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River Channel up to the new Neches River Saltwater Barrier, the Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW), west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and offshore in the Gulf to 13.2 miles beyond the end of the current navigation channel.

Several project components would specifically occur within Louisiana and include:

- direct impacts from channel deepening along the northern side of the Sabine Pass Channel;
- placement of dredged material for beneficial use along Louisiana Point (which would involve regular shoreline nourishment using maintenance material from the Sabine Pass Channel);
- dredged material placement within placement area (PA) 5 (located in Louisiana at Sabine Pass);
- Willow Bayou mitigation areas (two areas) within Sabine National Wildlife Refuge (NWR) (which also includes the associated sediment source-a borrow trench and access channel from the GIWW in Sabine Lake);
- Black Bayou East mitigation areas (two mitigation areas and associated sediment source – the dredging of accumulated sediment in Lake Charles Deepwater Channel/GIWW); and
- Black Bayou West mitigation area (one mitigation area, including the sediment source from regularly scheduled maintenance dredging already occurring as an existing action for Sabine River Channel).

The SNWW study area contains a high concentration of significant coastal wetlands. The USACE, in coordination with an Interagency Coordination Team (ICT) comprised of numerous State and Federal agencies, including the Louisiana Department of Natural Resources (LDNR), developed a dredged material management plan (DMMP) that uses dredged material from the proposed SNWW CIP in an environmentally acceptable and economically practical manner. The ICT identified, within the proposed project footprint, 109,175 acres (171 square miles) in Texas and 197,530 acres (309 square miles) in Louisiana of coastal marsh, bottomland hardwood, and cypress-tupelo swamp habitats.

No net loss of coastal wetlands was a specific goal of the SNWW CIP ICT and alternatives evaluation. All impacts from the Preferred Alternative within Texas would be offset by the DMMP, and impacts in Louisiana would be offset through compensatory mitigation. The Preferred Alternative's mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. This mitigation measure would restore 2,783 acres of emergent marsh in existing open water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing, adjacent marsh. Material for marsh mitigation would come from regular maintenance dredging of the Sabine River Channel and from dedicated dredging of the Sabine Lake borrow trench and of accumulated sediments from the Lake Charles Deepwater Channel/GIWW (Figure 1.1-2 of the FEIS).

In Louisiana, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998; U.S. Geological Survey-National Wetlands Research Center, 2004):

- 71,500 acres of saline, brackish, and intermediate marshes in the Louisiana Chenier Plain habitat at Louisiana Point, Blue Buck Point, and Johnson Bayou areas. Sensitive areas include Sabine Lake Ridges (33,500 acres of chenier ridge, and saline, brackish, and intermediate marsh), Johnson's Bayou Ridge (about 4,000 acres of saline and brackish marshes, and chenier ridges), West Johnson's Bayou (13,000 acres of brackish and intermediate marsh) and East Johnson's Bayou (26,719 acres of chenier ridge, and fresh, intermediate, and brackish marsh).
- 44,300 acres of brackish, intermediate, and fresh coastal marsh in the western half of the Sabine NWR. The Sabine NWR, as a whole, contains 124,500 acres of fresh, intermediate, and brackish marsh between Calcasieu and Sabine lakes in southwest Louisiana. Approximately 13,750 acres of marsh within this study area has degraded to open water. This sensitive area contains the Willow Bayou mapping unit (36,300 acres) and 8,000 acres in the west section of the Southeast Sabine mapping unit.
- 46,500 acres of brackish, intermediate, and fresh marsh in an area north of Willow Bayou and south of the GIWW. This sensitive area contains the Black Bayou mapping unit (36,300 acres), and 10,220 acres of fresh and intermediate marsh in the Southwest Gum Cove mapping unit.
- 25,700 acres of fresh and intermediate marsh and bottomland hardwood habitat in the Perry Ridge mapping unit, north of the GIWW and east of the Sabine River.

- 650 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp, east of the Sabine River and north of Interstate 10.
- 7,000 acres of cypress-tupelo swamp and bottomland hardwoods in the Sabine Island WMA, north of the Blue Elbow Swamp and east of the Sabine River.

## GUIDELINES

### 1. Guidelines Applicable to All Uses

**Guideline 1.1**: The guidelines must be read in their entirety. Any proposed use may be subject to the requirements of more than one guideline or section of guidelines and all applicable guidelines must be complied with.

**Response**: Acknowledged.

**Guideline 1.2**: Conformance with applicable water and air quality laws, standards, and regulations, and with those laws, standards and regulations which have been incorporated into the coastal resources program shall be deemed in conformance with the program except to the extent that these guidelines would impose additional requirements.

**Response**: Acknowledged.

**Guideline 1.3**: The guidelines include both general provisions applicable to all uses and specific provisions applicable only to certain types of uses. The general guidelines apply in all situations. The specific guidelines apply only to situations they address. Specific and general guidelines should be interpreted to be consistent with each other. In the event there is an inconsistency, the specific should prevail.

**Response**: Acknowledged.

**Guideline 1.4**: These guidelines are not intended to nor shall they be interpreted so as to result in an involuntary acquisition or taking of property.

**Response**: Acknowledged.

**Guideline 1.5**: No use or activity shall be carried out or conducted in such a manner as to constitute a violation of the terms of a grant or donation of any lands or water-bottoms to the State or any subdivision thereof. Revocations of such grants and donations shall be avoided.

**Response**: Acknowledged.

**Guideline 1.6**: Information regarding the following general factors shall be utilized by the permitting authority in evaluating whether the proposed use is in compliance with the guidelines.

a) Type, nature, and location of use.

b) Elevation, soil, and water conditions and flood and storm hazard characteristics of site.

c) Techniques and materials used in construction, operation, and maintenance or use.

d) Existing drainage patterns and water regimes of surrounding area including flow, circulation, quality, quantity, and salinity; and impacts on them.

e) Availability of feasible alternative sites or methods for implementing the use.

f) Designation of the area for certain uses as part of a local program.

g) Economic need for use and extent of impacts of use on economy of locality.

h) Extent of resulting public and private benefits.

i) Extent of coastal water dependency of the use.

j) Existence of necessary infrastructure to support the use and public costs resulting from the use.

k) Extent of impacts on existing and traditional uses of the area and on future uses for which the area is suited.

l) Proximity to and extent of impacts on important natural features such as beaches, barrier islands, tidal passes, wildlife and aquatic habitats, and forest lands.

m) The extent to which regional, State, and National interests are served including the National interest in resources and the siting of facilities in the coastal zones as identified in the coastal resources program.

n) Proximity to, and extent of impacts on, special areas, particular areas, or other areas of particular concern of the State program or local programs.

o) Likelihood of, and extent of impacts of, resulting secondary impacts and cumulative impacts.

p) Proximity to and extent of impacts on public lands or works, or historic, recreational or cultural resources.

q) Extent of impacts on navigation, fishing, public access, and recreational opportunities.

r) Extent of compatibility with natural and cultural setting.

s) Extent of long-term benefits or adverse impacts.

**Response**: Acknowledged.

**Guideline 1.7**: It is the policy of the coastal resources program to avoid the following adverse impacts. To this end, all users and activities shall be planned, sited, designed, constructed, operated, and maintained to avoid to the maximum extent practicable significant:

a) reductions in the natural supply of sediment and nutrients to the coastal system by alterations of freshwater flow.

**Response**: No alteration of freshwater flows would occur from the proposed project (Section 4.6 of the FEIS); however, additional sediments would be added to certain marsh areas to restore emergent marsh acreage and to allow for added productivity (sections 4.5 and 4.6 and Chapter 5 of the FEIS).

b) adverse economic impacts on the locality of the use and affected governmental bodies.

**Response**: The Preferred Alternative is expected to have a positive impact on the local economy (sections 1.0 and 4.15 of the FEIS); no adverse economic impacts on the locality or governmental bodies would occur as a result of the Preferred Alternative.

c) detrimental discharges of inorganic nutrient compounds into coastal waters.

**Response**: There could be a temporary increase in the concentration of inorganic nutrient compounds near the dredging BU and mitigation sites from resuspension of bottom sediments. Suspended particles resulting from placement would not result in detrimental effects to chemical and physical properties of the water column.

d) alterations in the natural concentration of oxygen in coastal waters.

**Response**: Oxygen concentrations at the dredging and placement sites could be reduced during dredging operations and temporarily afterward if organic or ammonia load in the sediments is sufficiently high. Anoxic conditions are not expected to develop, and no significant adverse impacts to aquatic species are expected (Section 4.5 of the FEIS).

e) destruction or adverse alterations of streams, wetlands, tidal passes, inshore waters and waterbottoms, beaches, dunes, barrier islands, and other natural biologically valuable areas or protective coastal features.

**Response**: Alterations to the SNWW, Sabine Lake, near-shore Gulf, beach, shallow-water areas, and wetlands are expected. Several project components would specifically occur within Louisiana and include direct impacts from channel deepening along the northern side of the Sabine Pass Channel, placement of dredged material for beneficial use along Louisiana Point (which would involve regular shoreline nourishment using maintenance material from the Sabine Pass Channel), dredged material placement within PA 5 (located in Louisiana at Sabine Pass), Willow Bayou mitigation areas (two areas) within the Sabine NWR (which also includes the associated sediment source-a borrow trench and access channel from the GIWW in Sabine Lake), Black Bayou East mitigation areas (two mitigation areas and associated sediment source-the dredging of accumulated sediment in the Lake Charles Deepwater Channel/GIWW), and Black Bayou West mitigation area (one mitigation area, including the sediment source from regularly scheduled maintenance dredging already occurring as an existing action for the Sabine River Channel). The compensatory mitigation for project-induced impacts are considered to be beneficial (Section 4.1 and Chapter 5 of the FEIS). The effects of dredging and dredged material deposition are discussed in more detail under Guidelines 4.1 to 4.7.

f) adverse disruption of existing social patterns.

**Response**: No disruption of existing social pattern is expected (Section 4.15 of the FEIS).

g) alterations of the natural temperature regime of coastal waters.

**Response**: The Preferred Alternative would not alter water temperatures in coastal waters (sections 4.4 and 4.6 of the FEIS).

h) detrimental changes in existing salinity regimes.

**Response**: A small increase in salinity would likely occur since alterations in an increase with saltwater intrusion would occur with deepening the SNWW. Essentially all detrimental impacts associated with the Preferred Alternative are from expected alterations in salinity. Extensive interagency coordination, combined with detailed ecological modeling, resulted in BU features and mitigation measures that offset and compensate for all ecological impacts (Chapter 5, appendices B and C of the FEIS).

i) detrimental changes in littoral and sediment transport processes.

**Response**: This plan would cause some changes in littoral and sediment transport processes. A small increase in Gulf shoreline erosion (0.42 foot/year) between 0.5 and 3.5 miles from the Sabine Jetty would be caused by changes in wave angles due to the offshore channel extension. This impact is more than offset by benefits of the Gulf Shoreline BU Feature. Beneficial changes would involve regular nourishment of 3 miles of shoreline at Louisiana Point once every 6 years, or eight placement episodes, or the 50-year project life.

j) adverse effects of cumulative impacts.

**Response**: A number of actions have influenced the study area and are expected to continue to do so. A cumulative impacts assessment was conducted that took into consideration 13 past or present actions, 6 reasonably foreseeable future actions, and 6 ongoing regional activities, initiatives, and programs that are likely to affect the study area. These included industrial activities such as pipelines and construction of liquid natural gas (LNG) facilities, as well as channel improvements and ecosystem restoration efforts. Details and additional discussion regarding the cumulative impact evaluation can be found in Section 4.16 of the FEIS; regional programs and initiatives are summarized in Chapter 7 of the FEIS.

Cumulative adverse impacts from past, existing, and reasonably foreseeable future projects, along with the Project, are not expected to have significant adverse effects within the study area. Many of the projects included in the cumulative impacts analysis are part of the continued port and shipping industry development. Other projects considered in the assessment are beneficial to certain natural resources and add to the diversity and health of the publicly held recreation and conservation areas, migratory bird habitats, Essential Fish Habitat (EFH), and other sensitive coastal resources. Existing governmental regulations, in conjunction with the goals and coordination of community planning efforts, address the

issues that influence local and ecosystem-level conditions. Cumulative adverse impacts that are expected to occur within the study area primarily include temporary and localized increased nitrogen oxides emissions and noise. Some projects considered in this assessment are beneficial to certain natural resources (predominantly wetlands and the species dependent on them) and add to the diversity and health of publicly held recreation and conservation areas, migratory bird habitats, EFH, and other sensitive coastal resources. Impacts associated with the Preferred Alternative have been fully offset by compensatory mitigation measures. In addition, the Preferred Alternative would have net beneficial effects on wetlands, water quality, and submerged aquatic vegetation (SAV) with the implementation of the Gulf Shoreline BU Feature at Louisiana Point. Results of cumulative impacts assessments for the Preferred Alternative are in Section 4.16.5 of the FEIS.

k) detrimental discharges of suspended solids into coastal waters, including turbidity resulting from dredging.

**Response**: Dredging and placement of dredged material would temporarily and locally increase turbidity and suspended solids in adjacent waters (sections 4.5 and 4.6 of the FEIS). The sediments have been determined to be suitable for placement, mitigation, and beneficial uses.

l) reductions or blockage of water flow or natural circulation patterns within or into an estuarine system or wetland forest.

**Response**: Gulf beach nourishment uses maintenance material from Sabine Pass Channel to reduce erosion impacts along Louisiana Point. Reducing erosion with maintenance material would alter flows and circulation patterns positively. Marsh creation, which would not use material from the project, would reestablish most of the natural circulation patterns and reduce marsh loss and salinity intrusion. Although beach nourishment and mitigation efforts may alter flow, alterations would be beneficial (Chapter 5, appendices B and C of the FEIS). No natural waterways would be blocked or otherwise restricted by navigation channel improvements or mitigation measures.

m) discharges of pathogens or toxic substances into coastal waters.

**Response**: Extensive analyses of sediment material associated with the project were conducted, including data recently collected in March 2008 and April 2009, and results indicate that there are no causes for concern related to pathogens or toxic substances. Section 3.4 of the FEIS discusses sediment testing results.

n) adverse alteration or destruction of archaeological, historical, or other cultural resources.

**Response**: Adverse effects or destruction of these resources is not expected. The USACE's Galveston District has consulted with the Louisiana State Historic Preservation Office in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and has executed a Programmatic Agreement to cover completion of cultural resource surveys and assessments in mitigation areas prior to

construction. Should any historic properties be identified, measures would be taken to ensure that project impacts would be avoided or mitigated.

o) fostering of detrimental secondary impacts in undisturbed or biologically highly productive wetland areas.

**Response**: Most of the wetlands in the study area have been significantly altered by subsidence and saltwater intrusion, although most areas remain highly productive fish and wildlife habitats. No secondary impacts would be induced in these areas by the Preferred Alternative.

p) adverse alteration or destruction of unique or valuable habitats, critical habitat for endangered species, important wildlife or fishery breeding or nursery areas, designated wildlife management or sanctuary areas, or forest lands.

**Response**: Critical Habitat for the federally endangered piping plover would be directly affected from dredged material beneficial use for beach nourishment along a 3-mile stretch of Louisiana Point. Beach nourishment efforts would result in positive effects for piping plover habitat (Appendix G of FEIS). Wetland mitigation areas in the Sabine NWR would result in short-term, localized adverse effects but the net, long-term effects would be positive, as determined by the Wetland Value Assessment (WVA) Model (Appendix C of the FEIS). In addition to the Sabine NWR, the Sabine Island WMA is located in the Louisiana study area; however no salinity impacts from the Preferred Alternative would affect Sabine Island WMA.

q) adverse alteration or destruction of public parks, shoreline access points, public works, designated recreation areas, scenic rivers, or other areas of public use and concern.

**Response**: Beneficial alterations to shoreline at Louisiana Point and degraded wetlands in Sabine NWR would occur as a result of the Preferred Alternative.

r) adverse disruptions of coastal wildlife and fishery migratory patterns.

**Response**: Wintering waterfowl, shore birds, and wading birds could be temporarily displaced from PA 5, marsh mitigation areas, and the Gulf shoreline during dredged material placement activities. The adults of various aquatic species, including brown shrimp, white shrimp, blue crab, red drum, and menhaden, spawn in the Gulf, and the young juveniles of these species use deep tidal passes such as the SNWW for immigration to inland estuarine nursery areas. Increased turbidity resulting from dredging activities could have a temporary, localized, adverse effect on the movement of these organisms, but would not permanently disrupt wildlife and fishery migration patterns.

s) land loss, erosion, and subsidence.

**Response**: Slightly higher salinities may lead to the loss of 691 acres of marsh, associated SAV and shallow-water habitat, as stressed emergent marsh converts to open water. The Preferred Alternative's BU feature at Louisiana Point and mitigation measures would nourish highly eroded areas and restore

subsided wetlands (which would not result in land loss). The Louisiana Point BU Feature would regularly nourish 3 miles of shoreline. The Mitigation Plan compensates for the Preferred Alternative's salinity increase and associated losses in marsh and productivity by marsh creation activities that would influence a total of 8,095 acres of Louisiana marshes in the Willow and Black Bayou watersheds. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone.

t) increases in the potential for flood, hurricane, or other storm damage, or increases in the likelihood that damage would occur from such hazards.

**Response**: The Preferred Alternative would not increase potential for flood, hurricane, or other storm damage, or increase likelihood of damage (Section 4.1 of the FEIS). The Preferred Alternative's effect on storm surge was evaluated with hydrodynamic salinity (HS) modeling; no effect on storm surge was found, and minor additional land loss would not affect wetland buffer functions on storm impacts.

u) reductions in the long term biological productivity of the coastal ecosystem.

**Response**: The Preferred Alternative would cause reductions in marsh biological productivity through salinity increases and associated land loss; however, these expected effects would be offset by the mitigation efforts and the BU feature in Louisiana. The Mitigation Plan compensates for the Preferred Alternative's losses in marsh productivity by marsh creation activities that would influence a total of 8,095 acres of Louisiana marshes in the Willow and Black Bayou watersheds. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. These efforts effectively mitigate losses in productivity and were modeled via WVA (Section 4.1 and Appendix C of the FEIS) and HS model (Section 4.1 of the FEIS).

**Guideline 1.8**: In those in which the modifier "maximum extent practicable" is used, the proposed use is in compliance with the guideline if the standard modified by the term is complied with. If the modified standard is not complied with, the use would be in compliance with the guideline if the permitting authority finds, after a systematic consideration of all pertinent information regarding the use, the site, and the impacts of the use as set forth in Guideline 1.6, and a balancing of their relative significance, that the benefits resulting from the proposed use would clearly outweigh the adverse impacts resulting from noncompliance with the modified standard and there are no feasible and practical alternative locations, methods, and practices for the uses that are in compliance with the modified standard, and:

a) significant public benefits would result from the use; or

b) the use would serve important regional, state, or national interests, including the national interest in resources and the siting of facilities in the coastal zone identified in the coastal resources program or the use is coastal water dependent.

The systematic consideration process shall also result in a determination of those conditions necessary for the use to be in compliance with the guideline. Those conditions shall assure that the use is carried out utilizing those locations, methods, and practices which maximize conformance to the modified standard; are technically, economically, environmentally, socially, and legally feasible and practical and minimize or offset those adverse impacts listed in Guideline 1.7 and in the guideline at issue.

**Response**: Acknowledged.

**Guideline 1.9**: Uses shall, to the maximum extent practicable, be designed and carried out to permit multiple concurrent uses which are appropriate for the location and to avoid unnecessary conflicts with other uses of the vicinity.

**Response**: The purpose of the Preferred Alternative is to improve navigational efficiency and thus result in a net benefit to the economy of the region and the Nation. Other uses of the channel, such as commercial and recreational fishing and water sports, are and would continue unaffected.

**Guideline 1.10**: These guidelines are not intended to be, nor shall they be, interpreted to allow expansion of governmental authority beyond that established by La. R.S. 49:213.1 through 49:213.21, as amended; nor shall these guidelines be interpreted so as to require permits for specific uses legally commenced or established prior to the effective date of the coastal use permit program nor to normal maintenance or repair of such uses.

**Response**: Acknowledged.

### 2. Guidelines for Levees

Not applicable.

### 3. Guidelines for Linear Facilities

Not applicable.

### 4. Guidelines for Dredged Spoil Deposition

**Guideline 4.1**: Spoil shall be deposited utilizing the best practical techniques to avoid disruption of water movement, flow, circulation, and quality.

**Response**: Placement of dredged material to build marsh and terraces in the Sabine NWR would not negatively disrupt water flow. Dredged material not beneficially used would be placed into upland confined PAs, which, like the channel improvements, would not negatively disrupt water movement, flow, or circulation. The sediments to be excavated are not contaminated, and no significant adverse effect on water quality is expected (sections 4.4 to 4.6 of the FEIS).

**Guideline 4.2**: Spoil shall be used beneficially to the maximum extent practicable to improve productivity or create new habitat, reduce or compensate for environmental damage done by dredging activities, or prevent environmental damage. Otherwise, existing spoil disposal areas or upland disposal shall be utilized to the maximum extent practicable rather than creating new disposal areas.

**Response**: No construction material would be used beneficially within Louisiana as most channels are too far to feasibly (both economically and physically) execute. The Sabine Pass Channel is located near Louisiana, but marshes near the channel are in good condition and offer no opportunities for restoration or mitigation. All mitigation areas within Louisiana would be constructed with borrow material from dedicated dredging or maintenance of the Sabine River Channel.

**Guideline 4.3**: Spoil shall not be disposed of in a manner which could result in the impounding or draining of wetlands or the creation of development sites unless spoil deposition is part of an approved levee or land surface alteration project.

**Response**: No dredged material would be used that would impound or drain wetlands. No new PAs would be created in wetlands.

**Guideline 4.4**: Spoil shall not be disposed of on marsh, known oyster or clam reefs, or in areas of submerged vegetation to the maximum extent practicable.

**Response**: Some submerged vegetation may be temporarily impacted during wetland mitigation, but restoration would improve conditions for SAV over the long term. The Preferred Alternative would restore and enhance degraded wetlands as determined by the WVA (Appendix C to the FEIS). No impacts to oyster reefs would occur from the Preferred Alternative.

**Guideline 4.5**: Spoil shall not be disposed of in such a manner as to create a hindrance to navigation or fishing, or hinder timber growth.

**Response**: Navigation or timber growth would not be hindered. Fishing activities could be temporarily affected during construction or placement activities.

**Guideline 4.6**: Spoil disposal areas shall be designed and constructed and maintained using the best practicable techniques to retain the spoil at the site, reduce turbidity, and reduce shoreline erosion when appropriate.

**Response**: The material to be used beneficially at Louisiana Point would cause temporary and localized increases in turbidity but would provide an overall benefit to the ecosystem by adding sediment to the littoral system and reducing shoreline erosion. Dredged material not used beneficially would be placed in confined PA 5. PAs are designed and managed to control turbidity and retain as much of the dredged material as practicable with use of confinement levees or spill boxes. Best management practices to minimize or avoid turbidity effects could include silt curtains.

**Guideline 4.7**: The alienation of state-owned property shall not result from spoil deposition activities without the consent of the Department of Natural Resources.

**Response**: No State lands would be alienated as a result of the proposed action.

### 5. Guidelines for Shoreline Modification

**Response**: Dredged material from the Sabine Pass reach of the SNWW would be pumped to Louisiana Point on alternated maintenance cycles (Appendix D of the FEIS) for shoreline restoration. Placement on this eroded shoreline would not be confined nor would any other structural measures be used.

**Guidelines 5.1–5.9:** Not applicable.

### 6. Guidelines for Surface Alterations

Not Applicable.

### 7. Guidelines for Hydrologic and Sediment Transport Modifications

Not Applicable.

### 8. Guidelines for the Disposal of Wastes

Not Applicable.

### 9. Guidelines for Uses That Result in the Alteration of Waters Draining into Coastal Waters

Not applicable.

### 10. Guidelines for Oil, Gas, and Other Mineral Activities

Not applicable.

## CONSISTENCY DETERMINATION

The guidelines of Louisiana's Coastal Resources Program have been applied to the proposed project for the SNWW CIP. The USACE, Galveston District has determined that implementation of the Preferred Alternative, which provides for deepening of the SNWW from 40 to 48 feet and an offshore channel from 48 to 50 feet in depth from offshore to the Port of Beaumont Turning Basin, extending the 50-foot-deep offshore channel by 13.2 miles, tapering and marking the Sabine Bank Channel from 800 feet wide to 700 feet wide, the bend of easings on the Sabine-Neches Canal and Neches River Channel, deepening and widening of the Taylor Bayou navigation channels and turning basins to 48 feet, and the addition of new

anchorages/turning basins on the Neches River Channel, would be consistent to the maximum extent practicable, with the State of Louisiana's approved Coastal Resources Program.

## REFERENCES

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 1998. Caring for Coastal Wetlands, a summary of the 1997 Evaluation Report to the U.S. Congress on the effectiveness of Louisiana Coastal Wetland Restoration Projects. http://www.lacoast.gov/reports/program/CaringBrochure/index.htm (accessed February 2007). U.S. Geological Survey, National Wetlands Research Center, Lafayette, Louisiana.

U.S. Geological Survey-National Wetlands Research Center. 2004. Louisiana Coastal Areas Mapping Units for the Calcasieu-Sabine Basin. U.S. Department of the Interior, U.S. Geological Survey, National Wetlands Research Center, Lafayette, Louisiana and Coastal Restoration Field Station, Baton Rouge, Louisiana.

# Appendix J

# SNWW CIP Mitigation/ Beneficial Use Monitoring Plan

Document No. 090198
PBS&J Job No. 100011305

# SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT FINAL MITIGATION/BENEFICIAL USE MONITORING PLAN SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

Prepared for:

U.S. Army Corps of Engineers
Galveston District
2000 Fort Point Road
Galveston, Texas 77550

Prepared by:

PBS&J
6504 Bridge Point Parkway
Suite 200
Austin, Texas 78730

June 2010

*Printed on recycled paper*

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## Acronyms and Abbreviations

| | |
|---|---|
| BU | beneficial use |
| CIP | Channel Improvement Project |
| CWPPRA | Coastal Wetlands Planning, Protection and Restoration Act |
| DMMP | dredged material management plan |
| GIWW | Gulf Intracoastal Waterway |
| ICT | Interagency Coordinating Team |
| mcy | million cubic yards |
| NWR | National Wildlife Refuge |
| ppt | parts per thousand |
| SAV | submerged aquatic vegetation |
| SNND | Sabine-Neches Navigation District |
| SNWW | Sabine-Neches Waterway |
| SONRIS | Strategic Online Natural Resources Information System |
| TNRIS | Texas Natural Resource Information System |
| USFWS | U.S. Fish and Wildlife Service |
| WRDA | Water Resources Development Act |

# Sabine-Neches Waterway Channel Improvement Project Mitigation/Beneficial Use Monitoring Plan Southeast Texas and Southwest Louisiana

## BACKGROUND

The Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) would deepen the SNWW to a depth of 48 feet for navigation purposes. This scenario is referred to as the Preferred Alternative. The project study area is located on the upper Texas Gulf Coast at the Texas-Louisiana state line and includes Sabine Lake and surrounding marshes in Texas and Louisiana, the Neches River channel up to the Neches River Saltwater Barrier, the Gulf Intracoastal Waterway (GIWW) west to Star Bayou and east to Gum Cove Ridge, the Sabine River to Niblett's Bluff, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf.

The project would create the opportunity to restore and protect emergent marsh with dredged material in the Neches River Beneficial Use (BU) Feature. Beneficial use of maintenance material in the Gulf of Mexico reach of the SNWW is proposed to protect the Gulf shoreline and marshes adjacent to Gulf beaches in Louisiana and Texas. Creation of emergent marsh using borrowed material and maintenance material has been proposed in Louisiana to mitigate impacts resulting from the proposed project.

Recent guidance issued by the USACE requires monitoring for mitigation and ecosystem restoration projects (Brown, 2009a, 2009b). The guidance includes:

- Memorandum for Commanders, Major Subordinate Commands, Subject: Implementation Guidance for Section 2036 (a) of the Water Resources Development Act of 2007 (WRDA 07) – Mitigation for Fish & Wildlife and Wetland Losses, CECW-PC, dated August 31, 2009.
- Memorandum for Commanders, Major Subordinate Commands, Subject: Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) – Monitoring Ecosystem Restoration, CECW-PC, dated August 31, 2009.

The monitoring requirements in these guidance documents are similar for mitigation and ecosystem restoration projects.

## PURPOSE

This document describes the monitoring plans for mitigation proposed in Louisiana as required by the Section 2036 guidance referred to above and the monitoring plans for beneficial use of dredged material in Texas and Louisiana as required by the Section 2039 guidance referred to above. Monitoring plans

described in this document are based on the assumptions that the relative sea level rise will be 1.1 feet and the freshwater inflows will be those projected by the Texas Water Development Board for the year 2060 using the Water Availability Model Run 8, modified to include "projected increased demand from existing water rights, expected change to return flows, projected new strategies to come online before 2060, and estimated year 2060 storage capacities for major reservoirs" (Brown and Stokes, 2009).

## BENEFICIAL USE PLANS

All dredged material management plan (DMMP) BU features proposed for inclusion in the DMMP of the Preferred Alternative are summarized in Table 1. Three former marsh areas on the Neches River (Rose City East, Bessie Heights East, and Old River Cove) would be combined into one large management feature called the Neches River BU Feature (Figure 1). In the Gulf Shore BU Feature, maintenance material would be used to nourish Gulf shorelines at Texas and Louisiana Points (Figure 2).

Table 1
Areas Affected by Each Component of Neches River and Gulf Shore BU Features

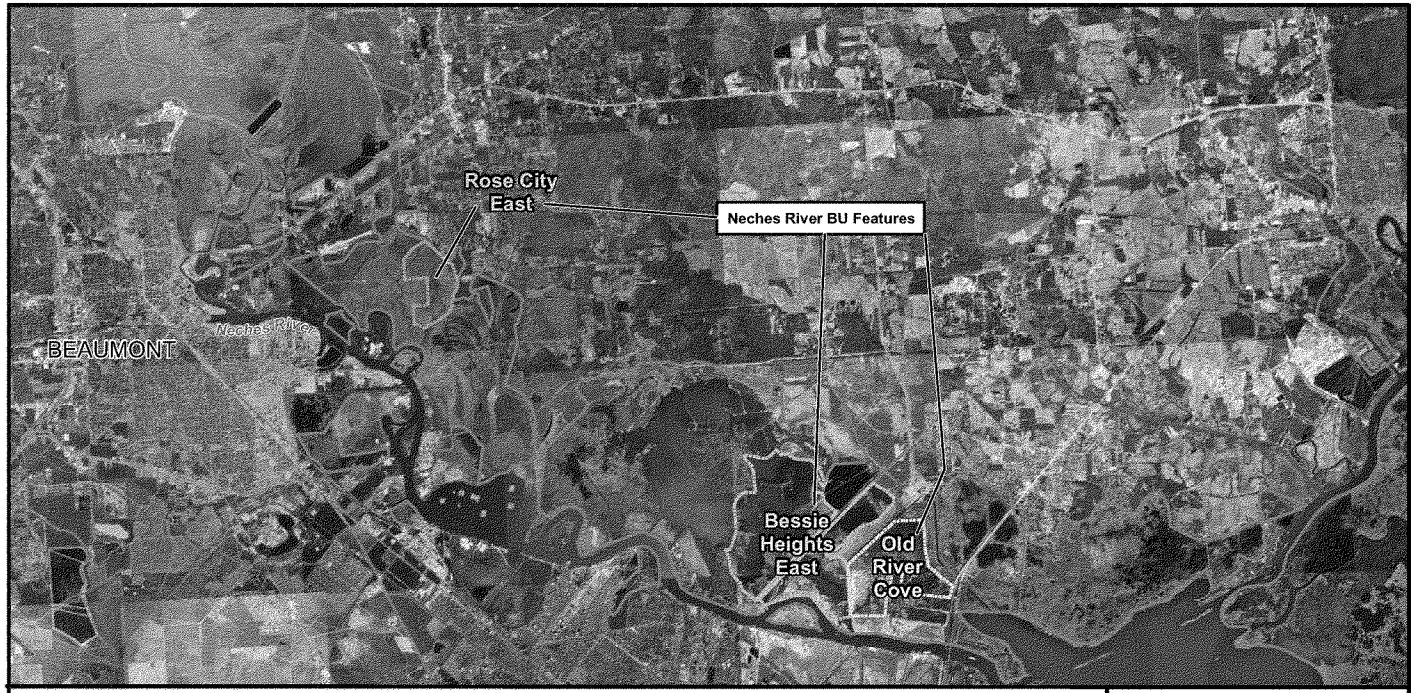
| | Restored Emergent Marsh (ac) | Improved Shallow-water Habitat (ac) | Nourished Existing Marsh (ac) | Total Influence Area (ac) |
|---|---|---|---|---|
| Rose City East | 345 | 72 | 151 | 568 |
| Bessie Heights East | 1,869 | 660 | 651 | 3,180 |
| Old River Cove | 639 | 139 | 432 | 1,210 |
| Total | 2,853 | 871 | 1,234 | 4,958 |
| Gulf Shore BU | nourishes 6 miles of Gulf beach and saline marsh behind the beach | | | |

### Rose City East (component of Neches River BU Measure) TX 3-1 East

- Would restore 345 acres fresh marsh, enhance 72 acres of shallow water, and nourish 151 acres of existing marsh in two construction events. New work material from the Neches River Channel would be used to restore a 225-acre marsh, construct hydraulic containment levees, and raise sediment elevations. Maintenance material from the first maintenance cycle would restore an additional 120 acres of marsh. Influence area – 568 acres

### Bessie Heights East (component of Neches River BU Measure) TX 5-2

- Would restore 679 acres of brackish and 1,190 acres of intermediate marsh, enhance 660 acres of shallow-water habitat, and nourish 651 acres of existing marsh. Marsh would be constructed with maintenance material from the Neches River Channel in seven maintenance cycles over 28 years. New work material would be used to build a hydraulic containment levee. Influence area – 3,180 acres




Rose City East
Bessie Heights East
Old River Cove
Hydrologic Unit

0 8,750 17,500
Feet

N
W E
S

**Figure 1**

**Neches River**

**BU Feature**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 100011305 | Scale: 1 inch equals 8,750 feet |
| Prepared by: 18827/ 20192 | Date: 10/14/2009 |

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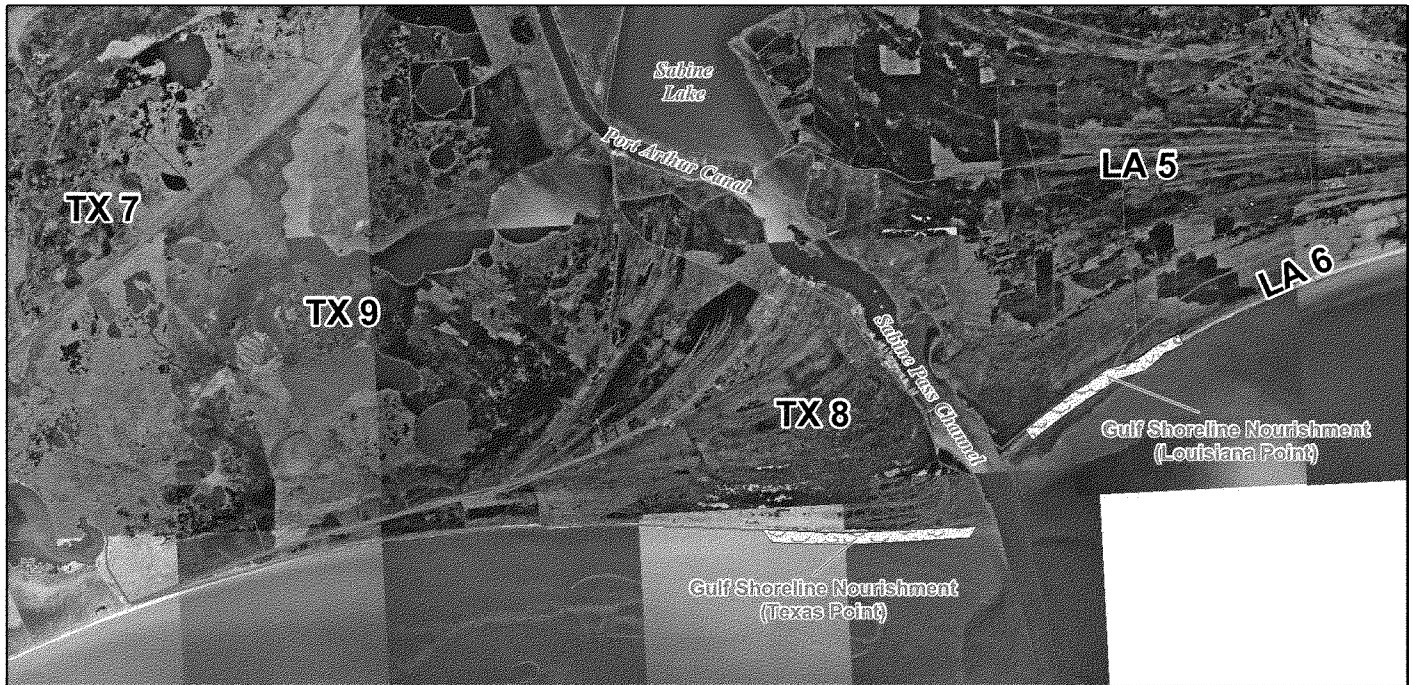


Shoreline Nourishment

Hydrologic Unit

2 1 0 2
Miles

N
W E
S

**Figure 2**

**Gulf Shore BU Feature**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.: 044198800 | Scale: 1:93,500 |
| Prepared by: A. Christansen | Date: 04/28/2008 |

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### Old River Cove (component of Neches River BU Measure) TX 6-1

- Would restore 639 acres of brackish marsh, enhance 139 acres of shallow-water habitat, and nourish 432 acres of existing marsh with new work material from Neches River Channel. New work material would be used to construct a hydraulic containment levee. Influence area – 1,210 acres

### Gulf Shore BU Feature (Texas and Louisiana Points) TX 8-11 LA 5-2/6-2

- Would nourish 3 miles of Gulf shoreline on both sides of Sabine Pass, from 0.5 to 3.5 miles from the east and west jetties, using maintenance material from Sabine Pass Channel. Maintenance material would be placed, unconfined, along the shoreline every 3 years for 50-year period of analysis (eight placement episodes with approximately equal volumes of material for each state). Material placement would alternate between each state every 3 years. Material would nourish eroding marsh and possibly create new saline marsh. Historic dredging records indicate material from Sabine Pass averages 51 percent silt, 31 percent clay, and 18 percent sand. The material would be hydraulically pumped into the nearshore zone and some material would be expected to flow over existing marsh while the remainder would flow into the nearshore waters. This mix of materials does not contain typical beach-quality sand; however, resource agencies have agreed that returning the material to the littoral system would have a net beneficial effect, regardless of the material type. Total affected shoreline – 6.0 miles.

## MITIGATION PLANS

Section 2036(a) guidance of WRDA 07 (Mitigation for Fish and Wildlife and Wetlands Losses), issued August 31, 2009, requires that the Preferred Alternative contain a specific plan to mitigate fish and wildlife losses since it has been determined that the Preferred Alternative would have unavoidable impacts after benefits of the DMMP BU features are applied. Adverse impacts to ecological resources caused by a proposed project must be avoided or minimized to the extent practicable, and remaining unavoidable impacts must be compensated to the extent justified. The Preferred Alternative must contain sufficient mitigation to ensure that the CIP would not have more than a negligible adverse impact on significant ecological resources.

USACE regulations (ER 1105-2-100) recognize wetland resources for special consideration in mitigation planning, and these are the type of resources that could suffer long-term impacts from the Preferred Alternative. The mitigation plan described below fulfills the special requirements for wetlands. The plan also contributes to multiagency regional plans (Louisiana Coast 2050 and the North American Waterfowl Management Plan) by restoring and preserving scarce and vulnerable wetlands and wildlife habitat, and using dredged material beneficially to the greatest extent possible.

Unavoidable impacts of the SNWW CIP remain only in Louisiana; all CIP impacts in Texas are minimized and offset by DMMP BU features. The mitigation plan was selected using the USACE certified version of IWR-PLAN software. Personnel from the following offices participated in at least one of two meetings to develop the mitigation plan.

- U.S. Fish and Wildlife Service (USFWS) Clear Lake (Texas) and Louisiana ecological services field offices, Chenier Plain National Wildlife Refuge (NWR), and Sabine NWR
- National Marine Fisheries Service – Galveston, Texas and Baton Rouge, Louisiana
- U.S. Environmental Protection Agency Region 6
- Texas General Land Office
- Texas Water Development Board
- Texas Parks and Wildlife Department – J.D. Murphree Wildlife Management Area
- Louisiana Department of Natural Resources
- Louisiana Department of Wildlife and Fisheries
- Sabine River Authority-Texas
- USACE (Galveston District and ERDC-CHL)

The mitigation plan would restore five degraded marshes east of Sabine Lake near Willow and Black bayous, Louisiana (Table 2) (Figure 3). Each of the mitigation marshes is described in detail below. The recommended mitigation plan compensates for the Preferred Alternative's salinity increase and associated losses in marsh and productivity by marsh creation activities that would influence a total of 8,095 acres of Louisiana marshes. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of existing open water by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the mitigation influence area.

Table 2
Acreage Created by Each Mitigation Site

| Mitigation Site | Restored Emergent Marsh | Improved Shallow Water Habitat | Nourished Existing Marsh | Total Influence Area |
|---|---|---|---|---|
| Willow Bayou | | | | |
| LA 21-8B | 251 | 63 | 367 | 681 |
| LA 2-ADD B | 436 | 104 | 745 | 1,285 |
| Subtotal | 687 | 167 | 1,112 | 1,966 |
| Black Bayou West | | | | |
| LA 3-10R | 792 | 356 | 1,317 | 2,465 |
| Black Bayou East | | | | |
| LA 3-15B | 683 | 227 | 878 | 1,788 |
| LA 3-18B | 621 | 207 | 1,048 | 1,876 |
| Subtotal | 1,304 | 434 | 1,926 | 3,664 |
| Total Mitigation | 2,783 | 957 | 4,355 | 8,095 |

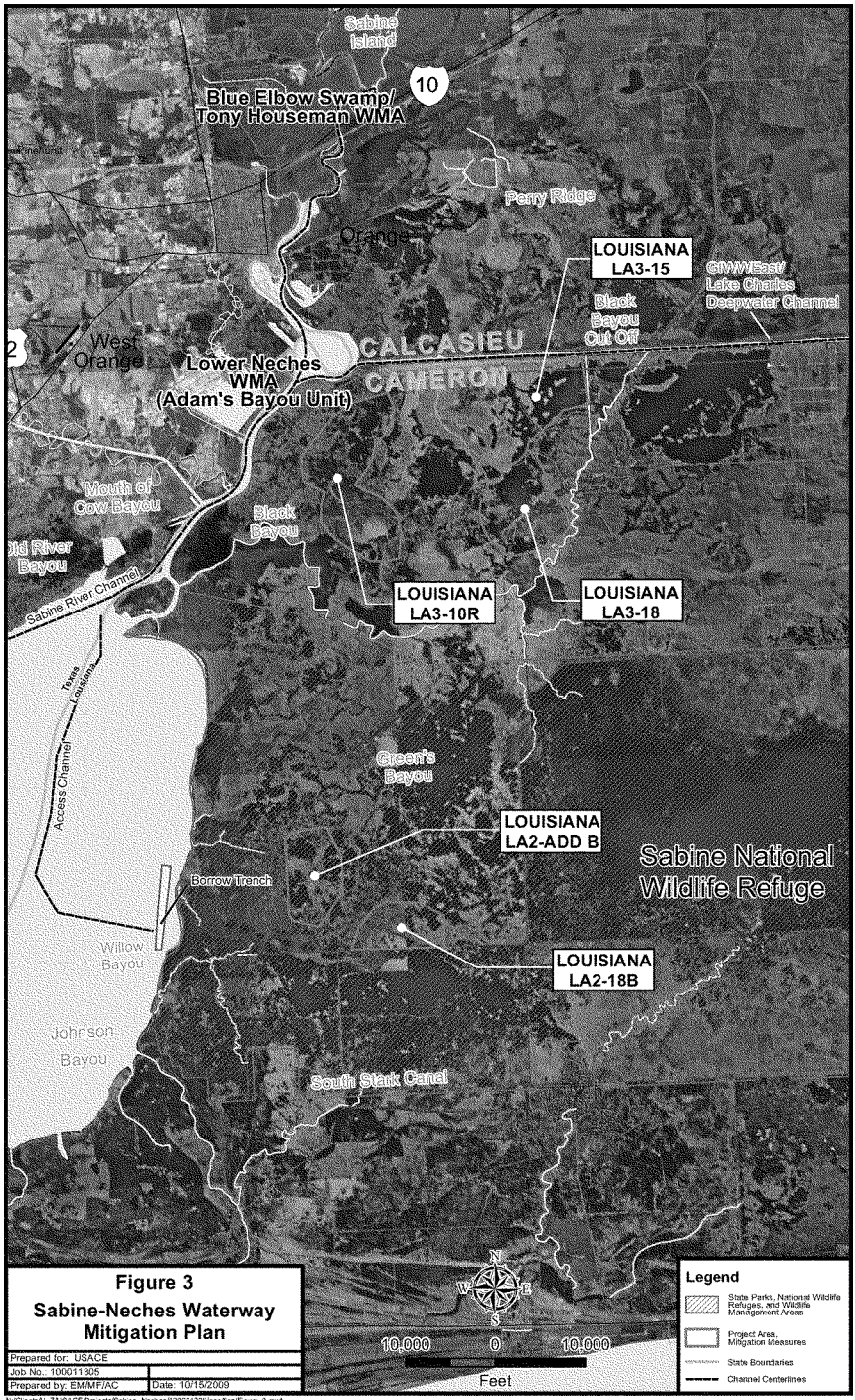


**Figure 3**
**Sabine-Neches Waterway Mitigation Plan**

| | |
|---|---|
| Prepared for: USACE | |
| Job No.. 100011305 | |
| Prepared by: EM/MF/AC | Date: 10/15/2009 |

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Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. A hydraulic pipeline dredge would be used to minimize turbidity. Small ponds and sinuous, interconnected channels would be created to maintain tidal connectivity, increase marsh edge, and create protected areas for submerged aquatic vegetation (SAV). Benthic fauna would be removed with sediment during dredging activities; however, benthic organisms can rapidly recolonize, and no long-term effects are anticipated. In order to maximize edge in the marsh, topographic relief would be created by varying the final elevation of material placement, and planting with appropriate native flora at each elevation. The varied topography would create differences in duration of tidal inundation, create different floral communities, and maximize biodiversity. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled. These would return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

### Willow Bayou, LA 2-18B and LA 2-ADD B

- Would restore 687 acres of emergent marsh, improve 167 acres of shallow water, and nourish 1,112 acres of emergent marsh located within the Sabine NWR. About 3.1 million cubic yards (mcy) of material dredged from a 1.8-mile-long borrow trench in Sabine Lake would be used. The borrow trench would be located at least 1,000 feet from the Sabine NWR shore and would average 1,030 feet wide by 7.5 feet deep. The borrow trench would be continuous and parallel to the current shoreline, in line with the common longshore circulation pattern in Sabine Lake. Normal bay circulation would prevent hypoxic conditions detrimental to aquatic organisms, and would eventually fill the trench with Sabine River sediments. An access channel, approximately 8 miles long, from the GIWW near the mouth of the Sabine River would allow the dredge to reach the proposed borrow area. Borrow trench and access channel dredging would temporarily increase water column turbidity during dredging activities, with localized effects on nekton, phytoplankton, and water quality. Due to low salinity (1 to 6 parts per thousand [ppt]) in this area of Sabine Lake, live oyster reefs are not likely (Fagerberg, 2003). A study by T. Baker Smith, Inc. (2006) found no live oyster reefs in this area. SAVs are probably not in this part of Sabine Lake because of the shallow, turbid, and turbulent water. Influence area – 1,966 acres.

### Black Bayou West, LA 3-10R

- Would restore 792 acres of emergent marsh, enhance 356 acres of shallow water, and nourish 1,317 acres of existing marsh. Material from maintenance dredging of the Sabine River Channel between East Pass and the GIWW would be used to restore a large area of marsh north of Black Bayou and west of Rusty Vincent Lake over a 30-year period. Maintenance dredging of the Sabine River Channel is considered a separate project within the SNWW navigation system, with a different non-Federal sponsor. Material would be hydraulically pumped into a large degraded marsh area west of Rusty Vincent Lake. This area is close to the navigation channel, minimizing pumping distance and cost. Marsh restoration would be accomplished in six 5-year dredging cycles, beginning by the first year of the completion of CIP construction. Each dredging cycle would pump approximately 526,000 cubic yards of material to create 132 acres with a total of 792 acres of emergent marsh created over 30 years. Influence area – 2,465 acres.

### Black Bayou East, LA 3-15B and LA 3-18B

- Would restore 1,304 acres of emergent marsh, enhance 434 acres of shallow water, and nourish 1,926 acres of existing marsh. Marsh would be restored in two areas just west of the Black Bayou Cut-Off Canal using dedicated dredging of accumulated material in the Lake Charles Deepwater Channel/GIWW. The Lake Charles Deepwater Channel was constructed in 1926 and coincides along its 24.9-mile length with the GIWW between the Sabine River and Lake Charles. Communications with USACE, New Orleans District indicate the depth of the 30-foot channel has been reduced to approximately 12 feet deep. Dedicated dredging of the Lake Charles Deepwater Channel for Black Bayou mitigation efforts would remove and kill benthic organisms; however, constant ship traffic in the shallow channel is an ongoing disturbance to these organisms. Recovery of benthic organisms would be rapid (Sheridan, 1999). No impacts to salinity would be expected because the dredged section would not connect with the Sabine River Channel or the Calcasieu Ship Channel; therefore, there would be no connection with the saltwater wedge in the Calcasieu Ship Channel (there is no Sabine River wedge; Brown and Stokes, 2009). Approximately 10.5 mcy of material would be pumped from a 13-mile stretch of the GIWW into the two areas. The first (LA 3-15B) would be located adjacent to the GIWW and would have the shortest pumping distance; the second (LA 3-18B) would be located south of LA 3-15B and pumping would move to it after the first is complete. Influence area – 3,664 acres.

## IMPLEMENTATION

Upon authorization of the CIP, the USACE would use its Navigational Servitude to obtain access for construction of the Texas and Louisiana DMMP BU features and the Louisiana mitigation measures for the purposes of planning, construction, and postconstruction monitoring. Landowners would be advised of the need for access for these activities. All restored areas would remain jurisdictional wetlands and continue to be subject to the Servitude; therefore, conservation easements would not be required. Agencies on the Interagency Coordinating Team (ICT) would be consulted to provide input to the future engineering, design, construction, and monitoring of the project. The ICT would participate in the detailed planning of the marsh creation areas, monitoring of construction of the mitigation areas, and postconstruction monitoring.

Pumping distances from all of the SNWW CIP channels are too long to permit use of new work or maintenance material from the proposed project to construct mitigation sites. For the BU sites, new work material is critical for the successful construction of containment levees and marsh creation. Therefore, construction contracts for mitigation and BU sites would incorporate an adaptive management approach to ensure that the initial construction contracts attain the appropriate elevation over the acreage specified for emergent marsh within each mitigation site.

The maximum optimal elevation for the marsh fill would be determined during preconstruction engineering and design. Elevation surveys would be conducted in the mitigation areas and nearby reference marshes. Dredged material quantities needed to achieve the targeted elevation would be calculated by taking into account future settling and compaction of placed material, as well as projected

relative sea level rise. The marsh fill would be sized to ensure creation of the requisite acres of emergent marsh, and it would be built to the highest elevation suitable for supporting marsh vegetation, as determined by preconstruction surveys and in consultation with the ICT. For planning and design purposes, this elevation is assumed to be approximately 1.6 to 1.7 feet NAVD88 after settlement. This should enable the marsh to withstand the projected rate of relative sea level rise over the period of analysis.

Elevations would be monitored during and immediately after placement to determine if material is settling as expected. One year after material placement, marsh elevations would be reviewed to identify whether other adjustments should be made to ensure that the target elevation has been met, and that tidal exchange and fisheries access are functioning as expected. Additional material would be added as needed at any point during or within 1 year of construction to ensure that the target marsh elevation is attained.

# MONITORING PLANS

## Monitoring Mitigation in Louisiana

Table 3 presents details of the monitoring plan for all of the mitigation sites in Louisiana, including the key monitoring parameters, periodicity, costs, and responsible parties. The same monitoring plan applies to all five mitigation sites since ecological success criteria are the same for all sites; they are ecologically similar and are situated relatively close to each other. Ecological success criteria for these mitigation sites are (1) each mitigation site contains 60 to 80 percent emergent marsh, 5 years after material placement; (2) each mitigation site remains intact and 60 to 80 percent vegetated with native, typical, emergent marsh through 50-year period of analysis; and (3) invasive noxious, and/or exotic plant species comprise less than 4 percent of mitigation site marsh cover at year 2 and year 5 after each material placement. The first criterion ensures that the requisite acres of emergent marsh are created and appropriately vegetated. The second criterion ensures that the mitigation sites will remain intact for the full period of analysis, producing the total benefits needed to mitigate for project impacts. The third criterion ensures that the mitigation sites are not overrun by invasive/noxious plants while typical marsh vegetation is trying to get established. Once established, marsh vegetation is expected to prevent the establishment of invasive, noxious, and/or exotic plants.

The USACE and the project non-Federal sponsor, the Sabine-Neches Navigation District (SNND) would manage the monitoring program. Information about plants colonizing the mitigation sites would be collected; however, past experience with marsh restoration in the area suggests soils at an appropriate elevation are naturally vegetated with typical marsh vegetation within a few years, and in many cases, planting is not required. The primary monitoring data for evaluating achievement of the ecological success criteria would be aerial photography collected according to procedures described by Steyer et al. (1995). Aerial photography of all five mitigation sites would be collected during the same data acquisition flight.

Table 3
Mitigation Monitoring in Louisiana for the
Sabine-Neches Waterway Channel Improvement Project

| | Willow Bayou | | Black Bayou West | Black Bayou East | |
|---|---|---|---|---|---|
| | LA 2-18B | LA 2-ADD B | LA 3-10R | LA 3-15B | LA 3-18B |
| **Ecological Success Criteria** | | | | | |
| Placed material will be 60–80% vegetated with native, typical, emergent marsh 5 years after placement of material | 176 ac vegetated emergent marsh | 305 ac vegetated emergent marsh | 92 ac marsh after 1st maintenance dredging, 185 ac marsh after 2nd maintenance dredging, 277 ac marsh after 3rd maintenance dredging, 370 ac marsh after 4th dredging cycle, 462 ac marsh after 5th dredging cycle, and 554 ac marsh after 6th dredging cycle | 478 ac vegetated emergent marsh | 435 ac vegetated emergent marsh |
| Marsh remains intact and 60–80% vegetated with native, typical, emergent marsh through 50-year period of analysis | 176 ac vegetated emergent marsh | 305 ac vegetated emergent marsh | 554 ac vegetated emergent marsh | 478 ac vegetated emergent marsh | 435 ac vegetated emergent marsh |
| Invasive, noxious, and/or exotic plants comprise less than 4% of marsh cover at yr 2 and yr 5 after each placement | Less than 7 ac with undesirable plants | Less than 12 ac with undesirable plants | Less than 22 ac with undesirable plants after the final dredging cycle | Less than 19 ac with undesirable plants | Less than 17 ac with undesirable plants |
| **Monitoring Organization** | U.S. Army Corps of Engineers and Sabine-Neches Navigation District will share responsibility and cost consistent with the apportionment of O&M costs for the project | | | | |
| **Cost and Periodicity** | | | | | |
| Field survey of vegetation using Braun-Blanquet method and marsh elevation | 2 years after material placement and 5 years after material placement. Total cost in constant dollars (4.375% interest rate) for each mitigation area is approximately $9,400. | | 2 yearrs after first dredging cycle placement and for 5 more cycles beginning 7 years after first dredging cycle. Total cost in constant dollars (4.375% interest rate) is approximately $23,000. | 2 years after material placement and 5 years after material placement. Total cost in constant dollars (4.375% interest rate) for each mitigation area is approximately $9,400. | |
| Aerial photography, collection and interpretation, and data analysis and reporting | Aerial photography and data analysis and reporting (Yr 2, Yr 5, Yr 10, Yr 22, Yr 34, and Yr 46). Total cost in constant dollars is approximately $728,000 | | | | |
| **Total Monitoring Estimated Cost over 50 years (constant dollars, 4.375% interest rate)** | **$789,000** | | | | |

Table 3
Mitigation Monitoring in Louisiana for the
Sabine-Neches Waterway Channel Improvement Project
(cont'd)

**Monitoring protocol (follow Steyer et al., 1995, Quality Management Plan for Coastal Wetlands Planning, Protection, and Restoration Act Monitoring Program), Frequency, and Duration**

Emergent marsh

Monitor species composition and relative abundance using Braun-Blanquet method 2 yrs after placement of material and 5 yrs after placement of material. Monitor area of created emergent marsh using aerial photography at 2 yrs after placement of material, 5 yrs after placement of material, and every 12 yrs through Yr 46.

**Disposition of Information and Analysis**

Annually, the District Engineer will consult with State and Federal agencies regarding the status of mitigation efforts and prepare a report summarizing the results of the consultations and evaluating: ecological success of the mitigation to date, likelihood mitigation will achieve success defined in the mitigation plan, projected time line for achieving success, and recommendations for increasing the likelihood of success. Copies of this report will be provided to members of the consulting State and Federal agencies.

Data collected will be georeferenced and stored in an electronic database. Aerial photography will be listed in the electronic database and digital copies will be provided to each of the consulting agencies, the Texas Natural Resource Information System (TNRIS), and Strategic Online Natural Resources Information System (SONRIS). Data will also be provided to the Coastal Wetlands Planning Protection and Restoration Act (CWPPRA) Regional Monitoring Database at the Louisiana Department of Natural Resources.

**Contingency Plan/Adaptive Management**

Emergent marsh

ICT will review aerial photography and species diversity and relative abundance data collected by the Braun-Blanquet method 2 yrs after material placement. Past experience indicates that marsh soils at an appropriate elevation are relatively rapidly colonized by natural, emergent marsh vegetation in this area. Vegetation monitoring data will be reviewed to determine whether or not the rate of vegetation and extent of vegetation coverage is appropriate or if manual planting is needed. The ICT will determine if marsh planting is needed and if so, to what extent and in which areas. The data will also indicate if the percentage of noxious or exotic species is meeting the success criterion. If the percentage of these species exceeds 4 percent of the marsh cover, the ICT will propose necessary actions to remove and manage those species.

Aerial photography at 5 yrs following material placement will be analyzed to determine if the rate of emergent marsh growth has proceeded as expected. If the extent of vegetation cover is not within the expected percentage range, the ICT will evaluate whether or not some corrective action, such as additional planting, marsh shaping, etc. is needed. The 5-yr review will also indicate if the percentage of noxious or exotic species is meeting the success criterion. If the percentage of these species exceeds 4 percent of the marsh cover, the ICT will propose necessary actions to remove and manage those species. It is assumed that invasive or noxious species review will no longer be needed after marsh vegetation is fully established at yr 5. Aerial photography and ICT review to evaluate the extent of vegetative cover will be repeated in yrs 25, 35 and 45.

**Project Closure**

Mitigation and monitoring activities will cease and each project will be formally closed when it is determined that the desired acres of marsh have been maintained through the 50-yr period of analysis. The adaptive management process described is intended to allow periodic modifications of mitigation and monitoring in order to achieve the desired number of acres at the end of the project. The ICT will meet to evaluate data collected during the last aerial overflight and will provide a recommendation to the Division Commander in the last scheduled annual report to close the mitigation project.

## Beneficial Use Monitoring in the Neches River BU Feature

Details of the monitoring plan for the BU sites in the Neches River BU Feature are described in Table 4. The ecological success criteria for these BU sites are the same as those for the mitigation sites in Willow and Black bayous. Ecological performance criteria for these BU sites are (1) each BU site contains 60 to 80 percent emergent marsh, 5 years after material placement; (2) each BU site remains intact and 60 to 80 percent vegetated with native, typical, emergent marsh through the 50-year period of analysis; and (3) invasive noxious, and/or exotic plant species comprise less than 4 percent of mitigation site marsh cover at year 2 and year 5 after each placement. The USACE and the SNND will manage the monitoring program for the first 10 years, and the SNND will assume responsibility for subsequent monitoring. The primary monitoring tool to evaluate achievement of ecological success criteria would be aerial photography. Photography of all BU sites in the area would be taken in each data acquisition flight. Invasive and noxious species would be identified by field surveys of species composition and relative abundance 2 and 5 years after placement of material.

## Beneficial Use Monitoring on the Gulf Shore

Monitoring the Gulf Shore BU Feature is described in Table 5. Maintenance material for this project would be pumped along the nearshore zone at Texas and Louisiana Points with the expectation that some sediment will remain in the area and prevent the slight amount of shoreline erosion projected to occur because of the SNWW CIP. Some sediment deposited in the nearshore zone is expected to occasionally wash over the beach during high tide and storm events and nourish the marsh behind the beach. The objective of monitoring is to evaluate the success of the nearshore disposal in achieving the ecological success criterion of reducing shoreline erosion. Monitoring will be undertaken every 3 years beginning with the first placement, and will continue for two full 6-year cycles at each point, ending in year 13. Aerial photography would measure the position of the shorelines at Texas and Louisiana Points every 3 years beginning in the first year of placement and ending in year 13 year. It is anticipated that periodic monitoring over 13 years will be sufficient to document the behavior and movement of the dredged material in the littoral zone, and its affect on shoreline erosion.

## Monitoring Cost Estimates

Cost estimates may change as detailed monitoring plans are designed and monitoring dates identified. For field measurements of vegetation (Braun-Blanquet method) and marsh elevation, cost estimates are based on two biologists spending a day in the field at each mitigation site or BU feature for each monitoring event. Costs are typically slightly higher for field surveys in later years. The cost of aerial photography includes acquisition, georeferencing, compiling photo-mosaics, and analysis and is estimated at $17,000/square kilometer (about 220 acres) based on information provided by Darryl Clark, USFWS-Louisiana (personal communication, 2009). Cost estimates include the cost of data management and distribution for the field data and aerial photography collected. Estimated costs also include costs for preparation of reports summarizing data for presentation to the Division Commander.

Table 4
Monitoring the Neches River Beneficial Use Feature
for the Sabine-Neches Waterway Channel Improvement Project

| | Rose City East | Bessie Heights East | Old River Cove |
|---|---|---|---|
| **Ecological Success Criteria** | | | |
| Placed material will be 60–80% vegetated with native, typical, emergent marsh 5 years after placement of material | 158 ac emergent marsh after one dredging cycle | 1,308 ac emergent marsh after 28 years and seven maintenance dredging cycles | 447 ac emergent marsh |
| Marsh remains intact and 60–80% vegetated with native, typical, emergent marsh at end of project, 50 years | 242 ac emergent marsh | 1,308 ac emergent marsh | 447 ac emergent marsh |
| Invasive, noxious, and/or exotic plants comprise less than 4% of marsh cover | Less than 6 ac with undesirable plants after the final dredging cycle | Less than 52 ac with undesirable plants after the final dredging cycle | Less than 18 ac with undesirable plants |
| Placed material elevation | Maximum optimal elevation (as determined by preconstruction surveys in consultation with ICT) 1 year after placement of material. | | |
| **Monitoring Organization** | USACE for 1st 10 years; SNND for monitoring after Yr 10 through 50-year period of analysis | | |
| **Cost and Periodicity** | | | |
| Field survey of vegetation using Braun-Blanquet method and marsh elevation | 2 years after new work and maintenance material placement and 5 years after material placement. Total cost in constant dollars (4.375% interest rate) is approximately $38,000. | 2 years after first dredging cycle placement and 4 years after material placement. 2 yrs after each maintenance cycle (five more maintenance cycles). Total cost in constant dollars (4.375% interest rate) is approximately $53,000. | $42,650 2 years after material placement and 5 years after material placement. Total cost in constant dollars (4.375% interest rate) is approximately $33,000. |
| Aerial photography, collection and interpretation, and data analysis and reporting | Aerial photography and data analysis and reporting (Yr 2, Yr 5, Yr 9, Yr 15, Yr 20, Yr 24, Yr 28, Yr 32, and Yr 46) Total cost in constant dollars is approximately $736,000. | | |
| **Total Estimated Monitoring Cost, over 50 years (constant dollars, 4.375% interest rate)** | **$860,000** | | |

Table 4
Monitoring the Neches River Beneficial Use Feature for the
Sabine-Neches Waterway Channel Improvement Project
(cont'd)

**Monitoring protocol (follow Steyer et al., 1995, Quality Management Plan for Coastal Wetlands Planning, Protection, and Restoration Act Monitoring Program), Frequency, and Duration**

Emergent marsh

Monitor species composition and relative abundance using Braun-Blanquet method 2 yrs after placement of material and 5 yrs after placement of material.

Monitor area of created emergent marsh using aerial photography at 2 yrs after placement of material, 5 yrs after placement of material, and every 12 years through Yr 45.

**Disposition of Information and Analysis**

Annually, the District Engineer will consult with State and Federal agencies regarding the status of marsh restoration efforts and prepare a report summarizing the results of the consultations and evaluating: ecological success of the marsh restoration to date, likelihood marsh restoration will achieve success defined in the beneficial use plan, projected time line for achieving success, and recommendations for increasing the likelihood of success. Copies of this report will be provided to members of the consulting State and Federal agencies.

Data collected will be georeferenced and stored in an electronic database. Aerial photography will be listed in the an electronic database and digital copies will be provided to each of the consulting agencies, the Texas Natural Resource Information System (TNRIS), and Strategic Online Natural Resources Information System (SONRIS). Data will also be provided to the CWPPRA Regional Monitoring Database at the Louisiana Department of Natural Resources.

**Contingency Plan/Adaptive Management**

Emergent Marsh

ICT will review aerial photography and species diversity and relative abundance data collected by the Braun-Blanquet method 2 yrs after material placement. Past experience indicates that marsh soils at an appropriate elevation are relatively rapidly colonized by natural, emergent marsh vegetation in this area. Vegetation monitoring data will be reviewed to determine whether or not the rate of vegetation and extent of vegetation coverage is appropriate or if additional planting is needed. The ICT will determine if marsh planting is needed and if so, to what extent and in which areas. The data will also indicate if the percentage of noxious or exotic species is meeting the success criterion. If the percentage of these species exceeds 4 percent of the marsh cover, the ICT will propose necessary actions to remove and manage those species.

Aerial photography at 5 yrs following material placement will be analyzed to determine if the rate of emergent marsh growth has proceeded as expected. If the extent of vegetation cover is not within the expected percentage range, the ICT will evaluate whether or not some corrective action, such as additional planting, marsh shaping, etc., is needed. The 5-year review will also indicate if the percentage of noxious or exotic species is meeting the success criterion. If the percentage of these species exceeds 4 percent of the marsh cover, the ICT will propose necessary actions to remove and manage those species. It is assumed that invasive or noxious species review will no longer be needed after marsh vegetation is fully established at year 5. Aerial photography and ICT review to evaluate the extent of vegetative cover will be repeated in yrs 25, 35 and 45.

**Project Closure**

Monitoring activities will cease and each project will be formally closed when it is determined that the desired acres of marsh have been maintained through the 50-year period of analysis. The adaptive management process described is intended to allow periodic modifications in order to achieve the desired number of acres at the end of the project and ensure amounts of unwanted vegetation are minimized. The ICT will meet to evaluate data collected during the last aerial overflight and will provide a recommendation to the Division Commander in the last scheduled annual report to close monitoring of the beneficial use features.

Table 5
Monitoring Beneficial Use Sites on the Gulf Shoreline in Texas and Louisiana
for the Sabine-Neches Waterway Channel Improvement Project

| | Texas Point | Louisiana Point |
|---|---|---|
| **Ecological Success Criteria** | | |
| Shoreline erosion rate is decreased or shoreline accretion rate is increased | After two disposal events (12 years), shoreline erosion rate averages less than 44 ft/yr (1,150 ft of erosion between 1974 and 2000 [Morang, 2006; King, 2007]) | After two disposal events (12 years), shoreline accretion rate averages more than 1.2 ft/yr (USACE, 2004) |
| **Monitoring Organization** | USACE for 1st 10 years; Sabine-Neches Navigation District for monitoring after Yr 10 through 50-year period of analysis | |
| **Cost and Periodicity** | | |
| Aerial photography, collection and interpretation, and data analysis, and reporting | Yr 1, Yr 4, Yr 7, Yr 10, and Yr 13 after project start; total cost in constant dollars is approximately $294,000 | |
| **Total Estimated Monitoring Cost, over 13 Years (constant dollars, 4.375% interest rate)** | **$294,000** | |

**Monitoring Protocol (follow Steyer et al., 1995, Quality Management Plan for Coastal Wetlands Planning, Protection, and Restoration Act Monitoring Program), Frequency, and Duration**

Shoreline Change Rate

Calculate shoreline erosion or accretion between the shoreline identified in the Yr 1 baseline photo and each subsequent set of aerial photography (yrs 4, 7, 10, and 13). The ICT will identify specific protocols for making that calculation since Steyer et al. (1995) do not identify a specific protocol for this purpose.

**Disposition of Information and Analysis**

Annually, the District Engineer will consult with State and Federal agencies regarding the status of shoreline and marsh elevation changes and prepare a report summarizing the results of the consultations and evaluating: ecological success of the disposal activities to date, likelihood disposal activities will achieve success defined in the beneficial use plan, projected time line for achieving success, and recommendations for increasing the likelihood of success. Copies of this report will be provided to members of the consulting State and Federal agencies.

Data collected will be georeferenced and stored in a Microsoft Access database. Aerial photography will be listed in the Microsoft Access database and digital copies will be provided to each of the consulting agencies, the TNRIS, and SONRIS. Data will also be provided to the CWPPRA Regional Monitoring Database at the Louisiana Department of Natural Resources.

**Contingency Plan/Adaptive Management**

Shoreline Erosion/Accretion Rate

ICT will review aerial photography and calculate the shoreline erosion/accretion rate along the Gulf shoreline. The Texas and Louisiana Gulf shorelines for 3 miles on each side of the Sabine Pass jetties will be analyzed for each overflight to understand the rate and locations of change in shoreline features. The ICT will determine if modifications should be made to the disposal process in order to ensure the success criteria are met.

Aerial photography at 5 yrs following material placement will be analyzed to determine if the rate of emergent marsh growth is proceeding as expected. If the rate of emergent marsh creation is not proceeding as expected, the ICT will evaluate whether or not there is a need for additional data collection. If there is no need for additional data collection, the ICT will evaluate whether or not some corrective action, such as additional planting, marsh shaping, etc., is needed. This review process will occur after aerial photography is collected every 10th year through the SNWW CIP project life.

**Project Closure**

Monitoring activities will cease when it is determined that the dredged material disposal pattern is achieving the goal of decreasing the rate of shoreline erosion. The adaptive management process described is intended to allow modifications of disposal activities and monitoring every 3 yrs for the first 12 yrs of the project. The ICT will meet to evaluate data collected during the last aerial overflight and the last marsh elevation study and will provide a recommendation to the Division Commander in the last scheduled annual report to close the mitigation project.

## Contingency Plan/Adaptive Management

The following contingency plan has been developed to guide corrective actions where monitoring demonstrates that mitigation measures and BU features are not achieving ecological success as measured by the success criteria. In this region, past experience indicates that marsh soils at an appropriate elevation are rapidly colonized by natural, emergent marsh vegetation. However, if monitoring determines that the extent of vegetation coverage does not meet ecological success criteria, manual planting would be employed to restore the requisite acres of emergent marsh at the times specified in tables 3 and 4. The ICT would determine if marsh planting is needed and if so, to what extent and in which areas. The ICT would also determine if noxious or exotic species are exceeding the percentage of marsh cover specified by criterion 3, and if so, propose necessary actions to remove and control the spread of those species. The likelihood of the need for corrective actions is considered to be low, because sufficient elevation would be provided by initial construction, and vegetation by typical marsh plants is typically easily achieved. The likelihood for the need to control invasives beyond the first 5 years is considered low for the Louisiana sites because undesirable plant species are generally not an issue in these marshes as long as the appropriate elevation is attained. The need for invasives control for the Texas BU sites is considered unlikely because invasives removal programs are typically only needed during the first 5 years of marsh establishment. Corrective actions for the Gulf Shore BU Feature are expected to be minimal. Any recommended modifications to pipe placement and construction techniques identified by the ICT after the first placement episode in each state would be applied in subsequent placement cycles.

## SUMMARY

Ecological success criteria for the SNWW CIP focus on the creation and restoration of emergent marsh and reduced Gulf shoreline erosion. Achievement of these criteria is expected to be maintained for the 50-year period of analysis. Monitoring focuses on the collection of data, particularly aerial photography that allows the area of emergent marsh created in each of the Louisiana mitigation sites and the Neches River BU Feature to be determined. Aerial photography will also be utilized to monitor changes in the Gulf shoreline at the Gulf Shore BU sites.

The total estimated cost (constant dollars, 4.375 percent interest rate) for monitoring all mitigation and BU sites is $1,943,000 including $789,000 to monitor mitigation sites in Louisiana, $860,000 to monitor the Neches River BU Feature, and $294,000 to monitor the Gulf Shore BU sites. These cost estimates include field sampling, aerial photography, data management and analysis, and report preparation.

Monitoring will be conducted primarily according to Steyer et al. (1995) and provided to the Texas Natural Resource Information System, Strategic Online Natural Resources Information System in Louisiana, and the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Regional Monitoring Database at the Louisiana Department of Natural Resources. Analysis of data collected will be reviewed by the ICT and provided to the USACE Division Commander annually. This analysis will include recommendations for changes in mitigation and/or beneficial use methodology necessary to

achieve the ecological success criteria. Recommendations will also be made for necessary modifications to monitoring plans.

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# Appendix K

# Public Meeting Transcripts

SABINE-NECHES WATERWAY PUBLIC MEETING

JANUARY 26, 2010

REPORTED BY: Ada V. Christy, CSR, RPR

1 MR. REESE: Good evening. My name is
2 Randall Reese. I am the general manager of the
3 Sabine-Neches Navigation District. We are the local
4 sponsor for the U.S. Army Corps of Engineers on the
5 Sabine-Neches Waterway. At this time, I'd like to
6 introduce those present with the Navigation District
7 that are here with us tonight. We have Paul Beard, our
8 board chairman; Joe Johnson, our commissioner, one of
9 our commissioners. We have Clay Henderson, who is our
10 assistant general manager. And we have our attorney,
11 Hubert Oxford, who is with us tonight.
12 I know we have a good presentation tonight.
13 So I'm not going to delay in getting started. At this
14 time, I'd like to introduce Colonel David Weston, who is
15 the commander of the Galveston District, U.S. Army Corps
16 of Engineers.
17 COL. WESTON: Good evening ladies and
18 gentlemen. And thank you, Randy, for the introduction.
19 Pleased to be here tonight. As Randy mentioned, I'm
20 Colonel Dave Weston. I'm the commander of the Galveston
21 District for the U.S. Army Corps of Engineers. And I
22 welcome you to tonight's public meeting concerning the
23 Sabine-Neches Waterway Channel Improvement Project.
24 Specifically, we're here tonight to present
25 information and accept public comments on the following

1 draft documents that were released for public review on
2 December 24, 2009: The Draft Feasibility Report for the
3 Sabine-Neches Waterway Channel Improvement Project,
4 Southeast Texas and Southwestern Louisiana; the draft
5 Environmental Impact Statement, Sabine-Neches Waterway
6 Channel Improvement Project, Ocean Dredge Material
7 Disposal Site Designation; the draft General Conformity
8 Determination, Sabine-Neches Channel Improvement
9 Project.
10 And for the record, I'd like to state that
11 this public meeting is being convened at 7:00 p.m. on
12 January 26th, 2010, at the Beaumont Civic Center in
13 Beaumont, Texas.
14 As you know, the Corps of Engineers and the
15 Sabine-Neches Navigation District have been performing a
16 study analyzing potential modifications to the portion
17 of the Sabine-Neches Waterway that serves in the Ports
18 of Beaumont and Port Arthur, Texas.
19 Two objectives were identified from the
20 study. And these objectives were improving navigational
21 efficiency along the Sabine-Neches Waterway and
22 maintaining the ecological value of coastal and
23 estuarine resources within the project area.
24 A cost-effective plan has been identified
25 by the study that meets these objectives. This plan,

1 which we refer to it as the "tentatively recommended and
2 locally preferred plan," will be described by study team
3 members after my presentation. We are specifically
4 seeking input concerning the plan and associated
5 environmental impacts that are described in these
6 documents.
7 I hope that you all had an opportunity to
8 read the announcement of the public meeting either on
9 our website in the Galveston District or in the
10 individual announcements that were mailed to
11 individuals, agencies, organizations, and news media
12 believed to have an interest in these proceedings. The
13 meeting notice was also published in the Beaumont
14 Enterprise in Beaumont, Texas, and the Southwest Daily
15 News in Lake Charles, Louisiana.
16 An addi- -- an additional fact sheet is
17 also available at the entrance. I hope you had a chance
18 to take a look at that. The announcement mailing list
19 and a list of those present will be made a part of
20 record of this meeting. And a court reporter is here
21 who will transcribe these proceedings and all public
22 comments.
23 Before we go any further, I'd like to
24 introduce the public officials we have here tonight. We
25 have Mr. Fred Jackson representing the Jefferson County

Judge's Office. There he is. Additional, I'd like to introduce those members of my team from the Corps of Engineers that are here tonight: Mr. Arthur Janecka, our deputy district engineer; Mr. Dolan Dunn, our chief planning, environmental, and regulatory division; Ms. Carolyn Murphy, our chief environmental section; Mr. Byron Williams, project manager for the Sabine-Neches Waterway Study; Ms. Sheri Willey, our planning lead; Ms. Gloria Appell, our economics lead; Ms. Janelle Stokes, our environmental lead; Ms. Nancy Young, project engineer; and Ms. Samantha Lambert, our hydrology and hydraulics engineer.

Now I'll turn this presentation over to Mr. Byron Williams who will describe the ground rules for the tonight's meeting. Thank you.

MR. WILLIAMS: Greetings again. My name is Byron Williams, project manager for the Sabine-Neches Waterway Project. First of all, we'd like to make sure everyone has filled out an attendance card. We need the cards to document all attendees here. In addition, if you check off on the card that you would like to speak, we need the card turned in so we may announce your name at the appropriate time. So anyone who has not filled out a card and would like to speak, please raise your hand now, and we can have one handed to you.

1 Okay. Thank you.
2 Everyone who did fill out the card will
3 have an opportunity to speak after the presentations
4 have been made by the Corps and the Sabine-Neches
5 Navigation District. And if you do not wish to speak,
6 we do have 8-1/2 by 11 comment cards that you may fill
7 out and either place in the baskets that we have in the
8 rear of the room and/or send them in via snail mail.
9 Anyone would like a card to send in comments? Okay.
10 Thank you very much.
11 First of all, I'd like to emphasize that
12 this is not a voting contest. We're not going to decide
13 just by standing up if you're for or against the
14 project. That's not the purpose of tonight's meeting.
15 The format, what we're going to do is we're going to
16 have Clayton Henderson of the Sabine-Neches Navigation
17 -- Sabine-Neches Navigation District, he's the assistant
18 general manager. He's going to come up and give you an
19 overview of the Sabine-Neches Waterway. Followed by Ms.
20 Sheri Willey, she is the planning lead. She's going to
21 give an overview of the Feasibility Study and the
22 recommended plan. Followed by Ms. Jan Stokes, she's
23 going to give an overview of the Environmental Impact
24 Statement.
25 Afterwards, Colonel Weston is going to open

1 the floor to comments. First by recognizing all public
2 and state officials -- federal and state officials that
3 wish to comment. Then followed by the public agencies,
4 federal and state that wish to comment, resource
5 agencies. Then followed by individual comments
6 addressed in the cards that I mentioned earlier.
7 Everyone will get a chance to speak. All
8 comments, however, will be limited to three minutes. I
9 will be standing here, and I'll raise my hand when you
10 have 30 seconds left. Please adhere to
11 three -- three-minute time rule, as we'd like to be
12 courteous. And -- well, yeah, just adhere to the
13 three-minute time rule. I'm going to raise my hand. We
14 won't have a security come in and take you out. But
15 after three minutes, we'd like you to just properly sit
16 down. Thank you very much.
17 And also, as far as applause and reaction
18 to certain comments, we ask that you do not do that as
19 well. So we can keep the meeting in a orderly fashion.
20 First of all, I think I covered everything. Without the
21 further ado, I'm going to introduce Mr. Clayton
22 Henderson of the Sabine-Neches Navigation District.
23 MR. HENDERSON: You have to bear with me
24 for a second.
25 MR. WILLIAMS: I'm going to try lowering

1 these lights and see what you -- will you still be able
2 to see?
3 MR. HENDERSON: I will.
4 MR. WILLIAMS: Okay.
5 MR. HENDERSON: Thank you. Evening. I'm
6 Clayton Henderson, assistant general manager of the
7 Sabine-Neches Navigation District. Sabine-Neches
8 Navigation District is the local sponsor to the Army
9 Corps of Engineers for the Sabine-Neches Waterway. In
10 short, we act a lot of times as the middleman between
11 industry in the area and the federal government for the
12 project.
13 So what I want to do before getting into
14 details of a lot of what you're going to hear tonight is
15 give you a sort of a recap a little bit of what brings
16 us here tonight from the local sponsor's perspective,
17 and how we got to tonight. The Sabine-Neches Waterway
18 has a long history of improvements. You know, a lot of
19 times because it's been quite a while since our last
20 improvement, we tend to think that, well, we've never
21 improved it before. But you can see that we're pretty
22 good at it. We've been doing it for quite a while.
23 There's been a federal interest in the -- in the project
24 since even before 1912. But I wanted you to realize
25 that it's not something new. It's something that we do

1 continually. It's -- as an area, we've embraced in the
2 past. We've always will embrace it probably in the
3 future. Because it's what's drives our area
4 economically. And I want to say I think you'll see
5 tonight that we've gotten smarter as we've done the
6 improvements, both from an economic perspective and an
7 environmental perspective.
8 But as I mentioned, the federal government
9 and the local sponsor in the area held hands on this
10 project for -- for quite some time. Since 1875 federal
11 government has had a hand in the project. That led
12 ultimately to that 1912 first improvement of the
13 waterway.
14 But it's always been kind of a -- kind of a
15 two- to three-party perspective for the project.
16 There's the federal interest, there's the industry,
17 local industry, and then there's the local area, local
18 economy, and the -- and the citizens. And so though we
19 share the funding for -- for the project, federal
20 government does pay for a lot of maintenance. The
21 Navigation District will pay for things like the
22 placement of the dredge areas or locating the real
23 estate. And then private industry has to pay their
24 portion that's outside of that federal channel. So we
25 all kind of pay our share. And we all kind of pay as we

1 go on a -- on an improved project, always have. That's
2 not going to change as we go forward and as we go into
3 improved projects into the future.
4 But I do want to kind of touch base on kind
5 of some of the things that we were looking for about a
6 decade ago when we kicked off looking at improving our
7 channel. Two main tenants that we started with were
8 deepening and widening. And you've probably heard the
9 project referred to as a "deepening-widening project"
10 for quite some time. We like to drop that widening here
11 recently, and we call it "deepening." But I want to
12 emphasize tonight, because I've heard in some other
13 meetings here recently since that time that well, is
14 that's a big change for the project, whatever. And I
15 want to emphasize the fact that this -- this is actually
16 a quote from a presentation that was given in '99 from
17 the Navigation District. But originally, the idea was
18 obviously to deepen it from out in the Gulf of Mexico
19 all the way to Port of Beaumont. The widening was going
20 to be some widening, "strategic widening" we like to
21 call it here and there. But it was never going to be
22 just a bulk widening all the way up the waterway. But
23 the point that I want to make in that statement is the
24 -- the italicized portion there "was to improve the
25 transportation, efficiency, and navigational safety of

1 the waterway."
2 Even though we've dropped this -- the term
3 of the widening, we retained a lot of the aspects of the
4 project that are going to give us the benefits of that.
5 And we, as the local sponsor and asked to kind of speak
6 for the area in that regard, don't feel like we've given
7 up one inch in efficiency or navigational safety on the
8 waterway. So I want to make that at least clear from
9 the nav- -- from the Navigation District's perspective.
10 We do believe that we're -- we're getting what we paid
11 for when it comes to this Feasibility Study and a good
12 product that the -- that the Corps has put out.
13 But that doesn't mean that the channel
14 itself hasn't been driving us toward this improvement.
15 With the advent or the oncoming and deepening and
16 widening of the Panama Canal, with the regulations that
17 are going to cause the ship hulls to start changing
18 about 2015, we are already starting to see and feel the
19 -- the pressures of improving this channel. You saw on
20 the slide where we've been improving. This will be our
21 sixth time. And when it started out, we improved about
22 every ten years, and then it got to be about every 15 or
23 so. And this one's been -- been a pretty good -- good
24 time frame. It's been since 1960, '62ish that we're
25 living with that project -- with that -- with this

1 project. So 50 years is a good horizon, and the Corps
2 shoots for a 50-year horizon. But what we're seeing is
3 the ship industry, the shipping industry and industry in
4 general, really starting to pressure and push that
5 project's edges. And so though our waterway is
6 sufficient today, we are -- we are receiving ships that
7 could go deeper, that could go beyond the design limits
8 of the waterway even today. And so we think that this
9 improved waterway is perfect timing, right in line with
10 when we wanted it, how we wanted it. And we were
11 stating this a decade ago. And it's still true today,
12 and gets truer every day I think as we work and operate
13 on the waterway.
14 So in that vein, this has been a long
15 process. The civil works process is lengthy -- I'm not
16 going take you through every one of those blocks. But I
17 do want to highlight kind of where we are, kind of a you
18 are here map. On that slide, you'll see the different
19 colors. We're -- we're pretty much smack-dab in the
20 middle or just to the right of the second line there, on
21 about Block 9. It's about a 21-step process, ballpark.
22 But we do believe though, though that we're on the Step
23 9, which is the final Feasibility Report, and right
24 about where we are today. We're going to slip pretty
25 quickly beyond that and just -- and down -- we believe

1 it's going to be downhill from here as far as the
2 time -- the timing. We're hopeful that we'll get a
3 water resources bill that'll time right with our
4 September chief signing this year. And we're hoping
5 that -- what's going to cause -- is maybe we'll be doing
6 the preliminary engineering by next year. So hope
7 spring's eternal always for the local sponsor I know,
8 but it does kind of give you an idea of where we are in
9 the bigger scheme of things as we bring this Feasibility
10 Report and this EIS to its public meeting.
11 In '99, we mentioned earlier, '97, '99 time
12 frame, we did the reconnaissance phase to kind of see
13 were we going to do to feasibility. And I think it's
14 important to point this out. These bullets were right
15 from -- kind of what was driving us in -- kind of what
16 came out of the -- the reconnaissance study. And I
17 think these are worth noting, because you're going to
18 see we were pretty accurate with them.
19 The project was found to be, or at the
20 time, the project was found to be in the interest of
21 federal government, absolutely still is. The
22 benefit-to-cost ratio 1.2 to 1. You're going to hear
23 tonight some numbers that are going to jive with these
24 numbers that are about a decade old. So I think the
25 project, what we're seeing is and what I'm saying is

1 that it's fleshing out to be what we were expecting it
2 to be even a decade ago with a lot of changes. I think
3 Jan and them are going to go through a lot hurdles and a
4 lot of loops that changed as the process went along,
5 that public works process, to square nine, a lot work in
6 those nine squares. But you're going to see that things
7 were pretty accurate.
8 The one -- the one I do like to -- to point
9 out is just to give the Colonel one last time to -- to
10 let us buy it for $260 million. But we do think that
11 the price is going to be a little lower than that. But
12 that was leftover from the reconnaissance phase.
13 But the two big bullets that I think that I
14 want to land on, as far as how we kicked off the
15 feasibility were these two, which were -- those kind of
16 our action items from the reconnaissance phase, which
17 was at the end of the feasibility phase. And tonight
18 being part of that is to be able to have the Corps
19 describe and evaluate alternative plans. And you've
20 seen back there in the presentations, you're going to
21 hear a lot about it. I think Jan and her team and
22 Colonel and his team and Byron, they've done a great job
23 at fleshing out all the ways we could improve our
24 waterway. There's -- there's a lot of probable ways we
25 could have done it. I think they've gone through all

1 these turn -- alternatives. I think it was about 120 or
2 so, when it was all said and done. Quite a lot of work,
3 quite a lot of extensive study to do that. And then,
4 not just to throw out all those alternatives and bring
5 all of them to us and let the industry pick, but to kind
6 of boil that down and -- and to fully propose a
7 recommended project. And so I think you're going to
8 hear a lot of that tonight. And I don't think you're
9 going to be disappointed in that respect.
10 Some of the particulars as we went through
11 the feasibility phase is from the local sponsor's
12 perspective, and as we hold hands with the Corps of
13 Engineers, was that we cost shared the whole Feasibility
14 Study. We didn't put it all burden on the federal
15 government, 'cause we're asking the government to take a
16 look at our waterway. But at the same time, they
17 realize the importance federally of the waterway. So
18 they held hands with us on the cost of it, and we've
19 shared that. And it always would, and tonight
20 is -- will include the preparation of Environmental
21 Impact Statement. We always wanted that to be part of
22 our study. In 1912 that might not have been the case.
23 But I think we've grown quite a lot as far as the way we
24 look at our environment and the ecology of our waterway
25 as we look at doing improvements such as this.

1 Forty-eight months to complete the
2 Feasibility Study and the $7 million price tag on it
3 might have slid off of that a little bit. But I -- but
4 I want to leave with you with the idea that from the
5 local sponsor's perspective, we think we definitely are
6 going to get our money's worth out this product. And
7 out of the study that the Corps has put together, we
8 think it's great study, fine study. Might have taken a
9 little longer than we might have wanted overall, but I
10 think at the end of day, it's for a good reason. I
11 think it's going to be a -- you'll see, I think you'll
12 agree with me at the end of this that's it's a good
13 project. It's a fully vetted project. And we always
14 wanted it to be an open process. And so that's kind of
15 how we come here tonight, kind of where I'll leave you
16 tonight is we always wanted to fully identify the
17 stakeholders and urge their participation in it. I
18 think Jan did a magnificent job in getting all the state
19 and federal resources together. I mean, that is a huge
20 task. Because our waterway is unique in the sense of
21 its federal importance, plus it straddles two states.
22 You can just imagine all the things that went into that.
23 Some of you were part of that. So we encourage that.
24 We wanted that early on to continue to make this an open
25 process. And so I look forward to tonight, to your

1 comments as well. Local sponsor clearly is behind the
2 project, the way the Corps has been presented tonight.
3 And 100 percent happy to hear your comments on the
4 project. And I thank you for your time tonight and your
5 participation tonight.
6 MS. WILLEY: I'm Sheri Willey with the
7 Corps of Engineers. I'm the planning lead. I'm -- I
8 just want to go through the basic idea of how we did the
9 study and basic information for the study. It started
10 out with the study authority, that was in 1997. The
11 authority stated that the Corps should determine the
12 feasibility of modifying the channels to the Ports of
13 Beaumont, Port Arthur, and Orange. That was what
14 started the reconnaissance study that Clayton had
15 referred to. That began in 1998. And then from the
16 results of the reconnaissance study, we moved into the
17 feasibility phase, which started in 2000. This phase,
18 we're now at the point where we have the draft
19 Feasibility Report and the draft EIS, Environmental
20 Impact Statement, which is currently out for public
21 review.
22 Here's a list of those study participants.
23 As you can see, there's been coordination with a number
24 of agencies throughout the study process. Ms. Stokes
25 will address this coordination further in her portion of

1 the presentation. She'll go into a lot more detail.
2 The channel extends from the Gulf of Mexico
3 to the -- to the Port of Beaumont. The channel to
4 Orange portion of the waterway is -- was -- is not part
5 of the Feasibility Study. Here is the geographic limits
6 of the study area. It's a very, very large study area.
7 The GIWW that there is a portion of the GIWW, it extends
8 from Star Bayou on the west to Gun Cove Ridge on the
9 east. The Gulf shoreline that was studied extended ten
10 miles on each side of the channel. This area includes
11 two ports, the Port of Beaumont and the Port of Port
12 Arthur; two counties in Texas, Jefferson and Orange; two
13 parishes in Louisiana, Cameron and Cal- -- Calcasieu;
14 the Golden Triangle of -- of Beaumont, Port Arthur, and
15 Orange, as well numerous smaller cities and communities.
16 So it was a very wide study area. This is just an
17 example of some of the facilities at the Port of Port
18 Arthur and Port of Beaumont.
19 The existing study dimensions are listed
20 here. It currently is a 40-foot deep channel. It's
21 42 feet at the section out by the jetties. But
22 over -- we still refer to it as the "40-foot project."
23 It's divided into a number of reaches. And the total
24 length is about 64 miles.
25 The Feasibility Study has taken a number of

1 years, but this is because this project is one of the
2 most complex projects in the nation. The project area
3 is very large and involves, you know, the state of Texas
4 and Louisiana. In addition, the project area has
5 multiple water bodies: The GIWW, the Sabine-Neches
6 Waterway, Sabine Lake, the Neches River. With -- and
7 all of this has a complex salinity and circulation
8 pattern. So there was much to be studied.
9 The channel is the longest current channel
10 in the state of Texas at 64 miles. And with the
11 proposed project, would be approximately 76 miles long.
12 The deepening of such a channel will resort -- will
13 result in enormous amount of dredge material that either
14 has to be placed in upland or offshore placement areas,
15 or used beneficially.
16 The area also contains a very diverse
17 habitats from bottomland hardwoods to emergent wetlands
18 to open shal- -- shallow open water. All of these
19 factors have required a much more time-extensive study
20 effort to adequately evaluate potential project impacts
21 for the deepening of the waterway.
22 And when we start to look at the project,
23 we had -- we wanted to look at the problems and
24 opportunities. And we were looking at these three
25 categories: Navigation and commerce, environmental

1 concerns, and social and economic factors. Under
2 "navigation and commerce," the existing 40-foot depth
3 result -- results in draft restriction and affects the
4 navigation efficiency. The existing channel is designed
5 for loaded drafts of about 36 feet. The projected
6 increases in the Sabine-Neches Waterway commodity
7 transport will compound the existing problems with the
8 transportation efficiency. The majority of the tonnage
9 is carried in deep-draft vessels. And the vast majority
10 of the deep-draft traffic is compromised of crude oil
11 and petrochemical products. About three-quarters of the
12 crude oil tonnage is transported in vessels with design
13 drafts over the current project depth of 40 feet. Often
14 there is off-loading from the larger vessels offshore
15 that has to occur. And then the cargo is being brought
16 in by shuttle vessels. Also there's been transit rules
17 adopted by the Sabine pilots that result in daylight
18 only and one-way sailing restrictions for certain
19 conditions of the waterway.
20 For the environmental concerns, there was
21 salinity intrusion, loss or deterioration of wetlands,
22 the effects on water and -- or sediment quality,
23 increased inshore channel and Gulf shore erosion, and
24 beneficial use of dredge material. The definition of
25 "beneficial use of dredge material" would be that we

1 would use this material from either the construction of
2 deepening the channel or the maintenance of deepening
3 the channel in a beneficial way. And in this project,
4 we propose to use it to restore marsh and renourish the
5 Gulf shoreline.
6 Social and economic factors. The economic
7 effects of reduced transportation efficiency is one.
8 Also regional economic effects in Louisiana and Texas,
9 there could be economic growth, growth and development
10 with the deeper channel.
11 There's -- we also have to look at
12 potential impacts. The potential impact to the public
13 infrastructure -- excuse me. This includes the
14 Port Arthur hurricane protection levee, and then there
15 were various state highways and bridges that we had to
16 consider in the state. Also there is an increased taxes
17 required possibly to fund the channel improvements.
18 The Feasibility Study objectives. In 2000
19 we began the Feasibility Study and sponsored public
20 scoping meetings in Lake Charles and also Beaumont. The
21 planning objectives for the study were to improve the
22 navigation efficiency of Sabine-Neches Waterway while
23 maintaining or enhancing the affected area's coastal
24 estuarine resources.
25 The Sabine-Neches Waterway plays a

1 significant role in the economy of the Golden Triangle
2 area. The amount of vessel traffic along the waterway
3 is increasing with the economic growth of the area.
4 With the current channel dimensions, there are size
5 restrictions on the large vessels, which utilize the
6 channel. The current 40-foot depth and the channel
7 width restrict the vessel movement to one-way convoys or
8 daylight-only sailing. Tankers also must anchor
9 offshore and lighter their cargo into shallower drafts
10 that can be navigated, and that can navigate the
11 waterway. So all of these things were taken into
12 account to try to improve the navigational efficiency of
13 the waterway.
14 For the alternatives evaluated during the
15 screening, with any feasibility study we have to take
16 into account the no-action alternative. And that's
17 pretty self-explanatory, it's what would happen if
18 nothing was done. We'd have to take into account how
19 the, you know, if we just continue to maintain the
20 channel as it is right now.
21 Additionally, we looked at some
22 nonstructural alternatives. A traffic management
23 system, that is the system the Coast Guard, the Coast
24 Guard managed system. It's already in place, but we had
25 to take into account using that or, you know, fully

1 utilizing that system.
2 Also, the -- we had -- we looked into the
3 relaxation of the pilot rules, such as allowing some
4 two-way traffic in certain areas or different things
5 that would relax their rules somewhat. And see if that
6 would help the efficiency of the waterway.
7 And another of the nonstructural
8 alternatives we looked at were alternative mode of
9 commodity transport. Such as offshore terminals where
10 tankers can dock and connect to a pipeline to off-load
11 the product. Two of those that we looked at were the
12 Louisiana Offshore Oil Port (LOOP), which is existing.
13 And we also looked into the bulk oil offshore transfer
14 system BOOTS, which was proposed, but is not currently
15 an active project.
16 Structural alternatives. We looked at more
17 than 120 combinations of different channel depths and
18 widths. It would have taken up many, many slides. So
19 this is a very short summary. We've basically looked at
20 deepening to between 43- and 55-foot depths. And we
21 also looked at the widening from 500- to 700-foot for
22 all the different depths.
23 The tentatively recommended plan
24 consisted -- consists of deepening to 48-foot channel, a
25 dredge material management plan, beneficial use plan,

1 and marsh mitigation. The widening that we had looked
2 at earlier in the alternatives was not economically
3 justified, and therefore, it was removed from the study.
4 Here's some more details of the tentatively
5 recommended plan. As you can see, the entrance channel
6 would have to be extended out 13.2 miles offshore.
7 That's what would add the additional length on to the
8 channel when I said the 64 miles currently, and that's
9 to get to the proposed depth offshore.
10 Also there's some deepening and widening of
11 the Taylor Bayou channels and turn -- turning basins.
12 It's -- it's just -- it's not a full widening, it's just
13 partial areas that were of concern. It -- also adding
14 enlarging turning and anchorage basins along the Neches
15 River channel. And there were some -- there were also
16 some bend easings on the Sabine-Neches Canal and the
17 Neches River channel.
18 The long-term management of the dredge
19 material portion of the tentatively recommended plan
20 includes the maintenance material, which is going to
21 increase from on average 405 million cubic yards to
22 650 million cubic yards. The average annual cost
23 increase will go from 36 to 68 million. There will be
24 16 existing upland placement areas for this plan and two
25 expanded placement areas. Additionally, there are going

1 to be four of the -- the existing offshore placement
2 areas, as well as four new offshore placement areas.
3 And the tentatively recommended plan construction cost
4 is on the screen, one, uh-huh, one billion. And the
5 benefit-to-cost ratio is 1.3 to 1, which I know Clayton
6 pointed out when he had a slide that it -- the
7 reconnaissance that was a 1.2 to 1 benefit-cost ratio.
8 And now Jan Stokes will present the
9 environmental portion of the study.
10 MS. STOKES: I'm not as tall. I want you
11 to know that we are very aware of the sensitive nature
12 of the wetlands in this area. This -- one of the
13 greatest challenges of this study was determining what
14 the potential environmental effects of the -- of the
15 deeper navigation channel would have on the extensive
16 wetlands in the area. There are 400, about 440-square
17 mile of coastal marsh. And on -- and this is in both
18 Texas and in -- in Louisiana, about 26 square miles of
19 Cypress-Tupelo swamp and 14 square miles of bottomland
20 hardwood. And all of this was considered in all of the
21 environmental work that we did -- did in analyzing the
22 effects of the this project.
23 There -- the study area also includes
24 several protected areas. We have portions of the Sabine
25 National Wildlife Refuge and the Sabine Island Wildlife

1 Management Area in Louisiana. The study area also
2 includes all of the Texas Point National Wildlife
3 Refuge, the Blue Elbow Swamp Wildlife Management Area,
4 and the Lower -- Lower Neches Wildlife Management Area
5 in Texas and portions of the J. D. Murphree Wildlife
6 Management Area, and the McFaddin Wildlife Refuge.
7 We recognize in our studies that -- that
8 the wetlands in this area have been undergoing high
9 rates of -- of marsh loss like those in Louisiana and in
10 the Western Chenier Plain in Louisiana. And -- and more
11 recently have suffered additional impacts from the
12 Hurricanes Rita and Ike. Because of the extensive
13 sensitive wetlands in the area and the large size of the
14 study area, we chose a collaborative approach in
15 determining what the impacts would be and eval- -- and
16 evaluating what would be an appropriate mitigation plan.
17 We formed what we call an "Interagency
18 Coordination Team," or ICT for short. And all of these
19 agencies helped us evaluate impacts and plan mitigation.
20 We have a suite of federal agencies, prominently
21 U.S. Fish and Wildlife -- U.S. Fish and Wildlife and EPA
22 and National Marine Fisheries. And then we have a -- a
23 full suite of agencies from both Texas and Louisiana,
24 Texas General Land Office, Texas Commission on
25 Environmental Qual- -- Quality, Texas Parks and

1 Wildlife, Texas Water Development Board, Sabine River
2 Authority. In Louisiana we have Louisiana Department of
3 Natural Resources, Department of Environmental Quality,
4 and Department of Wildlife and Fisheries.
5 Representatives from all these agencies
6 helped us in the planning study. We also included a lot
7 of the -- the managers from all of the -- the wildlife
8 management areas and refuges in all of our
9 considerations.
10 From -- Sheri listed some of the
11 environmental concerns that we had in studying this
12 project. And we evaluated them with an extensive amount
13 of technical studies. And I'm not going to go through
14 each one of these here. But some of the most
15 significant, are a three -- three-dimensional
16 hydrodynamic salinity modeling study that helped us
17 determine what the salinity impacts are likely to be
18 with the project. We looked at what effects there might
19 be on the shoreline of a longer navigation -- navigation
20 channel into the Gulf. We looked at the potential
21 effects of the new vessel fleets that would be using the
22 waterway on erosion in certain parts of the channel. We
23 looked at the potential for additional contaminants. We
24 modeled placing the material in the new offshore
25 placement areas, what the effect would be and in -- we

1 used modeling to determine the size that we needed to
2 have. Also, very significantly we used ecological
3 modeling to determine what -- what to -- to quantify
4 what the environmental impacts would be and to help us
5 determine what was the amount of mitigation that would
6 be required. What we -- the -- the modeling that we
7 used, the -- the model that we used is the same model
8 that has been used for about 15 years in Louisiana to
9 model CWPPRA project studies -- CWPPRA projects. And so
10 it's a well recognized model in this area. We also did
11 air modeling, air emissions modeling to determine if
12 there would be any air impacts during construction. We
13 did surveys for threatened and endangered species and
14 for cultural resources, archeological sites and -- and
15 shipwrecks.
16 Do you know what, I -- when I deleted, I
17 deleted the wrong slide. Okay. I'm going to tell you
18 the primary impact of this -- that we found was an
19 increase in salinity caused by the deeper navigation
20 channel. And this leads to a decrease in marsh
21 productivity and an increase in marsh land loss. Go
22 ahead. Skip that one. There we go. And go on.
23 The salinity changes are greatest in the
24 Sabine Lake, Port Arthur areas, and in the lower reaches
25 of the Neches and Sabine Rivers. We found negligible

1 impacts on the -- on the upper rivers north of I-10 and
2 the habitats for the swamp and bottomland hardwood. If
3 in -- however, we did identify -- point -- 1-1/2 to
4 2 parts per thousand increase in the lake and in the
5 lower -- the lower rivers. There's not much impact at
6 all in the southern parts near the -- near the
7 shoreline.
8 We used the -- the ecological model to
9 estimate what this additional salinity, what the impact
10 it might have on land loss. And these are the -- the
11 estimated -- this is the estimated increase in land loss
12 from the salinity. It was a -- a total of about
13 938 acres of loss in the study area, 691 acres in
14 Louisiana, and 247 in Texas. I want to point out that
15 this is a small, less than 1 percent, increase over what
16 we would expect in the area that is occurring now.
17 We -- there is a large land loss that occurs in this
18 area now, and the additional land loss would be a small
19 percentage.
20 When -- we are also planning to use a lot
21 of material beneficially to restore marsh. And when we
22 do that, we will be building about 2,800 acres of marsh,
23 which will more than offset the amount of -- of acres
24 that would be lost with the project. However, all of
25 this beneficial use of the restoration of marsh is in

1 Texas. And that leaves the 691 acres in Louisiana
2 without compen- -- with -- without -- without
3 compensation. And so we have developed an extensive
4 mitigation plan to -- to compensate for those -- those
5 losses.
6 There were some other minor environmental
7 effects. There is one wetland on the Neches River that
8 is being taken for the expansion of one of the placement
9 areas. That would convert 86 acres of marsh to the
10 placement area. And that -- that is included in
11 the -- the -- the impacts that I mentioned on the -- on
12 the slide before. There is also potential for impacts
13 to threatened and endangered sea turtles with all of the
14 offshore dredging that we do with the hopper dredges.
15 So we have developed management measures using draghead
16 deflectors. Yeah, let's see, monitoring on -- on the
17 boat during the -- during the dredging and relocation
18 trolling prior to the dredging to -- to keep the loss of
19 -- of sea turtles to a minimum. There is wintering --
20 there is critical habitat for the Piping Plover over
21 wintering at Louisiana Point. The beneficial use
22 project that we have there should help stabilize that
23 shoreline and provide protection -- additional
24 protection for the habitat that is there. And so we see
25 that as a long-term beneficial effect.

1 There are two major beneficial use features
2 that we're proposing with this project. One is
3 extensive restoration of degraded marsh on the Neches
4 River in three areas: Rose City, Bessie Heights,
5 and -- and Old River Cove. This is -- would result in
6 over 2,800 acres of new restored emergent marsh in this
7 area. In the others, Gulf shoreline beneficial use, in
8 both -- at both Texas Point and Louisiana, this would
9 use maintenance material to -- and that would be placed
10 along the shorelines to add material back into
11 the -- into the -- into the littoral drift and help with
12 the erosion -- high erosion rate in Texas and just
13 provided additional stabilizing material for the
14 Louisiana side.
15 This is a map of the Neches River areas.
16 Rose City is on the left side, upstream part of your
17 map. Bessie Heights and Old River are down near
18 the -- the mouth of -- of the Neches River. The Old
19 River Cove area is on Texas Parks and Wildlife property
20 for the most part. And the -- I think the Rose City and
21 Bessie Heights, these are on private property. The next
22 slide.
23 These are the locations of the proposed
24 beneficial use shoreline nourishment projects. They're
25 three miles on either side of the jetties. They -- each

1 side would -- would have material placed on the
2 shoreline every six years. And the material is coming
3 from Sabine Pass. It's coming from both states, and so
4 it would be used equally. The quantities would be split
5 equally between two states. The -- as I mentioned
6 earlier, the -- all the restoration, the beneficial use
7 features in -- in Texas, it fully compensates for all
8 the salinity and land loss impacts of the project in
9 Texas. It -- it more than compensates for it. But
10 there are unavoidable impacts in Louisiana that we were
11 unable to use. We were unable, although we searched
12 diligently. We were unable to find any beneficial use
13 projects that would offset those losses.
14 And so we are proposing to restore marsh in
15 five areas in Louisiana. Two are in the Willow Bayou
16 Watershed, and three are in the Black Bayou Watershed.
17 Here are numbers from the restored emergent marsh. In
18 each of the areas, as you'll see it's nearly 2,800 acres
19 of restored marsh in total in Louisiana. These are
20 the -- this is a map of the locations, the loca- -- the
21 Willow Bayou Watershed is in the -- in the bottom part
22 of the picture. That's in the Sabine National Wildlife
23 Refuge. The areas to the north are on private property.
24 That -- and that's Black Bayou Watershed.
25 And here we are. This is the estimated

1 completion, this our schedule for the remainder of the
2 study. The -- the reports were released for -- for
3 comment on the 24th of December. We -- comments are due
4 back to us on the 10th of February. And we hope to have
5 a review of the final EIS in August of this year
6 followed by approval of a chief's report in September.
7 Thank you.
8 MR. WILLIAMS: Okay. Before we start, I
9 would just like to remind everyone to be mindful of the
10 time again. And to turn off your cell phones or put
11 them on vibrate if you have them. In addition, just
12 like remind that this is not a question, ask, and answer
13 period. It's just a vent for you to say your comments
14 so we can record them. And your comments will be
15 addressed in the EIS. Right, Colonel.
16 COL. WESTON: Okay. Thanks, Byron. And
17 thanks to the folks that made those presentations. As
18 Byron just mentioned, we're go through the comment
19 period now. And then we'll start off with public
20 officials that are here and then go to general public at
21 large. So first of all, I'd like to invite Mr. Fred
22 Jackson from Jefferson County Judge's -- County Judge's
23 Office to --
24 MR. JACKSON: I'll waive comment.
25 COL. WESTON: Okay. And then we also have

1 Justin Veillon from Congressman Kevin Brady's office.
2 Like to make a statement?
3 MR. VEILLON: We have no comments at this
4 time.
5 COL. WESTON: Okay. And then Scott Hall
6 from the Lower Neches Valley Authority. Care to make a
7 statement?
8 MR. HALL: No comment.
9 COL. WESTON: All right. That was easy.
10 Okay. And we're going to go to the -- the public
11 comment period now, I have my notebook here. Okay.
12 Again, as Byron mentioned, we'd like you to, you know,
13 try to -- try your best to limit your comments to three
14 minutes. That means you, you know, you got to be pretty
15 succinct with your ideas and your thoughts on the
16 project. Specificity in -- in what your issue is with
17 the project would be great. And then Byron's going be
18 the time keeper. And he'll give us the high sign at
19 about 30 seconds out. And so if you could close up
20 that -- that thought that you're trying to express at
21 that point in time, and then we'll move on to the next
22 feature -- next speaker, really appreciate it. I would
23 tell you, three minutes is going to fly by for you. And
24 it is a pretty short period. But you have -- you have
25 time. And I'll talk about that a little bit later to

1 provide us more detailed comments in this process after
2 tonight's meeting. So -- so you'll have time to expand
3 on -- on those thoughts and ideas that you express here.
4 So -- okay. We're going to start with the public
5 comments. And the first individual I'd like to call on
6 is Mr. David Corban.
7 MR. CORBAN: Good evening. My name is
8 David Corban. I'm a lawyer with Fulbright & Jaworski,
9 L.L.P. And I'm authorized to make the following
10 comments on behalf of Shell Pipeline, Explorer Pipeline,
11 Enterprise Products, Kinder Morgan, and the other
12 members of the Texas Energy Coalition. The Texas Energy
13 Coalition was founded in 1995. And its membership is
14 made up of pipeline transmission companies that work
15 together on issues of common interest.
16 Prior to the release the Sabine-Neches
17 Waterway Draft Feasibility Report or DFR on
18 December 24, 2009, there was no prior communication by
19 the sponsors of the proposed project with the pipeline
20 industry regarding pipeline relocation issues. This was
21 the case, despite repeated requests to the Corps of
22 Engineers for information about the proposed project's
23 potential impact on the pipeline industry.
24 The DFR that was made available for the
25 first time in late December, describes a large number of

1 pipeline relocations that the project will require. The
2 replacement of pipelines to transport essential
3 commodities, such as natural gas, not only is costly but
4 also requires years of advance planning and coordination
5 and creates operational and engineering burdens for an
6 industry that has strategic significance to the American
7 economy. Yet the DFR provides little detail about the
8 project's impact on pipeline operations, which pipelines
9 will be need to be relocated, where those pipelines are
10 located at the present time, or costs are estimated for
11 pipeline relocations.
12 Given these circumstances, we do believe it
13 is unrealistic to expect that our members could provide
14 any meaningful comments on the DFR by
15 February 10th, 2010. We believe that a more realistic
16 comment period would allow at least 120 days. And we
17 therefore respectfully request that the comment period
18 be extended to at least April 26, 2010. In making this
19 request, we assume that the Corps will promptly and
20 definitively identify the pipelines that will need to be
21 moved, the owner of each such pipeline, and sufficient
22 information to enable us to understand and respond to
23 the Corps' estimate of the cost for moving such
24 pipelines.
25 Based upon the DFR, we do understand the

1 Corps of Engineers to have acknowledged that this
2 project, as proposed, would be a deep-draft project for
3 cost sharing purposes. And further, as required by the
4 deep-draft cost sharing provision of the Water Resources
5 Development Act of 1986, that the Corps will recommend
6 that half of the pipeline relocation cost for this
7 deep-draft project be borne by the pipeline owner. And
8 the other half by the local sponsor for the project. We
9 appreciate the opportunity to comment on this project.
10 COL. WESTON: Okay. Thank you. Next, I'd
11 like to call Ms. Linda Mathews.
12 MS. MATHEWS: I'm Linda Mathews. I
13 represent Enterprise Products Company here tonight. I
14 appreciate the opportunity to comment. We did get the
15 Feasibility Study the end of December. We have several
16 departments right now trying to investigate the -- which
17 pipelines are involved and make sure we have all of them
18 identified. And we do not believe that we will be able
19 to get that together by February 10th with any
20 meaningful comments. And so we would just like to
21 concur with the Texas Energy Coalition, the request for
22 a 120-day extension. Thank you.
23 COL. WESTON: Thank you. Next will be
24 Mr. Ronald Moon.
25 MR. MOON: Yes, my brother and I had a

1 dredge material containment area No. 11 on Pleasure
2 Island leased for five years. We did studies with Lamar
3 University and Texas A&M. Spoil in No. 11 is on the
4 north end of lake. And if these dredge material
5 containment areas are built like this design, they can
6 be beneficial. I'm not against the dredging. I'm just
7 pointing out the problems that these dredge sites have
8 from the intercoastal waterway from Galveston all the
9 way to Mississippi. I realized all these studies that
10 you've already done. Is there anybody going to be doing
11 studies as the dredging is done on the impact on the
12 fisheries? Because we have witnessed shrimp kills, fish
13 kills right there on the dredge material compartment No.
14 8 on Pleasure Island. We have got experience in these
15 areas for 32 years now that we've been watching them,
16 and fishing in them, and being out there all the time.
17 We've witnessed all this stuff. Now, you combine those
18 with all the dredge material containment areas all the
19 way up in the coastal canal, it's got a devastating
20 effect on the fisheries. Because high tides and storms
21 put the fish in these compartments, and they become
22 trapped, and they die. We've reported it to the Corps
23 on the island several times, and they come out and say,
24 "Well, that's going to happen." This is 2010.
25 Something's got to be done. These areas have to be

1 managed and watched properly. The placement spoil and
2 dredge material containment No. 8 is not being watched.
3 The south effluent ditch was filled completely with
4 silt. So the last two dredging operations in there, the
5 maintenance dredging, the water had not enough area to
6 be released. It all had to go through the north
7 effluent ditch. And it overflowed the road in two of
8 their dredgings. That's not supposed to happen. So
9 something needs to be done, and more management needs to
10 be done. But it definitely has an impact. And it has
11 for years. Has there been any marine biologist done
12 studies on the actual dredge material that's being dug
13 up off the bottom? What are the organisms involved,
14 marine life that's being dredged out of the channel?
15 Because we know what's on the top and bottom of the
16 soil. There's a lot more I'd like to say, but I don't
17 have time.
18 COL. WESTON: Thank you. Next will be
19 Mr. Dennis Moon.
20 MR. D. MOON: I'll waive mine.
21 MR. MOON: Okay. We tried to get his three
22 minutes, but they wouldn't let me.
23 COL. WESTON: And again, I know these times
24 are short. Like I said, there's -- there are other
25 avenues to talk about here shortly to -- to expand on

your -- on your comments for us. Next I'll follow with Mr. John Whittle.

MR. WHITTLE: Thank you. I, too, would like to suggest that February the 10th is a very short deadline. And three minutes is a very short time to comment on a 2,286-page EIS and other documents. My name is John Whittle. I'm secretary of the Golden Triangle Audubon Society and sitting on other Audubon boards. However, I need to stress that these comments have not yet been endorsed by any Audubon unit, because there's not been time since we received them.

My major concern is the coastal marshes and wetlands and Sabine Lake and the wildlife that uses them be protected from the adverse effects of increased salinities and unnatural increased water flow as from the Gulf under all conditions, both normal and abnormal, such as major hurricanes. Fully understand the beneficial function of coastal marshes and attenuating the inflow of water from tropical storms and hurricanes, but equally understand that they will not do this if they have already been degraded by the time of the event. This requires that salinity levels not be allowed to increase, the existing channels not be exposed to increased exchange with Gulf salt water.

The first real issue I have is one of

1 alternatives. The only alternative to no action that is
2 comprehensively addressed are those which the only
3 difference is the depth to which it's proposed to raise
4 the channel. These are in the larger picture, only
5 relatively small changes and one major alternative. I
6 believe the need for and common sense requires a broader
7 approach to the issues so that an outcome that solves
8 the problem that is the best possible from an
9 environmental's perspective can be selected.
10 The first obvious alternative we can
11 discuss in the draft document, involves an offshore oil
12 terminal after the manner of the -- the LOOP, the
13 Louisiana offshore project. This is has been
14 successful, involved vanishing small environmental
15 impact during construction and operation. They survived
16 two or three major hurricanes without environmental
17 damage, being restored to full commercial operation in
18 remarkably short times. Such a port could be located so
19 as to be capable of accommodating the very large crude
20 carriers up-to-date. While the proposed increase in
21 depth and channels in Sabine-Neches will only have a
22 comparatively small effect on the capacity of time
23 'cause they can be accommodated. This alternative is
24 dismissed in the draft document with minimal discussion.
25 Founded in part because the proponents for such a port

1 have not yet coalesced into a partnership with the
2 resources and desire to pursue it in an immediate future
3 and a Sabine-Neches-related location. However, I do not
4 believe they should prevent it being a third alternative
5 and a need for EIS. It is also indicated that such a
6 port would not address the prime objective increasing
7 the efficiency of the waterway system, because it would
8 serve only one commodity, namely oil. The nu- -- yet
9 it's clear, the root cause of any efficiency is the
10 number of oil tankers using the system. And there is no
11 significant demonstrated need to use larger drafts. If
12 the tanker traffic is removed from the waterway system,
13 basic traffic will be cut to a fraction of its current
14 volume, and the inefficiency will be no more.
15 I wanted to go on, Mr. Chair -- Chairman,
16 and say something about the increased effects of
17 increased water flow up a bigger channel during
18 hurricanes to the detriment of all the areas around
19 Sabine Lake, Bridge, City, Orange. The MRGO in New
20 Orleans was recently closed, and the Corps lost a court
21 decision who was responsible for the Katrina disaster.
22 And the Corps was found liable having not looked after
23 the marshes that surrounded the MRGO and not doing a
24 good EIS in the first place. I will submit further
25 comments in writing. And I appreciate the opportunity,

however brief, to address this.

COL. WESTON: Next I'll call Mr. Richard Harrel.

MR. HARREL: My name is Richard Harrel. And I'm with a citizen's environmental group, Clean Air and Water Incorporated. It's been active in this area for the past 40 years. My statement will be very, very short in that I will say ditto to Dr. Whittle's remarks.

COL. WESTON: Thank you. Next will be Mr. James Kaucher.

MR. KAUCHER: I'm Jim Kaucher. I'm the plant manager at the Sabine Pass LNG. And Cheniere and Sabine Pass LNG Terminal strongly support the proposed deepening and widening project of the Sabine-Neches Waterway. We wish to see our waterway remain highly competitive with other ports and waterways by being able to accommodate the larger ships that now carry so much of the world's trade with a higher degree of safety.

Of course, for our part we are most interested in promoting the capability of the Sabine-Neches Waterway to safely handle the world's largest existing LNG carriers. These ships are nearly 1,150 feet in length and 180 feet in breadth. These very large LNG carriers, like the other large ships trading into our area, are presently limited to a

1 40-foot freshwater depth when entering the
2 Sabine-Neches. Many such vessels would come in deeper
3 if the water -- waterway channels were deeper and wider.
4 Any deepening or widening will make our waterway a more
5 competitive for business that uses the larger ships and
6 automatically adds additional safety margins for the
7 existing shipping already present.
8 Cheniere supports the project and the
9 U.S. Army Corps of Engineers and hopes the deepening and
10 widening work will proceed without delay.
11 COL. WESTON: Thank you. Next will be
12 Mr. Chris Fisher.
13 MR. FISHER: My name is Chris Fisher. I'm
14 the port director of the Port of Beaumont. We manage
15 the public docks and wharves of the Port of Beaumont.
16 We are located at the very top end of the Sabine-Neches
17 Waterway. So the transportation efficiency of the
18 waterway is very important to us. Our sole mission is
19 to generate and create jobs for our area and generate a
20 positive economic impact.
21 The public docks are more directly a small
22 portion of the total economic activity that takes place
23 along the waterway. We handle about 200 deepwater
24 vessels, about 25,000 railcars, and 15,000 trucks
25 through the port, annually 3 to 4 million tons. This

1 generates about 2,000 jobs annually, about 150 million
2 in economic impact.
3 The transportation efficiency that this
4 channel -- that this project provides is greatly needed
5 to the Port of Beaumont, not only to allow us to grow
6 and satisfy our mission of -- of generating creating
7 jobs, but we're also the number one strategic port in
8 the country and handle more military cargo than any
9 other port in the U.S., and second in the world in
10 support of our troops in national defense. Therefore,
11 the transportation and navigational safety on the
12 waterway that this project provides is certainly very
13 important to us, and the Port of Beaumont has been a
14 strong supporter of this project since its inception.
15 And we strongly applaud the work the Sabine-Neches
16 Navigation District and the Corps has done to bring the
17 project to this point. Thank you.
18 COL. WESTON: Thank you. Next will be
19 Ms. Gina Dorsey.
20 MS. DORSEY: Good evening. I'm Gina Dorsey
21 from Kinder Morgan. I concur with the comments that
22 were presented by Fulbright & Jaworski. My question is:
23 Of course, there are numerous pipeline companies
24 affected by this project. And of course, we would have
25 to go through a series of planning and design and all

1 that to get the pipelines removed or relocated as part
2 of this project. And my question is more on the -- on
3 the extent of the permitting process for that.
4 Typically we had to go through surveys and planning
5 associated with those permits. Will the permits for the
6 pipelines that we have to remove or relocate be somewhat
7 relaxed or automated if they are done as part of this
8 project? That's my comment or question.
9 COL. WESTON: Okay. And -- and again,
10 we're not going answer the questions --
11 MS. DORSEY: Right.
12 COL. WESTON: Tonight. But -- but we'll
13 take a look at those and -- and get the appropriate
14 answers. I don't have anymore cards here. So the first
15 thing I'd ask, is there anybody here who didn't a chance
16 to turn in a card that would like to stand up and make
17 a -- make a comment on the -- on the project? Okay. So
18 we've gone through the list of cards.
19 And -- and again, I tell you, we welcome
20 your comments and -- and -- and constructive criticisms
21 of the work that we've done. And we look forward to
22 seeing those in further detail if you didn't get a
23 chance to -- to obviously make full comments. And we
24 understand it's a very technical report. It's a -- and
25 very lengthy. And so we look forward to seeing the

1 further comments that you may have as we go through
2 the -- the public process here.
3 In conclusion, the written comments on the
4 Draft Feasibility Report, the draft DIS, the draft DIS
5 for the designation of the ocean dredge material
6 disposal sites currently must be received on or before
7 February 10th, 2010, which is the conclusion of the
8 45-day comment period that began on December 24th of
9 2009. Comments on the air conformity determination must
10 be received on or before February 26th, 2010.
11 In closing, I'd like to thank the
12 Sabine-Neches Navigation District for their efforts and
13 assistance, not only as partners for the Feasibility
14 Report to date, but for their efforts and assistance for
15 setting up this meeting for us here. And I'd like to
16 thank each and every one of you for your attendance and
17 expressing your interest in the outcome of this project.
18 So again, we look forward to getting your comments
19 further clarified. And we -- and we hope folks that
20 didn't get a chance to come tonight will also provide us
21 those inputs. The information on how to do that is
22 in -- is in some of the brochures in the back. So thank
23 you very much for coming out. And this concludes the
24 meeting, and it is adjourned. Thank you.
25 (The meeting concluded at 8:07 p.m.)

1 THE STATE OF TEXAS :
COUNTY OF JEFFERSON :
2
3 I, ADA V. CHRISTY, a Certified Shorthand
4 Reporter in and for the State of Texas, do hereby
5 certify that the facts as stated by me in the caption
6 hereto are true; and same were reduced to typewriting
7 under my direction; that the above and foregoing meeting
8 as set forth in typewriting is a full, true, and correct
9 transcript of the proceedings had at the time of taking
10 of said meeting.
11 I further certify that I am not, in any
12 capacity, a regular employee of the party in whose
13 behalf this meeting is taken; and I certify that I am
14 not interested in the cause, nor of kin or counsel to
15 either of the parties.
16 GIVEN UNDER MY HAND AND SEAL OF OFFICE, on
17 this, the _____ day of February, 2010.
18
19
20
21 ADA V. CHRISTY, CSR, RPR
22 Texas Certification No.: 5141
Expires: 12-31-11
23 Reliable Court Reporting
CRCB NO.: 164
24 2626 Calder, Suite 205
Beaumont, Texas 77702
25 (409) 832-1776

SABINE-NECHES WATERWAY PROJECT

US ARMY CORPS OF ENGINEERS

JANUARY 27, 2010

7:00 P.M.

LAKE CHARLES CIVIC CENTER

JEAN LAFITTE ROOM, THIRD FLOOR

LAKE CHARLES, LOUISIANA

1 A P P E A R A N C E S

2

3

4 Janelle Stokes - US Army Corps of Engineers

5 Sheri Willey - US Army Corps of Engineers

6 Byron Williams - US Army Corps of Engineers

7 Col. David Weston - US Army Corps of Engineers

8 Randall Reese - Sabine-Neches Navigation District

9 Clayton Henderson - Sabine-Neches Navigation District

10 Arthur Janecka - US Army Corps of Engineers

11

12 Reporter: Betty Curry Minton, RPR, CCR

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1 P R O C E E D I N G S,

2

3 MR. REESE: We would like to go ahead and
4 get started. Good evening, my name is Randall Reese.
5 I'm the general manager of the Sabine-Neches Navigation
6 District. We're the local sponsor for the US Army
7 Corps of Engineers for the Sabine-Neches Waterway. At
8 this time, I'd like to introduce the other members of
9 the Navigation District that are here with us tonight.
10 We have Paul Beard our board chairman and Joe Johnson
11 is here with us tonight, one of our commissioners here
12 with us. We have Clayton Henderson here with us, our
13 assistant general manager.
14 We have a good presentation to present
15 tonight and without any further delay, I'd like to go
16 ahead and introduce Colonel David Weston. He is with
17 the Galveston District US Army Corps of Engineers.
18 COL. WESTON: Thanks, Randy. Good evening,
19 ladies and gentlemen. I'm pleased to be here tonight.
20 As Randy mentioned, I'm Colonel Dave Weston. I'm the
21 Commander of the US Army Corps of Engineers District in
22 Galveston, Texas. And I'm here to talk to you tonight
23 and welcome you to the public meeting of the
24 Sabine-Neches Waterway Channel Improvement Project.
25 Specifically, we're going to present

1 information and accept public comment on the following
2 draft documents that were released for public review on
3 December 24th, 2009; The Draft Feasibility Report for
4 the Sabine-Neches Waterway Channel Improvement Project
5 Southeast Texas and Southwest Louisiana; The Draft
6 Environmental Impact Statement for the Sabine-Neches
7 Waterway Channel Improvement Project for Southeast
8 Texas and Southwest Louisiana; The Draft Environmental
9 Impact Statement for the Sabine-Neches Waterway Channel
10 Improvement Project, The Ocean Dredge Material Disposal
11 Site Designation and the Draft General Conformity
12 Determination Sabine-Neches Channel Improvement
13 Project.
14 And for the record, I'd like to state this
15 public meeting is being convened at 7:00 p.m. on
16 January 26, 2010 at the Lake Charles Civic Center in
17 Lake Charles, Louisiana.
18 As you know or are learning here tonight,
19 the Corps of Engineers and the Sabine-Neches Navigation
20 District have been performing a study analyzing the
21 potential modification to the portion of the
22 Sabine-Neches Waterway that serves the ports of
23 Beaumont and Port Arthur, Texas. The two objectives
24 were identified for the study. These objectives were
25 improvement and navigational efficiency along the

1 Sabine-Neches Waterway and maintain the ecological
2 value of coastal and estuary sources within the project
3 area.
4 The cost effective plan as been identified
5 by the study that meets these objectives. This plan
6 will be referred to as the tentatively recommended and
7 locally referred plan will be described by study team
8 members in the following presentations.
9 We are specifically seeking input tonight
10 concerning the plan and associated environmental impact
11 that are described in these documents. I hope that all
12 of you have had an opportunity to read the announcement
13 of the public meeting either on our Galveston District
14 webpage or any individual announcements that were
15 mailed to individuals, agencies, organizations and news
16 media believed to have an interest in these
17 proceedings. The meeting notice was also published in
18 the Beaumont Enterprise in Beaumont, Texas and the
19 Southwest Daily News here in Lake Charles.
20 An additional fact sheet is also available
21 at the entrance here as you came in. The announcement
22 mailing list and a list of those present tonight will
23 be made a part of the record of this meeting. A court
24 reporter is here who will transcribe these proceedings
25 and all public comments.

1 Before we go any further, I'd like to
2 introduce those members of my District that are here
3 tonight representing the Corps of Engineers. Starting
4 with Mr. Arthur Janecka, who is my deputy district
5 engineer. Mr. Dolan Dunn who's my chief environmental
6 and regulatory; Ms. Carolyn Murphy my chief of the
7 environmental section; Mr. Byron Williams, my project
8 manager for the Sabine-Neches Waterway Study; Ms. Sheri
9 Willey our planning lead; Ms. Gloria Appell our
10 economic lead; Ms. Janelle Stokes our environmental
11 lead; Ms. Nancy Young project engineer; and Ms.
12 Samantha Lambert our hydrology and hydraulics engineer.
13 Now, I'll turn the meeting over to Mr. Byron Williams,
14 the project manager. He's going to describe the ground
15 rules for tonight's meeting and we will proceed from
16 here. Thank you.
17 MR. WILLIAMS: Thank you, Colonel Weston.
18 First, I'd like to ask did everyone fill out an
19 attendance card. We not only use an attendance card to
20 record your attendance but we also use them to
21 determine who would like to make a comment. So if
22 anyone doesn't have a card and you would like one,
23 please raise your hand. One will be brought to you.
24 Okay. Those who have filled out a card, you will be
25 given an opportunity to speak after all presentations

1 have been made. And if you do not wish to speak but
2 you would still like to make a comment, we also have 8
3 1/2 by 11 comment cards which you can fill out and
4 place in one of the baskets that we have in this room
5 or you can email or you can snail mail us. So if
6 anyone would like one of those comment cards, please
7 raise your hand. Okay. Thank you.
8 We want to emphasize that this is not a
9 voting contest simply to determine if you are for or
10 against the project tonight. So I would like to start
11 with the format. First, I'm going to introduce
12 Mr. Clayton Henderson, the assistant general manager
13 for the Sabine-Neches Navigation District he will be
14 giving you the project introduction; followed by Sheri
15 Willey, she's our planning lead. She's going to talk
16 about the planning study; and then followed by Ms.
17 Janelle Stokes. She's the environmental lead and she's
18 going to discuss the summary of the environmental
19 study.
20 Afterwards Colonel Weston is going to open
21 the floor for comments. First, he's going to recognize
22 federal and state officers. Then he'll recognize
23 federal and state resource agencies. Thirdly, he'll
24 recognize any individuals who have filled out comment
25 cards and would like to speak.

1 Again I'd like to remind you anyone who has
2 requested to speak will have an opportunity tonight. I
3 would like to ask you during the comment period that
4 you be courteous and have your phones off or on
5 vibrate, do not talk and please hold the applause and
6 or reactions until afterwards so that we can maintain
7 order at the meeting. Each comment period will be
8 three minutes. When 30 seconds are remaining, I'll
9 raise my hand at the table. Please act accordingly and
10 adjust your speech to finish in 30 seconds. A mic will
11 be brought to you when it is time to speak. You may
12 stand up at your chair. That's our mic. Okay.
13 Without further ado, I'd like to introduce
14 Mr. Clayton Henderson of the Sabine-Neches Navigation
15 District. Thank you.
16 MR. HENDERSON: Thank you, Byron. My name
17 is Clayton Henderson. I'm the assistant general
18 manager for the Sabine-Neches Navigation District.
19 We're the local sponsor to the Army Corps of Engineers
20 for the Sabine-Neches Waterway Project. So what I'd
21 like to do before we get into the technical aspect that
22 you're going to hear tonight is give you an idea of
23 what the project looks like through the local sponsors
24 eyes and what brings us here tonight.
25 I'd like to start with just a little bit of

1 the projects history. I know it seems this is the
2 first time we've done an improvement project on the
3 Sabine-Neches Waterway. Because it's been quite a
4 while, almost 50 years, since we've done an improvement
5 project.
6 You can see by the slide we're pretty good
7 at it. We've been doing it for quite a while. In
8 1912, we did the first improvement project. Took a
9 meandering river and dug it to about 25 feet,
10 straightened some of the bends and curves all of the
11 way up to the Beaumont channel, and we've done it five
12 times total. Hopefully, the sixth time will be this
13 year in 2010. That's kind of what brings us to
14 tonight. I wanted to point out that it may seem that
15 the improvement project is new for all of us. It may
16 be new to this generation, but it's not a new thing to
17 the waterway to the project itself, and we've become
18 pretty good at improving the project both from an
19 economical standpoint but we believe also from an
20 environmental standpoint. I think you're going to see
21 a lot of that tonight as they give you the details.
22 We've definitely learned our lessons as
23 we've gone since 1912, and I think you're going to see
24 the best product put forward tonight, both economically
25 and environmentally.

1 As I said, the project has a long history.
2 The total involvement started back in 1875. The local
3 sponsor was designated in 1909 for that first
4 improvement project and since then, it's always been,
5 we believe, a perfect coordination as far as the
6 federal project goes. Although the federal government
7 pays for the lion's share of the maintenance of the
8 project. The local sponsor has a big hand in paying
9 for the real estate or the placement areas where you
10 put the dredge material that you dredge out of the
11 channel and then industry kind of plays the other part
12 of that perfect triangle and paying their share of
13 their terminals and when they dredge their terminal
14 anything that is outside of the federal footprint. So
15 we do believe that the way our project was engineered,
16 the one we're living with now and the one that we're
17 going to go forward with is a really good coordinated
18 effort. We share the burden all of the way around and
19 it really gives everyone a seat at the table as we
20 discuss the waterway going forward.
21 Some of the original tenets that we started
22 with for this feasibility study were pretty simple to
23 deepen the channel and to widen the channel starting
24 off in the Gulf of Mexico and going all of the way up
25 to the Port of Beaumont for the deepening and widening.

1 And you may have seen as you've been following the
2 project along here lately, we have dropped the widening
3 from the terminology it has been just a deepening
4 project.
5 I wanted to point out to you this is an
6 excerpt from the original feasibility bullets back in
7 1999. And one of our original tenets was to be sure
8 that we kept the vision to improve the transportation,
9 efficiency and navigational safety of the waterway. So
10 although we have dropped the word "widening," we
11 absolutely haven't dropped off the efficiency or the
12 safety of the waterway and no doubt we're strategically
13 widening places we have absolutely adjusted. I think
14 you're going to hear a lot of that as the specifics
15 roll out for tonight.
16 Let me back up one. Also, I want to point
17 out that the waterway has been driving us as we go
18 along. This project although I said it's been about
19 50 years since we've improved the project, it doesn't
20 mean we haven't been needing an improved project. With
21 the way the world vessels are going and the world
22 market is going, vessels are getting bigger, with the
23 Panama Canal improving itself coming due pretty soon
24 and with the regulations requiring double hull tankers
25 in 2015. Our waterway is already seeing vessels that

1 are easily exceed the design limits currently so
2 they'll come either short loaded so they can make it up
3 the waterway to design depth or they'll come fully
4 loaded and have to offload offshore and lighter. All
5 of those things impact the efficiency of the waterway
6 and it impacts industry and ultimately impacts our
7 area.
8 So part of this channel improvement was to
9 alleviate that specifically. So the need is still
10 there. It's still driving us. Although it's taken us
11 a little while to get to it, we believe it's going to
12 be just in time and a perfect fit for our area once we
13 get it out.
14 But it's a bit of process to get there.
15 The federal civil works process it looks pretty lengthy
16 I know on that slide about a 21-step process on that
17 slide starting with the identification of improvement
18 need all of the way through the operation and
19 maintenance of a channel once it's authorized and
20 constructed.
21 But to give you an idea of where we are
22 tonight, we're highlighted there at block eight or nine
23 which is the finalization of the Feasibility Report.
24 So it looks like we have a long way to go, but we
25 really believe we've climbed a lot of the hill going

1 forward essentially to get us here tonight. And going
2 forward, we believe that things are going to go a
3 quicker pace hopefully with a local sponsor so we are
4 looking for a chief's report sometime this September to
5 sign off on the feasibility study and then we can
6 swiftly move into the Water Resource Act passed by
7 Congress this year and that will put us into the
8 preliminary engineering design in 2011 and 2012. So
9 it's taken a little bit, sure, but we do believe as we
10 go forward, we're going to see the pace pick up quite a
11 bit.
12 We started the reconnaissance phase in '97
13 and through '99. I wanted to kind of point out some of
14 the things that it did propose as we were going to go
15 into the feasibility phase as a way for you to kind of
16 gauge some of the things you're going to hear tonight.
17 The reconnaissance report said the project would be
18 found in the federal interest and that we would have a
19 favorable benefit cost ratio about 1.2 to 1. I think
20 you're going to hear some numbers from Ms. Willey that
21 are going to dovetail right with that but these are
22 decade old numbers or predictions. You're going to see
23 that the feasibility study track pretty much along with
24 what the reconnaissance report predicted.
25 The yardage is quite large although we're

1 going to be a little north -- quite a bit north of the
2 260 million dollar price tag on the thing. You
3 probably all can agree with me that over a decade and
4 with the scale of economy and industry and also with
5 the cost of doing business in industry has really
6 accelerated that project cost, but the benefit to cost
7 ratio was maintained and I believe even improved just a
8 little bit so you're going to see that.
9 In the feasibility phase, it was pretty
10 simply from a local sponsor as we listen to industry
11 and we saw the need for an improved channel, the
12 direction we were giving the Corps as we were asking
13 them to do a feasibility study for our project or for
14 our current project was to describe and evaluate
15 alternative plans for improvement probably a lot of
16 ways we can come up with and there were a lot of ways
17 that came up to improve our project.
18 I believe Jan and her team went through 120
19 different alternatives just on the environmental side
20 of things. And so they had to wade through quite a bit
21 of alternatives to get it down to a presentable
22 package. And then ultimately proposed the recommended
23 project. I think you're going to see that tonight. I
24 think that the Colonel and his staff and over the years
25 they've done a great job at doing just that that led to

1 a complex project like we see tonight. It's a tough
2 thing to wrestle down. But I think you're going to see
3 and agree with me that they've done quite a job doing
4 that.
5 As we went through the feasibility phase,
6 some of the particulars were the cost sharing between
7 the navigational district and the federal government to
8 pay for actually doing the study. And early on even
9 before we started this thing, we knew that we would be
10 at a meeting much like tonight where you would be
11 presented with an environmental impact statement
12 because the project does have such an environmental
13 impact. It's a very large waterway. It touches a lot
14 of ecosystems and so Jan's work has been cut out for
15 her probably from the beginning, but I think she's done
16 a good job of gathering all of the agencies to kind of
17 sit down and go through that.
18 The 48 months to complete, 78 million
19 dollars to do that absolutely got escalated, but I
20 think most of that could be attributed to new policies
21 within the Corps. Our project was the first project to
22 go through some of the new policies. And in the end, I
23 think, it was a good thing for our project to go
24 through those because the project we are now going to
25 pass on to headquarters for their review phase is a

1 better project for it. It's going to be a more vetted
2 project for it. And as I said in the beginning since
3 1912, we looked at getting better at doing projects and
4 I think this is a part of it. So it's a little bit
5 painful at times for us to go through those over and
6 over, but at the end of the day, I think we're going to
7 see the results and the benefits of that when it goes
8 into the headquarter's review phase.
9 So the project all along and this process
10 all along has always meant to be an open process. We
11 wanted early on to identify the stakeholders and urge
12 their participation in the project. We wanted
13 intensive state and federal resource agency
14 involvement. Jan has done, I think, a great job as far
15 as coordinating all of the different agencies. This
16 waterway splits two states, a lot of federal interest
17 as well. So that's been quite a task to do but if --
18 some of you may have been at some of those coordination
19 team meetings, and you'll see that we were able to
20 smooth out the majority of the wrinkles environmentally
21 and so I think you're going to see some benefits of
22 that tonight as well.
23 And so I look forward to your open comments
24 tonight to continue that openness. I think as you hear
25 the details of the project, you're going to see that

1 the project that the Corps is proposing tonight and as
2 we press it forward, is the project that we all can get
3 behind and endorse. It's a project that more
4 importantly that we started out looking toward and you
5 can see that tonight. Thank you for your time and now
6 I would like to introduce you to Ms. Sheri Willey and
7 she's going to go through some of the details.
8 MS. WILLEY: Good evening. My name is
9 Sheri Willey and I'm the planning lead on the project
10 and I'm going to be giving you an overview of the
11 project and then Ms. Stokes will be following up with
12 the environmental portion. This is the study authority
13 that gave us the authority to study this project. This
14 authority stated that the Corps should determine the
15 feasibility of modifying the channels to the ports of
16 Beaumont, Port Arthur and Orange. The reconnaissance
17 study began in 1998 with the feasibility study starting
18 in 2000. The results of this is the Draft Feasibility
19 Report and The Draft Environmental Impact Statement
20 currently out for public review.
21 Here's a list of the study participants.
22 As you can see there's been coordination with a number
23 of agencies throughout the study process. These were
24 the cooperating agencies for the environmental review.
25 There's also going to be another list of agencies that

1 Ms. Stokes will be providing in her presentation that
2 is the interagency coordination team.
3 The channel extends from the Gulf of Mexico
4 to the Port of Beaumont. The channel to the Orange
5 portion of the waterway is not a part of this
6 particular study. The geographic limits of the study
7 area is a very extensive study area, 2000 square miles.
8 It includes Sabine Lake, the marshes in Texas and
9 Louisiana, the Neches River Channel, Sabine River, a
10 portion of the Gulf Intracoastal Waterway is the
11 portion that extends to Star Bayou on the west and to
12 Gum Cove Ridge on the east. Also the Gulf of Mexico
13 shoreline extends ten miles on either side of the
14 channel. That was the portion that was in the study
15 area. Also it extended 35 miles offshore into the Gulf
16 of Mexico.
17 It includes two ports, the Port of Beaumont
18 and the Port of Port Arthur. Two counties in Texas,
19 Jefferson and Orange. Two parishes in Louisiana,
20 Cameron and Calcasieu. The Golden Triangle that
21 includes Beaumont, Port Arthur and Orange, Texas and
22 numerous smaller cities and communities. This is just
23 a picture of -- a photo of some of the facilities on
24 the Port of Port Arthur and also the Port of Beaumont.
25 Of the existing Sabine-Neches Waterway

1 project dimension, it's current project is a 40-foot
2 deep channel. It's divided into a number of channel
3 reaches, the total length is about 64 miles. The
4 Feasibility Study has taken several years, but this is
5 because the project is one of the most complex projects
6 in the nation. The project area is very large
7 involving the states of Texas and Louisiana. In
8 addition, the project area has multiple water bodies
9 such as the GIWW, the Sabine-Neches Waterway, Sabine
10 Lake, Neches River. All of these have a complex
11 salinity and circulation pattern.
12 The channel is the longest current channel
13 in Texas at 64 miles and with the proposed project will
14 be approximately 76 miles long. Deepening such a
15 channel would result in an enormous amount of dredge
16 material that either has to be placed in upland or
17 offshore placement areas or used beneficially.
18 The area also contains very diverse habitat
19 from bottom land hardwoods to emergent wetlands to
20 shallow open water. All of these factors have required
21 a much more time extensive study effort to adequately
22 evaluate potential project impact of deepening the
23 waterway.
24 We had to look into the problems and
25 opportunities for the study. These were the categories

1 that were addressed: Navigation and commerce,
2 environmental concerns, and social and economic
3 factors. For navigation and commerce, the existing
4 40-foot depth results in draft restriction and affects
5 the navigation efficiency. The existing channel is
6 designed for loaded drafts of 36 feet. Projected
7 increases in the commodity transport will compound the
8 existing problems of the transportation efficiency.
9 The majority of the Sabine-Neches Waterway
10 tonnage is carried in deep draft vessels and the vast
11 majority of deep draft traffic is comprised of crude
12 oil and petrochemicals. Three quarters of the crude
13 oil tonnage is transported in vessels with design
14 depths over the current projected depth of 40 feet.
15 Because of this, offloading from very large -- from
16 large vessels offshore occurs with the cargo being
17 brought in on shuttle vessels.
18 Also there's been transit rules adopted by
19 the Sabine pilots that result in daylight only and one
20 way sailing restrictions for certain conditions. There
21 are a number of environmental concerns. Saltwater --
22 I'm sorry. Salinity intrusion, loss and deterioration
23 of wetlands, effects of water and sediment quality,
24 increased inshore channel and Gulf shore erosion and
25 also the beneficial use of dredge material. What the

1 beneficial use of dredge material definition is is that
2 you would use the material from the construction of the
3 deeper channel or the maintenance of that channel for a
4 beneficial use, and in this project, we propose to use
5 it to restore marsh and renourish the Gulf shoreline.
6 There were a number of social and economic
7 factors. The economic effects of reduced
8 transportation efficiency. There's regional economic
9 effects in Louisiana and Texas. Additionally, there
10 could be economic growth and development in the areas
11 near the waterway. There's potential impacts to public
12 infrastructure. Some of this infrastructure that we
13 had to consider includes the Port Arthur hurricane
14 protection levee and various state highways and
15 bridges. Additionally, there are pipeline relocations
16 and removals to be considered and also the increased
17 taxes required to fund the channel improvements.
18 As we stated before, the objectives of the
19 study are to improve the navigational efficiency of the
20 Sabine-Neches Waterway and maintain and/or restore
21 coastal and estuary natural resources.
22 In 2000 we began the feasibility study and
23 sponsored public scoping meetings here in Lake Charles
24 and also in Beaumont. The plan objectives were to
25 improve this navigation efficiency while maintaining or

1 enhancing the effected areas coastal and estuary
2 resources. The Sabine-Neches Waterway plays a
3 significant role in the economy of the `Golden Triangle
4 area, the amount of vessel traffic along the waterway
5 is increasing with the economic growth of the area.
6 As I've stated before with the current
7 channel dimensions, there are size restrictions on the
8 large vessels which utilize the channel. The current
9 40-foot depth and width of the channel restrict the
10 vessel movement to one way convoys and daylight sailing
11 -- daylight only sailing. Additionally, the tankers
12 must anchor offshore and lighter the cargo to get into
13 the waterway.
14 There are a number of alternatives
15 evaluated in the study. First alternative that we
16 always must consider is the no action alternative. It
17 would be the plan that we would maintain the existing
18 waterway but not improve it. Additionally, we looked
19 at some nonstructural alternatives. Traffic management
20 system which is a Coast Guard managed system that is
21 already in place. Also the relaxation of pilot rules
22 such as allowing -- possibly allowing two way traffic
23 in certain areas to see if that would be possible while
24 improving the efficiency. Also we considered
25 alternative mode of commodity transport, such as the

1 Louisiana offshore oil port LOOP or the bulk oil
2 offshore transfer system BOOTS. The LOOP is an
3 existing system and BOOTS was proposed but is not
4 currently active.
5 The structural alternatives that were
6 considered during this study were extensive. More than
7 120 combinations of different channel depths and
8 widths. Deepening ranged from 43-feet to 55-feet, and
9 then we looked into the widening from 500 to 700 feet
10 wider for all -- I'm sorry. 500 to 700 feet for all
11 depths.
12 The tentatively recommended plan consists
13 of deepening to 48-foot channel, dredge material
14 management plan, beneficial use plan and marsh
15 mitigation.
16 As was mentioned before, the widening was
17 dropped out of the project because it was not
18 economically justified. The tentatively recommended
19 plan includes the deepening from the -- deepening the
20 entire Sabine-Neches Waterway to Beaumont to 48 feet.
21 In doing so we would have to extend the entrance
22 channel over 13 miles offshore to reach that depth
23 contour.
24 Also we're deepening and widening Taylor
25 Bayou Channel and Turning Basin, adding and enlarging

1 turning and anchorage basins along the Neches River
2 Channel and bend easements on the Sabine-Neches Canal
3 and Neches River Channel.
4 For long-term management of the dredge
5 material, we are looking at increases of the
6 maintenance material from 405 million cubic yards to
7 650 million cubic yards over the entire 50-year project
8 life that we had to examine. The average annual cost
9 increase is from 36 to 68 million dollars.
10 Additionally, we're going to be using the 16 existing
11 upland placement areas, expanding two of the placement
12 areas, and using the four existing offshore placement
13 areas as well as four additional offshore placement
14 areas. The tentatively recommended plan, we have a
15 construction cost of a little over 1 billion dollars
16 and the benefit to cost ratio is 1.3 to 1.
17 At this time Ms. Stokes will come up and
18 continue the presentation with the environmental
19 aspect.
20 MS. STOKES: Good evening. The
21 Sabine-Neches Waterway Feasibility Study needed to
22 consider an extremely large complex and sensitive study
23 area for all of the environmental impact analyses. The
24 area contains about 440 square miles of coastal marsh,
25 26 square miles of Cypress Tupelo swamp and 14 square

1 miles of bottomland hard woods. It also contains a
2 number of protected lands in protected status that are
3 held by a National Wildlife Refuge and Wildlife
4 Management Areas.
5 It includes -- in Louisiana it includes
6 portions of the Sabine National Wildlife Refuge and the
7 Sabine Island Wildlife Management Area. In Texas the
8 study area includes all of Texas Point National
9 Wildlife Refuge, the Blue Elbow Swamp Wildlife
10 Management Area and the Lower Neches Wildlife Area, and
11 it also effects portions of the J. D. Murphree Wildlife
12 Management Area and the McFaddin National Wildlife
13 Refuge.
14 The environmental impact assessment has
15 recognized that wetlands in this area have been
16 undergoing high rates of marsh loss like those in the
17 Western Cheniere Plain in Louisiana and more recently
18 have suffered adverse effects of Hurricanes Rita and
19 Ike.
20 Because of the large and sensitive study
21 area and the complex environmental issues that we are
22 facing, we used a collaborative approach in assessing
23 the impacts and determining the mitigation. And we
24 formed what we call an Interagency Coordination Team.
25 As you can see this team is very large.

1 It contains members from federal agencies
2 like EPA, US Fish and Wildlife with representatives
3 from both Texas and Louisiana, Natural Marine Fisheries
4 also with representatives from both states, Natural
5 Resources Conservation Service.
6 In Texas, we had Texas General Land Office,
7 Commission on Environmental Quality, Water Development
8 Board, and Parks and Wildlife, the Sabine and Neches
9 River Authorities. And in Louisiana, we had
10 representatives from the Department of Natural
11 Resources, Department of Environmental Quality and
12 Department of Wildlife and Fisheries.
13 We had meetings over several years, I think
14 five years worth of meetings to evaluate all of these
15 -- to evaluate this project and it was an enormous
16 amount of work that was done by all of these agency
17 representatives and we really appreciate their
18 involvement in helping in studying this project. We
19 couldn't have done it without them.
20 We also included many of the actual men on
21 the ground, men and women on the ground that manage
22 these refuges and wildlife management areas. They
23 participated in the ICT Team.
24 Sheri listed all of the environmental
25 concerns or most of the major environmental concerns

1 that we had and these are the technical studies or most
2 of the technical studies that we undertook in order to
3 address these concerns. I'm not going to go through
4 all of them, but I want to talk about some of the most
5 significant. And those are the hydrodynamic salinity
6 modeling. There was a large 3D estuary model run by
7 the environmental -- it used to be a Waterway
8 Experiment Station Corps laboratory for us to evaluate
9 salinity and circulation and surface elevation changes
10 that could occur with the deepening project.
11 We modeled different project effects. We
12 modeled the potential for the longer offshore channel
13 to affect erosion on the shoreline at the Gulf on
14 either side of the jetties. We looked at the potential
15 for the changes in vessel fleets coming up the confined
16 channel to increase erosion along the channel. We
17 looked at the offshore disposal sites and did modeling
18 to make sure that we had the right size and placement
19 areas and to determine what the possible impacts
20 offshore would be.
21 Very significantly, we used an ecological
22 model to evaluate the impacts to the wetland
23 communities. We used a model that has been used for
24 more than ten years in Louisiana, The Wetlands Value
25 Assessment Model if you're familiar with it, to

1 quantify the impact to the environmental communities
2 and to help us then determine what the amount of
3 mitigation that would be required for those damages
4 that could not be avoided.
5 The primary impact that we found after all
6 of these studies was that there would be an increase in
7 salinity caused by the deeper navigational channel and
8 this would lead to a decrease in marsh productivity and
9 an increase in marsh loss. Salinity changes would be
10 felt the highest in Sabine Lake and the lowest reaches
11 of the Neches River and Sabine River, and those changes
12 would be on the order of about one and a half parts per
13 thousand possibly up to two parts per thousand in the
14 average condition.
15 There was no significant change found in
16 the upper regions of both the rivers and the
17 Cypress-Tupelo Swamp Habitat north of Interstate 10 and
18 very little change down toward the mouth. So the major
19 differences were in the Sabine Lake and the lower
20 regions.
21 The ecological model that we used then
22 predicted an increase in land loss that would be
23 associated with the increase in salinity. In Texas,
24 it's predicted that there would be around 250 more
25 acres lost over what is occurring now. And in

1 Louisiana about 690 acres more than what is occurring
2 now. There is extensive land loss that is occurring in
3 this area, both in Texas and Louisiana. And when you
4 compare this loss with the channel to what is occurring
5 now, it would be less than between a half percent and
6 one percent increase.
7 I'm going to describe the beneficial use
8 areas that we have been able to develop in a little
9 while and those areas are primarily located in Texas
10 along the Neches River Channel. And they restore about
11 2,800 acres on the Neches River Channel which more than
12 offsets the loss in Texas, but we were unable although
13 we tried -- we tried diligently over several years to
14 find cost effective beneficial use opportunities in
15 Louisiana that would actually restore marsh. And so
16 that leaves 691 acres in Louisiana as an unavoidable
17 impact that we addressed with a very robust mitigation
18 plan.
19 There were some other minor impacts
20 associated with the project for example on the Neches
21 River 86 acres of fresh marsh would be converted into a
22 placement area. The offshore channel deepening has the
23 potential to effect threatened and endangered sea
24 turtles, and we have consulted with the National Marine
25 Fisheries to develop management measures to help us

1 avoid those impacts to the greatest extent possible
2 with using pre-construction, relocation surveys and
3 drag head deflectors and monitors on the dredges.
4 There is critical piping-plover habitat at
5 Louisiana Point where we have another beneficial use
6 area that is shoreline nourishment and consultation
7 with Fish and Wildlife determine that there might --
8 that the project would have a long-term beneficial
9 effect by stabilizing and possibly providing more habit
10 there.
11 The beneficial use areas are of two major
12 types as I described before. There was a large
13 beneficial use project on the Neches River that would
14 restore over 2,800 acres of emergent marsh in three
15 areas on the river at Rose City, Bessie Heights and Old
16 River Cove. The other beneficial use feature is Gulf
17 shoreline nourishment and that would occur at both
18 Texas point and Louisiana point. This would be done
19 with maintenance material and the placement would
20 alternate from one placement cycle to the next between
21 Texas and Louisiana so that all of the maintenance
22 material is shared equally between the two states.
23 This map shows the location of the
24 beneficial use areas on the Neches River for Rose City
25 it is on the upstream end on the left and Bessie

1 Heights and Old River Cove are on your right toward the
2 -- near the mouth of the Neches River. These are the
3 locations of the beneficial use shoreline nourishment
4 projects on either side of the jetties. It would
5 extend about three miles from each side of the jetties.
6 As I mentioned before the beneficial use
7 features in Texas actually fully compensate or more
8 than compensate for all of the impacts that were
9 projected for Texas using the ecological model but
10 unavoidable impacts in Louisiana remain. And so for
11 those impacts, we propose to restore marsh in five
12 large degraded marsh areas in the Willow Bayou and
13 Black Bayou watersheds. They restore -- restoration
14 that we would be doing with these mitigation measures
15 has exactly the same on the ground effect of the
16 beneficial use areas in Texas where we are restoring
17 marsh. They just have different names because the
18 material has different origin and it has different
19 funding implications.
20 These give you the acres for each one of
21 the areas proposed for mitigation. I'm not going to
22 read them all here but you'll see it's over 2,700 --
23 nearly 2,800 acres of mitigation and for the loss of
24 690 acres or the predicted loss of 690 acres. Several
25 times more than are predicted to be lost.

1 These are the locations of the mitigation
2 areas. At the southern part, you will see two areas in
3 the Sabine National Wildlife area. In the northern
4 part, there are three areas that are located on private
5 property just south of the GIWW in the Black Bayou
6 Watershed.
7 This is the estimated completion schedule
8 for our project right now. We released the draft of
9 our environmental impact statement and a feasibility
10 report on December 24th and comments on the EIS are due
11 back on February 10th. If you have comments on the
12 conformity determinations those do not have to be
13 returned until the 26th of February. We plan to have
14 the public review of the final EIS in August of this
15 year and hope to have approval of -- by the chief of
16 engineers in September. And that's all. Thank you. I
17 think it's Colonel Weston.
18 COL. WESTON: Okay. Thank you for those
19 presentations and I hope you found them to be
20 informative. What we're going to start now is the
21 comment period of the presentation. Before I do that,
22 I would like to acknowledge my lack of time and space
23 situational awareness. At the beginning I said we were
24 starting the meeting on the 26th of January which is
25 the meeting I was at last night. We are actually

1 starting this meeting the day of the 27th of January.
2 I know you all know that. But I caught myself after I
3 was sitting there thinking how unsmart I was when I
4 said the 26th. So it is the 27th in case you were
5 wondering.
6 We will go to the public comment period
7 here today and just remind you as Byron talked about we
8 are looking about a three-minute comment from you. So
9 be concise in your thought and your delivery, and he
10 will give you the high sign about 30 seconds out by
11 raising his hand. At that point, we would like you to
12 wrap up the thought you're on. We understand you may
13 have more comments than that. As you've seen with the
14 material if you picked up some on the way in, we have
15 other methods and means for you to continue to do that.
16 You can continue to fill out your comments on the
17 comment card here tonight, for example, or you can go
18 to the webpage or mail them in within the timelines
19 that were just talked about. So with that, we'll get
20 started here with the presentations and I'll start off
21 with first Mr. Darryl Clark.
22 MR. CLARK: All right. Thank you, Colonel.
23 I had to be first. Okay. Yes, I'm Darryl Clark. I'm
24 from the Fish and Wildlife Service. I work in
25 Louisiana, Lafayette, Louisiana at the Louisiana field

1 office in the ecological services branch and I have
2 positive comments for the whole process. I've been
3 with the process I believe ten years now. I started in
4 the year 2000 as those of you know who started with the
5 program way back then. I'm not going to give Official
6 Department of Interior or Fish and Wildlife Service
7 comments at this time, although Janelle Stokes and
8 Carolyn have received and we have submitted a draft
9 Fish and Wildlife Coordination Act report in 2008 and
10 that is being revised now, and it's in the final
11 process should be submitted within a few weeks.
12 I was the primary reviewer, member of the
13 team for the Fish and Wildlife service for the
14 Louisiana part of the project primarily reviewing the
15 Louisiana impacts and Louisiana and the benefits of
16 beneficial use and mitigation in Louisiana. And I want
17 to mention as I've already submitted for the Department
18 of Interior comments that the draft environmental
19 impact statement is well written and describes Fish and
20 Wildlife resources especially in Louisiana and project
21 impacts and benefits in Louisiana all very well.
22 I want to thank the Galveston Corps for
23 being open-minded for various beneficial use and
24 mitigation types of measures that are included in the
25 final plan, especially the Gulf of Mexico beneficial

1 use along the shoreline. There were many naysayers
2 that said the material is not going to stick. It's
3 going to go away, but it actually has been tried on the
4 Texas Point side and worked.
5 And we -- I was on the hydrodynamic
6 modeling team although I'm not an engineer. But they
7 seemed to have done a good job with that. We used that
8 material, that data as Jan mentioned to fit into The
9 Wetlands Value Assessment Ecological Model to arrive at
10 the impacts and the benefits which I'm not going to go
11 over. Jan just mentioned that. We are pleased at the
12 ratio benefits to impacts multi-times, the benefits are
13 multi-times larger than the impacts that were predicted
14 by the models.
15 In Louisiana the threatened endangered
16 species are not -- the project is not likely to
17 adversely effect the threatened endangered species in
18 Louisiana and as Jan mentioned the piping-plover
19 habitat will actually be enhanced by the beneficiary
20 use along the Gulf shoreline. So we'd like to also
21 recommend the ICT Team be constituted for the
22 development of the final BU and mitigation plan. Thank
23 you very much.
24 COL. WESTON: Thank you. The next
25 individual will be Mr. Darryl Reed.

1 MR. REED: Thank you. I just want to
2 comment that I think your whole plan looks excellent
3 from an untrained eye. It looks like it's a well
4 needed channel expansion. I along with two others here
5 work for TARGA Resources a pipeline company. This
6 project doesn't interfere with any of our Sabine River
7 pipeline crossings of that we're very happy. However
8 TARGA Resources is a successor in interest to Dynegy
9 and there are several Dynegy pipelines that will be
10 affected or previously owned by Dynegy Pipeline that
11 will be affected and are slated for relocation in this
12 study. That is the Pelican 10-inch line and the
13 Pelican 12-inch line. I just kind of wanted to go on
14 record to say we'll make our comments. Of course,
15 we're totally adverse to having to relocate those
16 pipelines and it's mainly at the southern portion of
17 the proposed entrance expansion and the ODMDS's
18 proposed.
19 However, the cost of relocation is
20 tremendous plus the cost -- the loss of service and
21 production from those pipelines, there gathering lines
22 from offshore wells would be a tremendous loss of
23 dollars for the company. And so that's just the only
24 thing I had to say. We will be sending you a letter.
25 But it looks like a very good and well conceived

1 project.
2 COL. WESTON: Thank you. Next will be
3 Mr. David Richard.
4 MR. RICHARD: When you're on this side of
5 Sabine, it's Richard. Thank y'all for coming over here
6 and I appreciate Janelle's work. I've been involved
7 with this a long time. My name is David Richard and
8 I'm executive vice president of Stream Property
9 Management and we manage probably the majority of
10 private lands of Louisiana side that would be effected.
11 Three minutes is not near long enough to answer
12 13 years of work. So I'm going to make it brief on a
13 couple of things.
14 In your -- and I want to say that I think
15 we were very ably represented by Darryl. Darryl, I
16 know has put in a lot of time from the Fish and
17 Wildlife Service perspective. I've got two or three
18 things I want to say. Number one, after the advent of
19 Hurricane Ike, I feel like deep water channels as we've
20 seen channels across the State of Louisiana has
21 accentuated flooding from hurricanes. And I did not
22 see a hydrodynamic model that looked at hurricane
23 surge. We've done a number of those in Louisiana and I
24 suspect that the deepening of that channel is going to
25 accentuate that.

1 One thing I don't see in your plan is ways
2 to control the hydrology. What it is going to do and
3 what we've seen and I think what your model shows is it
4 going to increase the salinity in the northern portion
5 of Sabine Lake which should be the fresher areas of
6 Sabine Lake. We would propose to contain that water
7 inside the channel instead of letting it circulate in
8 Sabine Lake.
9 Also, I didn't see tidal amplitude and
10 maybe y'all ran tidal amplitude and tidal amplitude is
11 also going to increase due to the deepening of the
12 channel. I do think the economics, I understand your
13 economics and I understand the port. I also would like
14 to see more of the spoil used beneficially. We are in
15 desperate needs. We have huge losses in Louisiana and
16 we would like to see as much spoil as possible used.
17 The beneficial use areas that are on the north end of
18 the Black Bayou area are actually using spoil from the
19 Sabine River going to the Port of Orange unless I'm
20 mistaken which is outside of the project that you are
21 actually doing here. So it would actually be dedicated
22 mitigation, I suppose, to go to the Port of Orange.
23 Which is fine, beneficial use in Louisiana to Orange,
24 we support that all of the way along.
25 Deepening of the channels and the building

1 of the channels have caused tremendous problems as
2 we've just seen with the closing of the MR-GO in New
3 Orleans that caused extensive flooding in the lower
4 Ninth Ward and St. Bernard Parish. Again I think this
5 has been a long process and I want to commend
6 especially Janelle for having to go through the many
7 comments and the many remarks that were made and I'll
8 send my detailed remarks by email I'm sure. Thank you.
9 COL. WESTON: Thank you. Next will be
10 Mr. James Kaucher.
11 MR. KAUCHER: I'm Jim Kaucher. I work for
12 the Sabine Pass LNG in Cheniere. The Sabine LNG
13 terminal strongly supports the proposal of deepening
14 and widening of the Sabine Waterway. We wish to see
15 our waterway remain highly competitive with other ports
16 and waterways by being able to accommodate the larger
17 ships that now carry so much of the worlds trade with a
18 higher degree of safety.
19 Furthermore, we are most interested in
20 promoting the capability of the Sabine-Neches Waterway
21 to safely handle the worlds largest LNG carriers.
22 These ships are nearly 1,100 feet in length and 108
23 feet in breath. These very large LNG carriers are
24 presently limited to a 40-foot fresh water draft when
25 entering the Sabine-Neches Waterway. Many such vessels

1 would come in deeper if the waterway's channels were
2 deeper and wider. Any deepening or widening will make
3 our waterway more competitive to business. It uses the
4 larger ships and automatically eliminates the
5 untraditional safety margins for the existing shipping
6 already present.
7 LNG Cheniere supports this project and the
8 US Army Corps of Engineers work will proceed.
9 COL. WESTON: Okay. Thank you. That's all
10 of the cards I have for folks that indicated that they
11 would like to make a public comment. Is there anyone
12 else in the room that either didn't get their card in
13 or is having a change of thought and would like to
14 stand up and make a public comment at this time? Okay.
15 I don't see anybody raising their hand.
16 So in conclusion, the written comments on
17 the Draft Feasibility Report, the Draft Environmental
18 Impact Statement, the Draft Environmental Impact
19 Statement for the Designation of Ocean Dredge Material
20 Disposal Sites must be received on or before
21 February 10, 2010, the conclusion of the 45-day comment
22 period that began on December the 24th, 2009.
23 Comments on the General Conformity
24 Determination must be received on or before
25 February 26, 2010 and acknowledged as many of you said

1 this is a complex project with a complex study area.
2 Many of your comments, I'm sure will be more detailed
3 than was provided tonight, and we look forward to
4 receiving those by the deadlines so we can take a fair
5 shot of analyzing and assessing the merits, et cetera,
6 with respect to the overall project of your comments.
7 I would like to thank those of you who came out and
8 showed interest in the project this evening and made
9 your comments to us. Those are greatly appreciated.
10 I also would like to take time to thank the
11 Sabine-Neches Navigation District who's our local
12 sponsor. For those of you not familiar with Civil
13 works projects, they are cost shared between the
14 federal government and the local government entity. So
15 there's a considerable investment on their part in this
16 project and they have been great partners over what's
17 already been ten years going on this particular
18 Feasibility Report Study. So I thank them here in
19 public and also for their assistance in setting up this
20 meeting for us. Again, thank y'all for your
21 attendance, and the interest that you have shown. I
22 will now adjourn this meeting. Thank you.
23 (MEETING CONCLUDED AT 8:00 P.M.)
24
25

1 C E R T I F I C A T E
2
3
4 I, Betty Curry Minton, Registered Professional
5 Reporter, Certified Court Reporter for the State of
6 Louisiana, do hereby certify that the above and
7 foregoing testimony was taken by the undersigned and
8 represents a true and correct copy of the proceedings
9 had at the time and place set forth on page one (1)
10 hereof.
11 I further certify that I am not related to any
12 of the parties named herein, nor their counsel, and
13 have no interest, financial or otherwise, in the
14 outcome of the proceedings.
15 IN WITNESS WHEREOF, I have hereunto affixed my
16 significant at Lake Charles, Louisiana, this 8th day of
17 February, 2010.
18
19
20
21 _____
22 Betty Curry Minton, RPR, CCR
23
24
25

# ADDENDUM

## SABINE-NECHES WATERWAY
## CHANNEL IMPROVEMENT PROJECT
## FINAL FEASIBILITY REPORT AND FEIS

## I.A PURPOSE

The purpose of this Addendum is to document changes to the project costs as presented in the Final Feasibility Report of March 2011, based on revision of the final project costs to reflect October 2010 price levels and the current interest rate of 4.125 percent. The March 2011 report presented cost levels in October 2009 price levels with the interest rate of 4.375 percent. The costs have been inflated to October 2010 cost levels using factors developed by price leveling the labor and contracts using the Cost Estimate Updating Rates from Budget EC 11-2-199 dated 31 Mar 2010 and its midpoint of construction inflation factor of 1.101 for March 2016 which is estimated to be the midpoint of the construction of the project.

## I.B PROJECT COSTS

### Costs for the Recommended Plan

#### Total First Cost and Annualized O&M Costs

The Total First Cost is the cost at current levels and does not include IDC, or expected price escalation. The Total First Cost for all project components ($1,096,817,000; Table 1) includes implementation costs and associated costs. Implementation costs include postauthorization planning and design costs, construction costs, LER, relocations, mitigation costs, and O&M. Construction costs include costs for dredging, PA construction, aids to navigation (e.g., channel markers) and protection for MLK Bridge supports and bridge fender replacement. The USACE coordinated with the USCG to develop costs for aids to navigation, and with the Texas Department of Transportation to develop costs for bridge support protection and fender systems. Costs for compensatory fish and wildlife mitigation (including deferred construction costs for one mitigation measure) and cultural resource mitigation are also included.

Associated Federal and non-Federal costs are the costs of resources directly required for project construction, but for which no project expenditure is made, such as USCG navigation aids, relocations (including utility relocations), and non-Federal berthing/dock modifications. A formal cost risk analysis was performed in accordance with Engineering and Construction Bulletin 2007-17 that developed project contingencies at the 80 percent confidence level. First costs and incremental O&M costs are expressed as total average annual costs in the bottom portion of Table 1. Construction funding would fund all project construction components.

### Deferred Construction Costs

Deferred construction costs are related to one mitigation measure at West Black Bayou, Louisiana (LA 3-10R). This mitigation measure would be constructed using material from regular maintenance dredging of the Sabine River Channel to Orange over a 30-year period. The cost of the mitigation measure is the incremental cost of pumping the additional distance to Louisiana and marsh restoration activities. The first cycle of placement is included as a first cost of construction in the Recommended Plan cost estimates (Contract 14). Intermittent construction over 30 years (six additional 5-year maintenance cycles) is shown separately as an annualized deferred construction cost in Table 1. The Deferred construction would be cost shared with the non-Federal project sponsor for the SNWW CIP.

Table 1
Total First Cost and Annualized O&M for the Recommended Plan
(All costs in dollars)
(October 2010 price level; 4.125% interest rate)

| | |
|---|---|
| First Cost of Construction | 894,454,000 |
| Fish and Wildlife Mitigation | 79,041,000 |
| Cultural Resources Mitigation | 1,273,000 |
| Lands | 3,689,000 |
| Lands (Admin. costs) | 774,000 |
| Relocations | 42,575,000 |
| Bridge Modifications | 52,830,000 |
| Navigational Aids | 1,522,000 |
| Berthing and Dock Modifications | 20,659,000 |
| Total Project Cost | 1,096,817,000 |
| Months to Construct | 96 |
| Interest During Construction | 114,700,000 |
| NED Investment Costs | 1,211,500,000 |
| | |
| Average Annual Interest and Amortization | 57,600,000 |
| Incremental O&M | 32,739,000 |
| Deferred Construction (Fish and Wildlife Mitigation) | 214,000 |
| non-Federal Disposal Facility Costs | 61,000 |
| Total Annual Costs | 90,614,000 |
| Annual Benefits | 115,400,000 |
| Net Excess Benefits | 24,786,000 |
| BCR | 1.3 |

Since the Sabine River Channel is a separate project with a different non-Federal sponsor, each Sabine River Channel maintenance cycle involving deferred construction would utilize three funding sources (Federal O&M funds from the Sabine River Channel, and Federal construction funds and Sponsor construction funds from the SNWW CIP). The Federal government and Sponsor must diligently budget for the deferred construction so that funds are available when needed to avoid any delays in channel maintenance and mitigation site construction.

### O&M Costs

*Federal O&M Costs*

The maintenance of project features would be funded through annual appropriations of the O&M program. The actual amounts would vary on a year-to-year basis because of variability in the volume of material removed during each dredging cycle and the variability of the cycles. O&M costs also vary between channel depths. In accordance with Section 101(b) of WRDA 86 (Policy Guidance Letter [PGL] 47), O&M dredging and placement costs for maintenance of the channel depths between 40 and 45 feet would be allocated as 100 percent Federal; this would be calculated as 62.5 percent of the total O&M cost, determined as described for the GNF features in the Fully Funded Cost section, below. Costs for maintenance of the channel depth below 45 feet (37.5 percent of the total O&M costs) would be allocated as 50 percent non-Federal and 50 percent Federal. Expected cost sharing for all project components is compliant with PGL 47, Dredged Material Disposal Facilities, and Dredged Material Disposal Facility Partnerships.

Additional PA capacity for the Recommended Plan would be constructed regularly over the 50-year period of analysis in conjunction with maintenance dredging cycles. Since established dredged material management practices for the SNWW 40-foot project include regularly recurring levee raisings and the enlargement or installation of new dewatering structures, the additional investment required to provide the increased PA capacity for the Recommended Plan and PA costs attributable to the 40-foot project Base Plan would be cost shared as O&M costs. Costs for disposal facility maintenance would be allocated as 100 percent Federal for maintenance of channel depths between 40 and 45 feet. Costs for disposal facility maintenance associated with channel deepening below 45 feet would be allocated as 50 percent non-Federal and 50 percent Federal.

*Non-Federal O&M Costs*

In the SNWW, non-Federal maintenance material has traditionally been placed into the same PAs as Federal material, at the request of the non-Federal sponsor. Additional capacity needed for the non-Federal maintenance material was therefore considered when determining improvements needed to provide capacity for the 50-year period of analysis. It is projected that approximately 5.2 percent of the 48-foot project 50-year maintenance dredging quantity to be placed in upland disposal facilities would originate from non-Federal dredging. Costs of providing the capacity needed to contain the non-Federal

dredged material are a local responsibility and are shown separately from the incremental Federal O&M costs that would be cost-shared as described above.

## National Economic Development Investment Cost

The Investment Cost is expressed in current dollars with IDC added (see Table 1). The Investment Cost includes all of the implementation costs and non-Federal and Federal associated costs included in the First Cost as described above. First costs, incremental O&M, and deferred construction for fish and wildlife mitigation are expressed as total average annual costs in the bottom portion of Table 1, and then net excess benefit totals and the BCR are calculated. Total average annual costs are compared to projected annual benefits to determine net excess benefits and the BCR. The BCR for the Recommended Plan is 1.3.

### Fully Funded Cost

Total First Costs and price escalation, calculated by estimating the midpoint of the proposed construction contracts, are combined to create the Fully Funded Cost. In order to allocate the share of construction and O&M costs between the Federal government and the Sponsor, the cost must first be allocated by depth in accordance with Section 101 of Public Law 99-662 (USACE, 2000b). Costs for the transportation and placement of material during construction of the 48-foot project are GNF costs. The GNF costs are assigned to the two depth ranges, in accordance with Section 101(a) of WRDA 86, by applying the proportion of the channel deepening that would occur within each depth range. The cost allocation by depth in first cost is shown in Table 2. Table 3 shows this cost allocation using the fully funded cost. The amount associated with deepening between 40 and 45 feet (cost shared at 25 percent non-Federal and 75 percent Federal) was calculated by using an estimate for the 45-foot project. This 45-foot cost estimate was developed to a level comparable to an MII cost estimate. The amount associated with deepening below 45 feet (cost shared at 50 percent non-Federal and 50 percent Federal) was calculated by taking the cost difference between the 48-foot alternative and the 45-foot plan. Costs for various categories such as

Table 2
Recommended Plan First Costs Allocation by Depth
(October 2010 Price Level)
(All costs in dollars)

| | Costs Allocated to 45-foot Depth | Costs Allocated to Increment below 45-foot Depth | Total Costs |
|---|---|---|---|
| **General Navigation Features** | | | |
| Construction Dredging and Placement Areas | 530,816,000 | 188,260,000 | 719,076,000 |
| Bridge Modifications | 46,489,000 | 6,341,000 | 52,830,000 |
| Engineering and Design | 86,211,000 | 23,729,000 | 109,940,000 |
| Construction Management | 50,362,000 | 15,076,000 | 65,438,000 |
| Lands (Administration Costs) | 774,000 | 0 | 774,000 |
| Fish and Wildlife Mitigation | 56,316,000 | 22,725,000 | 79,041,000 |
| Cultural Resources Mitigation | 1,273,000 | 0 | 1,273,000 |
| Subtotal | 772,241,000 | 256,131,000 | 1,028,372,000 |
| **Lands, Easements, Rights-of-Way, and Relocations** | | | |
| Land | 3,689,000 | 0 | 3,689,000 |
| Utility Relocations | 0 | 21,287,500 | 21,287,500 |
| Subtotal | 3,689,000 | 21,287,500 | 24,976,500 |
| **Other Federal Costs** | | | |
| Aids to Navigation - USCG Channel Markers | 1,522,000 | 0 | 1,522,000 |
| **Associated non-Federal Costs** | | | |
| Deep-Draft Utilities | | 21,287,500 | 21,287,500 |
| Berthing Areas & Dock Modifications | 13,451,000 | 7,208,000 | 20,659,000 |
| Associated non-Federal Costs Subtotal | 13,451,000 | 28,495,500 | 41,946,500 |
| First Costs | 790,902,000 | 305,915,000 | 1,096,817,000 |

Table 3
Recommended Plan Fully Funded Costs Allocation by Depth
(October 2010 Price Level)
(All costs in dollars)

| | Costs Allocated to 45-foot Depth | Costs Allocated to Increment below 45 feet | Total Fully Funded Costs |
|---|---|---|---|
| **General Navigation Features** | | | |
| Construction Dredging and Placement Areas | 575,137,000 | 203,979,000 | 779,116,000 |
| Aids to Navigation – Bridge Modifications | 50,370,000 | 6,871,000 | 57,241,000 |
| Engineering and Design | 93,409,000 | 25,711,000 | 119,120,000 |
| Construction Management | 54,567,000 | 16,334,000 | 70,901,000 |
| Lands (Administrative Costs) | 838,000 | 0 | 838,000 |
| Fish and Wildlife Mitigation | 61,018,000 | 24,622,000 | 85,640,000 |
| Cultural Resources Mitigation | 1,379,000 | 0 | 1,379,000 |
| Subtotal | 836,718,000 | 277,517,000 | 1,114,235,000 |
| **Lands, Easements, Rights-of-Way, and Relocations** | | | |
| Land | 3,997,000 | 0 | 3,997,000 |
| Utility Relocations | 0 | 23,065,000 | 23,065,000 |
| Subtotal | 3,997,000 | 23,065,000 | 27,062,000 |
| **Other Federal Costs** | | | |
| Aids to Navigation – USCG Channel Markers | 1,649,000 | 0 | 1,649,000 |
| **Associated non-Federal Costs** | | | |
| Utility Relocations | 0 | 23,065,000 | 23,065,000 |
| Berthing Areas and Dock Modifications | 14,574,000 | 7,810,000 | 22,384,000 |
| Subtotal | 14,574,000 | 30,875,000 | 45,449,000 |
| Fully Funded (Escalated) Costs | 856,938,000 | 331,457,000 | 1,188,395,000 |

advance maintenance and allowable overdepth dredging were included in both the 45-foot estimates and 48-foot estimates and are included in both depths in the same manner as other GNF costs. None of the existing berthing areas and docks is presently deeper than the 40-foot channel, and therefore these costs would also be allocated between the depths as are all other GNF costs. The Federal costs for lands, fish and wildlife mitigation, cultural resources, and aids to navigation are the same in both the 45-foot and 48-foot plans; therefore, there are no additional costs included in the analysis for deepening from 45 to 48 feet.

## I.C COST SHARING ALLOCATION

The GNF costs for deepening between 40 and 45 feet are cost shared at 25 percent non-Federal and 75 percent Federal; costs for deepening below 45 feet are cost shared at 50 percent non-Federal and 50 percent Federal. The costs are separated into expected Federal and non-Federal shares and detailed in Tables 4 and 5. Table 4 used the projects first costs while Table 5 is in fully funded escalated costs. Fish and wildlife mitigation is considered a GNF and is cost shared in the same manner as other GNF costs. Costs for cultural resources data recovery would be handled in accordance with PL 93-291 (Section 7), e.g., data recovery costs would be 100 percent Federal up to 1 percent of the total amount appropriated for the project. Based upon information available at this time, data recovery costs are not expected to exceed the 1 percent limitation.

The Sponsor also must pay an additional 10 percent of the GNF costs in cash over a period not to exceed 30 years. This additional 10 percent cash contribution is offset by credit for LER and relocations (including utility relocations) pursuant to Section 101(a)(2) of WRDA 86, as amended. Owners of berth and dock facilities that would require modification in conjunction with the Recommended Plan would be responsible for 100 percent of those associated costs. The USCG is responsible for 100 percent of the cost for aids to navigation.

Table 4
Recommended Plan – First Costs Allocation
(October 2010 Price Level)

| | Costs Allocated to 45-foot Depth | | | Costs Allocated to Depth Increment below 45 feet | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Federal Share (75% of 45-Ft Costs) | Non-Federal Share (25% of 45-Ft Costs) | Total | Federal Share (50% of Cost - Depth Increment Greater than 45 Feet) | Non-Federal Share (50% of Cost - Depth Increment Greater than 45 Feet) | Total | Total Federal Share | Total Non-Federal Share | Total First Cost |
| **General Navigation Features** | | | | | | | | | |
| Construction Dredging and Placement Areas | $ 398,112,120 | $ 132,704,040 | $ 530,816,160 | $ 94,130,190 | $ 94,130,190 | $ 188,260,380 | $ 492,242,310 | $ 226,834,230 | $ 719,076,540 |
| Bridge Modifications | $ 34,866,405 | $ 11,622,135 | $ 46,488,540 | $ 3,170,670 | $ 3,170,670 | $ 6,341,340 | $ 38,037,075 | $ 14,792,805 | $ 52,829,880 |
| Engineering and Design | $ 64,658,100 | $ 21,552,700 | $ 86,210,800 | $ 11,864,840 | $ 11,864,840 | $ 23,729,680 | $ 76,522,940 | $ 33,417,540 | $ 109,940,480 |
| Construction Management | $ 37,771,500 | $ 12,590,500 | $ 50,362,000 | $ 7,537,920 | $ 7,537,920 | $ 15,075,840 | $ 45,309,420 | $ 20,128,420 | $ 65,437,840 |
| Lands | $ 580,320 | $ 193,440 | $ 773,760 | $ - | $ - | $ - | $ 580,320 | $ 193,440 | $ 773,760 |
| Fish and Wildlife Mitigation | $ 42,237,180 | $ 14,079,060 | $ 56,316,240 | $ 11,362,290 | $ 11,362,290 | $ 22,724,580 | $ 53,599,470 | $ 25,441,350 | $ 79,040,820 |
| Cultural Resource Mitigation | 100% Federal up to 1% Limitation | | | 100% Federal up to 1% Limitation | | | | | |
| | $ 1,272,960 | $ - | $ 1,272,960 | $ - | $ - | $ - | $ 1,272,960 | $ - | $ 1,272,960 |
| Subtotal | $ 579,498,585 | $ 192,741,875 | $ 772,240,460 | $ 128,065,910 | $ 128,065,910 | $ 256,131,820 | $ 707,564,495 | $ 320,807,785 | $ 1,028,372,280 |
| **Lands, Easements, Rights of Way, and Relocations** | | Lands, Easements, ROW, and Relocations (LERRs) | | 100% Non-Federal | | | 100% Non-Federal | | |
| Lands | $ - | $ 3,689,340 | $ 3,689,340 | $ - | $ - | $ - | $ - | $ 3,689,340 | $ 3,689,340 |
| Utility Relocations | $ - | $ - | $ - | $ - | $ 21,287,340 | $ 21,287,340 | $ - | $ 21,287,340 | $ 21,287,340 |
| Subtotal | $ - | $ 3,689,340 | $ 3,689,340 | $ - | $ 21,287,340 | $ 21,287,340 | $ - | $ 24,976,680 | $ 24,976,680 |
| **Other Federal Costs** | | 100% Federal | | | 100% Federal | | | | |
| Aids to Navigation - USCG Channel Markers | $ 1,521,840 | $ - | $ 1,521,840 | $ - | $ - | $ - | $ 1,521,840 | $ - | $ 1,521,840 |
| **Associated Non-Federal Costs (owner cost)** | | | | 100% Non-Federal | | | 100% Non-Federal | | |
| Utility Relocations | $ - | $ | $ - | $ - | $ 21,287,340 | $ 21,287,340 | $ - | $ 21,287,340 | $ 21,287,340 |
| Berthing Areas & Dock Modifications | $ - | $ 13,450,740 | $ 13,450,740 | $ - | $ 7,208,340 | $ 7,208,340 | $ - | $ 20,659,080 | $ 20,659,080 |
| Subtotal | $ - | $ 13,450,740 | $ 13,450,740 | $ - | $ 28,495,680 | $ 28,495,680 | $ - | $ 41,946,420 | $ 41,946,420 |
| **Fully-Funded (Escalated) Costs** | $ 581,020,425 | $ 209,881,955 | $ 790,902,380 | $ 128,065,910 | $ 177,848,930 | $ 305,914,840 | $ 709,086,335 | $ 387,730,885 | $ 1,096,817,220 |

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Table 5
Recommended Plan – Fully Funded Costs Allocation
(October 2010 price level)

| | Costs Allocated to 45-foot Depth | | | Costs Allocated to Depth Increment below 45 feet | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Federal Share (75% of 45-Ft Costs) | Non-Federal Share (25% of 45-Ft Costs) | Total | Federal Share (50% of Cost - Depth Increment Greater than 45 Feet) | Non-Federal Share (50% of Cost - Depth Increment Greater than 45 Feet) | Total | Total Federal Share | Total Non-Federal Share | Total Fully Funded Cost |
| **General Navigation Features** | | | | | | | | | |
| Construction Dredging and Placement Areas | $ 431,351,983 | $ 143,783,994 | $ 575,135,977 | $ 101,989,470 | $ 101,989,470 | $ 203,978,940 | $ 533,341,452 | $ 245,773,464 | $ 779,114,917 |
| Bridge Modifications | $ 37,777,531 | $ 12,592,510 | $ 50,370,041 | $ 3,435,401 | $ 3,435,401 | $ 6,870,802 | $ 41,212,932 | $ 16,027,911 | $ 57,240,843 |
| Engineering and Design | $ 70,056,645 | $ 23,352,215 | $ 93,408,861 | $ 12,855,480 | $ 12,855,480 | $ 25,710,959 | $ 82,912,125 | $ 36,207,695 | $ 119,119,820 |
| Construction Management | $ 40,925,183 | $ 13,641,728 | $ 54,566,911 | $ 8,167,289 | $ 8,167,289 | $ 16,334,578 | $ 49,092,472 | $ 21,809,017 | $ 70,901,489 |
| Lands | $ 628,773 | $ 209,591 | $ 838,364 | $ - | $ - | $ - | $ 628,773 | $ 209,591 | $ 838,364 |
| Fish and Wildlife Mitigation | $ 45,763,719 | $ 15,254,573 | $ 61,018,292 | $ 12,310,970 | $ 12,310,970 | $ 24,621,940 | $ 58,074,689 | $ 27,565,543 | $ 85,640,232 |
| Cultural Resource Mitigation | | **100% Federal up to 1% Limitation** | | | **100% Federal up to 1% Limitation** | | | | |
| | $ 1,379,244 | $ - | $ 1,379,244 | $ - | $ - | $ - | $ 1,379,244 | $ - | $ 1,379,244 |
| Subtotal | $ 627,883,079 | $ 208,834,611 | $ 836,717,690 | $ 138,758,609 | $ 138,758,609 | $ 277,517,219 | $ 766,641,688 | $ 347,593,221 | $1,114,234,909 |
| **Lands, Easements, Rights of Way, and Relocations** | | **100% Non-Federal** | | | **100% Non-Federal** | | | | |
| Lands | - | $ 3,997,377 | $ 3,997,377 | - | | $ - | $ - | $ 3,997,377 | $ 3,997,377 |
| Utility Relocations | $ - | $ - | $ - | $ - | $ 23,064,699 | $ 23,064,699 | $ - | $ 23,064,699 | $ 23,064,699 |
| Subtotal | $ - | $ 3,997,377 | $ 3,997,377 | $ - | $ 23,064,699 | $ 23,064,699 | $ - | $ 27,062,076 | $ 27,062,076 |
| **Other Federal Costs** | | **100% Federal** | | | **100% Federal** | | | | |
| Aids to Navigation - USCG Channel Markers | $ 1,648,904 | $ - | $ 1,648,904 | $ - | $ - | $ - | $ 1,648,904 | $ - | $ 1,648,904 |
| **Associated Non-Federal Costs (owner cost)** | | **100% Non-Federal** | | | **100% Non-Federal** | | | | |
| Utility Relocations | $ - | $ - | $ - | $ - | $ 23,064,699 | $ 23,064,699 | $ - | $ 23,064,699 | $ 23,064,699 |
| Berthing Areas & Dock Modifications | $ - | $ 14,573,792 | $ 14,573,792 | $ - | $ 7,810,191 | $ 7,810,191 | $ - | $ 22,383,983 | $ 22,383,983 |
| Subtotal | $ - | $ 14,573,792 | $ 14,573,792 | $ - | $ 30,874,890 | $ 30,874,890 | $ - | $ 45,448,683 | $ 45,448,683 |
| **Fully-Funded (Escalated) Costs** | $ 629,531,983 | $ 227,405,781 | $ 856,937,763 | $ 138,758,609 | $ 192,698,199 | $ 331,456,809 | $ 768,290,592 | $ 420,103,980 | $1,188,394,572 |

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## I.D ADDITIONAL NON-FEDERAL SPONSOR CASH CONTRIBUTION

For all navigation channel depths, the Sponsor must provide an additional cash contribution equal to 10 percent of fully funded GNF costs as shown below in Table 6 (USACE, 2000b). These costs may be paid over a period not exceeding 30 years. The Sponsor's costs for LER and relocations (including utility relocations) are credited against the additional cash contribution.

Table 6
Total General Navigation Features Costs and Credits
(October 2010 Price Level)
(All costs in dollars)

| | |
|---|---|
| Cost-Shared GNF | 1,114,235,000 |
| 10% of GNF | 111,423,500 |
| | |
| Creditable Land Costs | 3,997,000 |
| Deep Draft Utility Costs | 23,065,000 |
| Total non-Federal Sponsor Creditable Costs | 27,062,000 |
| Creditable Difference | (84,361,500) |

# II. RECOMMENDATIONS

## II.A PROJECT COSTS (October 2010 Price Levels)

For the purpose of calculating the Section 902 limit, the total estimated first cost of the project is $1,053,349,000, including an estimated Federal share of $707,564,000 and an estimated non-Federal share of $345,785,000. Total First Cost of all project components including associated costs in current dollars, without escalation and IDC, totals $1,096,817,000. The Fully Funded Cost for the project, which includes Total First Costs and expected escalation, is $1,188,395,000. The Investment Cost of all components totals $1,211,600,000, and includes $114,700,000 in IDC. Total annual costs for the project are $90,614,000 and total annual benefits are $115,400,000, resulting in a project BCR of 1.3.